# Developing a distinct body of knowledge on Nursing Informatics

# A mixed-methods study


by

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# Contents

# LIST OF ORGANISATIONAL ACRONYMS

| | |
|---|---|
| AACN | American Association of Colleges of Nursing |
| ADHA | Australian Digital Health Agency |
| AIDH | Australasian Institute of Digital Health |
| AMIA | American Medical Informatics Association |
| ANA | American Nurses Association |
| ANMAC | Australian Nursing and Midwifery Accreditation Council |
| ANMF | Australian Nursing and Midwifery Federation |
| CASN | Canadian Association of Schools of Nursing |
| CHIA | Certified Health Informatician Australia |
| COAG | Council of Australian Governments |
| DESE | Department of Education, Skills and Employment, Australian Government |
| HIMAA | Health Information Management Association of Australia |
| HIMSS | Health Information and Management Systems Society |
| HISA | Health Informatics Society of Australia |
| IMIA | International Medical Informatics Association |
| IMIA-NI | International Medical Informatics Association-Nursing Informatics |
| IOM | Institute of Medicine |
| JBI | Joanna Briggs Institute |
| JSA | Jobs and Skills Australia |
| NEHTA | National E-Health Transition Authority |
| NIA | Nursing Informatics Australia |
| NICE | National Institute for Health and Care Excellence |
| NMBA | Nursing and Midwifery Board of Australia |
| OECD | Organisation for Economic Co-operation and Development |
| WEF | World Economic Forum |
| WHO | World Health Organization |

# LIST OF OTHER ACRONYMS

| | |
|---|---|
| BCMA | Bar Code Medication Administration |
| CPD | Continuing Professional Development |
| EBP | Evidence-Based Practice |
| EHR | Electronic Health Record |
| eMar | Electronic Medication Administration Record |
| EMM | Electronic Medication Management Systems |
| EMR | Electronic Medical Record |
| ICT | Information and Communications Technology |
| PRISMA-ScR | Preferred Reporting Items for Systematic reviews and Meta-Analyses – Scoping reviews |
| PCEHR | Personally Controlled Electronic Health Record |
| PIAAC | Programme for the International Assessment of Adult Competencies |
| QSEN | Quality and Safety Education for Nurses |
| RN | Registered Nurse |
| TAM | Technology Acceptance Model |
| TIGER | Technology Informatics Guiding Education Reform Initiative |

# ABSTRACT

Health care is underpinned by the desire to provide safe, cost effective, efficient and accessible care, that prioritises patient outcomes and uses the latest evidence to inform practice. Over the past 70 years, health care has increasingly used information and communication technologies to improve the safety and efficiency of health care, develop evidence-based practices, provide data to leverage change, inform health care policy, and articulate the role of health care in society. Reflecting this digital revolution in health care, health informatics fields have sought to integrate health information and knowledge with information and communication technologies to promote optimal patient health outcomes. Nursing informatics has the potential to transform patient care through streamlining of care provision, increasing the capacity to predict patient needs, enhancing the quality of nursing care, and elucidating the importance of nursing within the health care setting. However, nurses, despite being the largest workforce within health care, are still not being adequately prepared to use nursing informatics to improve patient care through rapid access to crucial patient data, systematic patient assessment, the reduction of clinical errors, the enhanced use of evidence-based practice, cost-effectiveness and improved patient outcomes and safety.

This study using a mixed-methods approach, underpinned by Dewey’s philosophy of pragmatism, consisted of two distinct phases. A scoping review was conducted to identify contemporary literature that examined the nursing informatics content in undergraduate nursing education. The study integrated findings from a scoping review of 3227 articles with 53 selected sources of evidence and was analysed using frequency counts and qualitative content analysis. Informed by the findings of the scoping review, a Classical Delphi study of four rounds explored the experiences of 61 nurse educators, nurse informaticians and experts in nursing informatics and was analysed using reflexive thematic analysis and descriptive statistics. The findings from the scoping review and the Delphi study were integrated with contemporary literature to define nursing informatics and address its significance to nursing practice and to address the integration of nursing informatics into undergraduate nursing curricula. Recommendations for the integration of nursing informatics content into undergraduate nursing curricula, for nursing bodies and nursing leadership and for future research were also detailed.

Key findings emerging from this study included the ongoing deficit in the workforce preparedness of Registered Nurses and limited ongoing digital health education opportunities. A lack of nursing informatics content integrated into undergraduate nursing curricula, in Australia, was identified, with barriers including the associated costs of implementing and maintaining digital health technologies, and a lack of access to digital health technologies on placement and in university settings. A lack of university faculty understanding of nursing informatics was aligned with limited professional development and varying levels of digital literacy. Other barriers included a lack of incentive to include nursing informatics due to minimum standards for registration not addressing

the requirement for Registered Nurses to have basic informatics skills and the lack of integration of nursing informatics throughout Australian undergraduate nursing curricula. Recommendations for the integration of nursing informatics content into Australian undergraduate nursing curricula, included the need for a clear understanding of nursing informatics, the development of specific competency standards and increased professional development for university faculty, and the development of an open access repository for nursing informatics education. Access to digital health technologies, in university and on clinical placement, were identified as an essential requirement for nursing students, with recommendations that relationships be established between key stakeholders to facilitate this access. It was also recommended that the development of undergraduate nursing curricula be explicitly linked with relevant professional competency standards, against which educators and universities could measure their own competence and delivery of appropriate information. Digital literacy was identified as an issue, in the development of nursing informatics competency of nursing students, with recommendations for a baseline assessment of digital literacy with ongoing evaluations throughout assessments, and further opportunities to develop these skills throughout their degree studies. Leadership from professional nursing bodies was identified as a determinant in the effective adoption and use of nursing informatics, with recommendations that nursing informatics competency standards for nursing leadership, including those nurses working in professional nursing bodies, be implemented as a priority. Finally, recommendations for future research, included investigating the disparities in gendered responses to the integration of nursing informatics into undergraduate nursing education, investigating the disparities in country of practice responses to the integration of nursing informatics into undergraduate nursing education, and how nurse educators perceive ongoing education opportunities within tertiary institutions.

My original contribution to knowledge was the integration of contemporary literature and the voices of nursing experts to support understanding of current nursing informatics content in undergraduate nursing education. This study provided a snapshot of contemporary nursing informatics understanding and application in undergraduate nursing education and in professional practice. It provided a discussion of enablers, barriers and recommended content for nursing informatics education and the development of digital literacy of all key stakeholders. And it provided recommendations for how these gaps could be addressed to develop workforce readiness and digital competency in both undergraduate nursing students and Registered Nurses.

# DECLARATION

I certify that this thesis: Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university

2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and

3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

Signed: R. Reid

Date: 16th October 2024

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# Chapter 1 Introduction

## 1.1 Introduction

Global healthcare is in a state of transition that in transforming traditional models of care (Hussey & Kennedy, 2016; Meskó et al., 2017; Yeung et al., 2023). Increasing costs associated with the escalating demand for services, an ageing population and medical advances are projected to increase worldwide health expenditure by 6.1% in 2024 (Economist Intelligence Unit (EIU), 2023), with the World Economic Forum (WEF, 2024) reporting that global spending on health care, in 2021, accounted for 10.3% of gross domestic product and reached $9.8 trillion. Digital technologies have the potential to enhance the coverage and quality of universal health practices and services by providing targeted care to individuals, up to date clinical education and decision-making support for clinicians, and enhanced communication between health professionals (World Health Organization (WHO), 2019), and through improving safety, efficiency and accessibility of healthcare (Deloitte Touche Tohmatsu Limited, 2018). The adoption and development of digital technologies has been underpinned by the desire to improve the safety and quality of patient care (Hersh, 2009). In Australia, digital health has experienced rapid investment in infrastructure; including the national My Health Record ©, clinical information systems for public hospitals and software for GP practices (Hambleton & Aloizos, 2019; Health Informatics Society of Australia (HISA), 2018). As the largest healthcare workforce (Australian Institute of Health and Welfare (AIHW), 2024; WHO, 2020; 2024), nurses play a crucial role in digital health through the use of digital health information systems (Australian Nursing & Midwifery Accreditation Council (ANMAC), 2014; Bichel-Findlay, Dixon, & Alexander, 2020; Peltonen, Pruinelli, et al., 2019), with the need for nurses to embrace information technology strongly linked with an ability to effectively function within the contemporary healthcare environment (Chang et al., 2011; McGonigle et al., 2014; Reid, Button, et al., 2022). Underpinning this digital transformation is the need for education to inform development of digital health competency.

## 1.2 A brief history of nursing education

The nursing profession has been around almost since the beginning of time; although it has significantly changed over the centuries (Birchenall, 2003; Bullough & Bullough, 1979; Dock & Stewart, 1920; Nutting & Dock, 1907; Theofanidis & Sapountzi-Krepia, 2015). In ancient times, forms of nursing care were provided, with the nurse often being a female relative, and knowledge of these practices passed on between caregivers (Bullough & Bullough, 1979). As societies developed, so did the provision of health care; in Ancient Egypt, temples were often used for healing, with people seeking healing from divinities and individuals working in these temples performing what would now be considered nursing duties (Bullough & Bullough, 1979; Elhabashy &

Abdelgawad, 2019). In Ancient Greece, sanitariums or sanitoriums provided some form of nursing care and knowledge regarding medicinal herbs was shared between caregivers (Theofanidis & Sapountzi-Krepia, 2015). Some of the earliest written records of nursing, include those of the nurses in the Byzantium period, when women worked in the Christian Church caring for the sick and needy (Kourkouta, 1998). At the end of the fourth century, male nurses (hypourgoi) and female nurses (hypourgisses), were employed as professional nurses in Byzantium and worked in hospitals (Kourkouta, 1998), providing nursing care (Kourkouta, 2012). These hospitals were often annexed to religious buildings, including monasteries, with care provided by nuns and monks, with nursing associated with religious observance (Kourkouta, 2012). In the Middle Ages, health care continued to be centred around religion, with nuns and monks working as doctors and nurses (Theofanidis & Sapountzi-Krepia, 2015). In the late fifth Century, the Spanish built their first hospital, referred to as a xenodochium, in Mérida, Spain (Hurd-Mead, 1933; Retief & Cilliers, 2010) and after the sixth century, volunteer caregivers were replaced by professional physicians and nurses (Risse, 2023), with these nurses learning through oral traditions and direct observance of other caregivers (Egenes, 2017). Then, in the fourteenth century, the Protestant Reformation forced the closure of the monasteries and convents which had served as places for health care and the role of nursing was taken over by individuals who lacked any understanding of care (Dock & Stewart, 1920; Egenes, 2017).

At the beginning of the nineteenth century, any individual could describe themselves as a nurse, with nursing described as “a very basic form of domestic service” (Dingwall, Rafferty, & Webster, 1988, p. 10). It was in this environment, that the outbreak of the Crimean War became a crucial part of nursing history with the urgent need for nurses to tend to the injured soldiers (Dock & Stewart, 1920; Oliver, 2018). Learning of the high mortality rate for soldiers, Florence Nightingale sought to introduce new standards of sanitation and cleanliness, resulting in a dramatic decline of mortality rates (Egenes, 2017; Oliver, 2018). This secular tradition of nursing, resulted in nursing training being established by Florence Nightingale at St. Thomas’ Hospital in London in 1860 (Dingwall, Rafferty, & Webster, 1988; Egenes, 2017; Nyborg & Hvalvik, 2022). It is also important to note, that nursing was already changing and that much of the narrative that exists about Nightingale dwells on myth, rather than historical accuracy (Dingwall, Rafferty, & Webster, 1988); however, the education started at St. Thomas’ differed from earlier nurse education due to the inclusion of theory and practice, with a set curriculum and training in aspects of nursing care (Egenes, 2017). Shortly after this nursing, the outbreak of the American Civil War, further progressed the call for professional nurses with formal education (Egenes, 2017), with three education programs beginning in 1873, and reflecting the ideals of Nightingale (Whelan, n.d.).

In Australia, nursing arrived with the arrival of the First Nations people, more than 60,000 years ago, who brought with them and developed “systems of healing, tending to the sick and providing bush medicine" (Burrows, 2018). The first trained nurses in Australia were five Irish Sisters of Charity who arrived in Sydney in 1838, and established St. Vincent's Hospital in Sydney in 1857 (Burrows, 2018; St Vincent's Health, 2022). In 1868, Lucy Osburn and five Nightingale nurses arrived to commence a training school, at the Sydney Infirmary, which focused on the provision of a sanitary and clean environment with healthy food and fresh air (Australian College of Nursing (ACN), 2020). Lucy Osburn is credited with playing a significant role in establishing modern nursing in Australia (ACN, 2020) and spreading Nightingale schools of nursing throughout the Australian colonies (Bessant & Bessant, 1999). In 1974, basic nursing training programs commenced in tertiary institutions, with the Prime Minister, Bob Hawke, announcing the transfer of all nursing education to the Colleges of Advanced Education by 1990 (Bessant & Bessant, 1999), and by 1993, entry to registered nursing was via a tertiary education pathway (Lowe, 2020).

## 1.3 Nursing education today

As evidenced by the brief summary of some key points in the history of nursing education, with the evolution from oral knowledge passed between ancient caregivers, to health care within religious orders, to the development of training schools for nursing, and then the transition into the tertiary sector, nursing has progressed into the profession that is known today. The International Council of Nurses (ICN, n.d.) defines nursing as encompassing "autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well and in all settings" and a nurse as "a person who has completed a program of basic, generalized nursing education and is authorized by the appropriate regulatory authority to practice nursing in his/her country"; however, despite this, vocational training is still used in some countries (Baker, Cary, & da Conceicao Bento, 2021). The World Health Organization (WHO, 2021, p. 7), in *Global Strategic Directions for Nursing and Midwifery 2021–2025*, noted the broad range of entry-level nursing education programs and stated that "the quality of nursing and midwifery education programmes and the preparation of qualified faculty remain critical challenges", with recommendations to develop competencies, including in the use of digital technologies.

## 1.4 A brief history of nursing informatics

Computers were introduced to nursing care in the 1950s (Blažun Vošner et al., 2020; Ozbolt & Saba, 2008; Saba, 2001), with the first global conference on medical informatics held in 1974 in Stockholm, Sweden and five papers presented on nursing informatics at this time (Marin & Marques, 2005; Saba, 2001). However, conceptually, some authors have linked the concept of nursing informatics with the data collection and statistical analyses of Florence Nightingale (Betts & Wright, 2020; Blažun Vošner et al., 2020; Cummins et al., 2016; Ozbolt & Saba, 2008; Saba, 2001). The term *nursing informatics* was first proposed by Scholes and Barber (1976) and arose "from the French term, *informatique*" referring to the use of computers" (Saba, 2001, p. 177).

Globally, efforts to promote nursing informatics included the formation of the International Medical Informatics Association – Nursing Informatics working group in 1982 (Cummins et al., 2016; Mihalas & Kulikowski, 2021), the Canadian Nursing Informatics Association in 2002 (Canadian Nursing Informatics Association (CNIA), n.d.), the Alliance for Nursing Informatics in 2004 (Greenwood, 2010), and the Technology Informatics Guiding Education Reform (TIGER) Initiative (O'Connor et al., 2017). In Australia, nursing informatics first emerged around 1984, with Hovenga (1997, n.p.), in *Nursing Informatics in Australia*, noting that despite its "torturous history", nursing informatics has "played a very significant role in creating an awareness about the discipline and in educating nurses and other health professionals regarding the use of digitised health information using the technologies available". And in 1991, Nursing Informatics Australia (NIA), following the International Medical Informatics Association - Nursing Informatics Conference in Melbourne, Australia, with the objective of bringing together nursing informatics groups from across Australia (Health Informatics Society of Australia (HISA), Hovenga, & Kidd, 2018).

## 1.5 Nursing informatics today

Despite these efforts, a lack of understanding of nursing and health informatics has persisted (O'Connor & LaRue, 2021; Raghunathan, McKenna, & Peddle, 2022), with studies identifying limited understanding of the role of nursing informatics in patient care outcomes (Gonen, Sharon, & Lev-Ari, 2016; Peltonen, Pruinelli, et al., 2019), and concerns that nursing informatics may intrude on the traditional role of nursing (Agnew, 2022; Al-Rawajfah & Tubaishat, 2019; Booth, Strudwick, McBride, et al., 2021), by limiting clinical reasoning skills (Kent et al., 2015; Robichaux et al., 2019) and detracting from therapeutic communication with patients and their families (Alanazi, Butler-Henderson, & Alanazi, 2020). Further compounding these issues have been the ways in which nursing informatics has been defined (Cummins et al., 2016), with "at least 14 definitions of nursing informatics" emerging over the past four decades (Hussey & Kennedy, 2016, p. 1034), resulting in confusion regarding the nature of nursing informatics and its relevance to nursing practice (Reid, Maeder, Button, et al., 2021). This deficit in understanding has resulted in a lack of nursing faculty with sufficient nursing informatics knowledge (Hamilton, Iradukunda, & Aselton, 2021; Procter, 2021) and with limited access to appropriate professional development (Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020). Despite, a long history of nursing informatics, a recent integrative review of the current nursing and midwifery contribution to leading digital health policy and practice, identified a lack of nursing voices in international digital health discussions, with the call for digital health skills, competencies and capabilities to be integrated into health professional education (Janes et al., 2024).

## 1.6 Genesis of the research study

When originally conceiving of this research, I wanted to understand how nursing informatics was being integrated into undergraduate nursing education, because in my experience as a university tutor, I saw very little evidence of informatics content. My concern was primarily that the new graduate leaving the university environment would encounter a clinical setting far different from that which was reflected in the current undergraduate nursing curriculum. Therefore, in response to these concerns, my research proposal sought to address this knowledge gap by adding to the body of knowledge on Nursing Informatics and defining Nursing Informatics as a field.

## 1.7 Research scope, aims and questions

The aim of this study was to address whether a distinct body of knowledge on nursing informatics could be further developed to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula. Underpinning this aim were three research questions:

1. Can a distinct body of knowledge of nursing informatics be developed?
2. Can operational definitions for nursing informatics be achieved through consensus?
3. Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?

## 1.8 Research format

This research study was underpinned by a pragmatic theoretical framework. As a research paradigm, pragmatism is based on the concept of researchers using the methodological or philosophical approach that best aligns with the phenomenon of interest being investigated (Kaushik & Walsh, 2019), and focuses on the problem to be researched and practical outcomes, offering the potential to integrate research, practice and policy (Glasgow, 2013). Pragmatism does not seek to find an absolute truth or reality but aims to facilitate problem solving applicable to the human experience (Powell, 2001), moving beyond ‘what works’ and providing a coherent paradigm in which pragmatism “insists on treating research as a human experience that is based on the beliefs and actions of actual researchers” (Morgan, 2014, p. 1051). So too, the philosophy underpinning the study was to bring together multiple sources of knowledge to find workable solutions to integrating nursing informatics education into undergraduate nursing curricula. This study was aligned with the work of John Dewey, an American philosopher, famous for his theory on the social and interactive nature of education, and the assertion of education and schooling as an instrumental aspect of social reform (Fott, 2009; Garrison, Neubert, & Reich, 2012; Pavlis & Gkiosos, 2017). Dewey's built on the work of earlier pragmatists, developing a philosophy that framed inquiry as an evolving social process with the construction of meaning emerging during interactions between people (Elkjaer & Simpson, 2011).

The purpose of research is to "discover a reality that is believed to exist through exposition and discussion" (Al-Motlaq & Chapman, 2012, p. 31), with the reason for choosing a particular paradigm based on the purpose of the study and the research question (Francis, Chapman, & Whitehead, 2016). Mixed-methods research studies draw upon the strengths of both quantitative and qualitative approaches (Creswell, 2015; Creswell & Plano Clark, 2018; Whitehead & Day, 2016), providing an innovative approach for addressing contemporary issues in nursing, and most closely resembling nursing practice through the integration of both quantitative and qualitative data, in the same way nurses integrate clinical data obtained in the form of numbers and words (Fawcett, 2015). This study used a mixed-methods approach underpinned by Dewey's pragmatism, consisting of two distinct phases that collected both qualitative and quantitative data.

From this foundation, the study was developed to include a scoping review using Arksey and O'Malley's (2005) scoping review framework and was underpinned by the recommendations from Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Scoping Reviews (PRISMA-ScR) (PRISMA, Moher et al., 2009; 2024; Sohrabi et al., 2021; Tricco et al., 2018) and JBI (Joanna Briggs Institute) Evidence Synthesis (Peters et al., 2020; Peters et al., 2021; Pollock et al., 2021). In adherence with the recommendations from Peters et al. (2020) for the use of the PCC mnemonic (population, concept and context) to identify the focus and context of the review, the population of the scoping review was undergraduate nursing students, the concept was nursing informatics and the context was education. Therefore, to be included in the scoping review, papers needed to include nursing informatics education for undergraduate nursing students at any time during a Bachelor of Nursing program (or equivalent). Sources of information were included if they were published between 2015-2022 and described curriculum recommendations (including barriers to implementing nursing informatics education), with the purpose of the identified timespan to reflect the rapidly evolving nature of health informatics and digital technologies and the requirement for curriculum recommendations to reflect the purpose of the scoping review as the basis for a Delphi study, in which Nursing Informatics and its integration into undergraduate nursing curricula was explored and described in collaboration with domain experts. The study integrated findings from a scoping review of 3227 articles with 53 selected sources of evidence.

Informed by the findings of the scoping review, a Classical Delphi study of four rounds explored the experiences of 61 participants and was underpinned by the CREDES (Conducting and REporting

DElphi Studies) recommendations (Equator Network (Enhancing the QUAlity and Transparency Of health Research), 2022; Jünger et al., 2017). Nurse educators, nurse informaticians and experts in nursing informatics were sought to give their opinions on key issues emerging from the scoping review. These issues included current understanding and relevance of nursing informatics; barriers to nursing informatics content in undergraduate nursing education, including a lack of infrastructure and resource, student access to digital technologies in university and clinical settings, the evolving nature of nursing informatics, and faculty responses to nursing informatics; recommendations for nursing informatics content in undergraduate nursing curricula; professional development of faculty relevant to nursing informatics competency; the use of best practice guidelines or evidence-based strategies to inform nursing informatics practice and education; and the computer and digital literacy of the student cohort, including how these literacies should be defined, how to develop digital literacy, and relevance of the digital native.

Methodological triangulation was used to gain a deeper understanding of nursing informatics education, through integrating the findings from the scoping review and the Delphi study, supported by contemporary literature. The integrated findings addressed the aims of the study and the research questions, identifying current issues in integration of nursing informatics content into undergraduate nursing curricula and providing recommendations for the integration of nursing informatics content into undergraduate nursing curricula, defining nursing informatics and associated fields, developing university faculty digital competency, the provision of access to digital health technologies, the application of competency standards, and defining and developing digital literacy in universities. Recommendations for nursing bodies and nursing leadership and for future research were also detailed.

## 1.9 Significant original contribution to knowledge

The significant original contribution to knowledge of a doctoral thesis requires that research “builds on existing knowledge and practices by stimulating an interplay between old and new” (Baptista et al., 2015, p. 64), through “the discovery of new facts, the formulation of theories, or the innovative re-interpretation of known data and established ideas” (Flinders University, 2024b); Klein and Rowe (2008) argue that it should also take into account the professional experience of the student and note that many doctoral students bring intellectual capital to their research. The study aimed to provide a significant contribution to knowledge through integrating contemporary literature and the voices of nursing experts to provide findings that enhanced understanding of the adoption of nursing informatics into education and professional practice. It is anticipated that these findings will support the integration of nursing informatics content into undergraduate nursing education and that recommendations, for the development of nursing informatics competency and workplace readiness in the digital health care environment, and that the recommendations will inform this process.

## 1.10 Thesis structure

This thesis consists of 9 chapters:

**Chapter 1: Introduction** identifies the context of the study, the history of nursing informatics and nursing education, and contemporary approaches to nursing informatics and nursing education. The research aims, scope and questions and the significant original contribution to knowledge are also addressed.

**Chapter 2: Literature review** addresses health informatics, nursing informatics, the Australian Government's response to health informatics, international and Australian health informatics organisations, nursing informatics competency standards, and how nurses are educated. The current gaps in nursing Informatics education for undergraduate nursing students are then linked with the rationale for research.

**Chapter 3: Study methodology** describes the mixed-methods approach, pragmatism as a theoretical framework, the two phases of data collection – the scoping review and the Delphi study and the challenges in using mixed-methods.

**Chapter 4: Research methods: Phase 1 – Scoping review** addresses the development of a scoping review protocol and the data collection, data extraction and data analysis of the scoping review.

**Chapter 5: Phase 1 – Scoping review findings** presents the findings from the scoping review using frequency counts and qualitative content analysis. The themes used in the development of the First Round Questionnaire for the Delphi study are detailed.

**Chapter 6: Research methods: Phase 2 – Delphi study** addresses development of a Delphi study protocol, reporting guidelines, participant recruitment, data collection and data analysis. Pilot testing and the four rounds of the Delphi study are detailed.

**Chapter 7: Phase 2 – Delphi study findings** presents the findings from the Delphi study using reflexive thematic analysis and descriptive statistics.

**Chapter 8: Integration of findings** revisits the study aim and research questions and integrates the scoping review and Delphi study findings with contemporary literature. The limitations of the study, including limitations of the research methods, response bias and the researcher's reflections on the challenges associated with the study are addressed.

**Chapter 9: Conclusions and Recommendations** summarises the current issues in workforce readiness of Registered Nurses and integration of nursing informatics content into undergraduate nursing curricula. Recommendations for integration of nursing informatics content into undergraduate nursing curricula, for professional nursing bodies and future research are addressed, with the final section identifying the significant original contribution to knowledge of this study.

## 1.11 The researcher

Underpinning doctoral research, is the development of transferable practical and professional skills, that can facilitate the candidate in future employment (Disney et al., 2013; Matas, 2012). Learning about research and how to be a researcher are requirements embedded in doctoral education and are associated with internal and external validation (Mantai, 2017); however, practical skills, including collaboration with key stakeholders, dissemination of research and public engagement, are also relevant skills for the doctoral candidate (Disney et al., 2013). As identified by the Office of Graduate Research, Flinders University (2022), the development of attributes and skills associated with doctoral research include research and critical thinking skills, depth of disciplinary expertise, person and professional awareness, project management and research integrity, integrity and ethics, effective communication skills, teamwork and collaboration, and engagement and impact. The development of these graduate attributes and skills, as reflected in my PhD candidacy are addressed in *Appendix D1*.

**Conferences**

Digital Health Summit 2020 – AIDH (Australasian Institute of Digital Health)
Presented: *Nursing informatics: bridging the gap between theory and practice* (Reid et al., 2020)

18th National Nurse Education Conference 2021 – Inspire, Motivate, Educate - ANTS (Australian Nurse Teachers Society)
Presented: *Workforce readiness and the Undergraduate Nursing Student* (Reid, Maeder, Button, & Breaden, 2021)

18th National Nurse Education Conference 2021 – Inspire, Motivate, Educate – ANTS
Chairperson: *Student Learning*

NI2021 – Nurses and midwives in the digital age – AIDH
Presented and published: *Defining Nursing Informatics: a narrative review* (Reid, Maeder, Button, et al., 2021)

7th Asia Pacific Congress of Paediatric Nursing 2022 – The Asia Pacific Paediatric Nurses Association
Presented: *Nursing in the digital age: Bridging the gap between theory and practice in Nursing Informatics* (Reid, Maeder, et al., 2022)

MedInfo23 – The Future is Accessible - AIDH (Australasian Institute of Digital Health)
Presented and published: *Nursing Informatics: Competency Challenges for Nursing Faculty* (Reid et al., 2024)

19th National Nurse Education Conference 2023 – Create, Innovate, Energise – ANTS
Presented: *Nursing Informatics and Undergraduate nursing education: Preparing Nurses for the digital workforce* (Reid et al., 2023)

**Publications – with the researcher as the primary and corresponding author**

Reid, L., Maeder, A., Button, D., Breaden, K., & Brommeyer, M. (2021). Defining Nursing Informatics: A Narrative Review. In M. Honey, C. Ronquillo, T.-T. Lee, & L. Westbrooke (Eds.), *Nurses and Midwives in the Digital Age* (Vol. 284, pp. 108-112). http://doi.org/10.3233/shti210680

Reid, L., Button, D., Breaden, K., & Brommeyer, M. (2022). Nursing informatics and undergraduate nursing curricula: A scoping review protocol. *Nurse Education in Practice*, *65*, 1-6. https://doi.org/10.1016/j.nepr.2022.103476

Reid, L., Button, D., & Brommeyer, M. (2023). Challenging the Myth of the Digital Native: A Narrative Review. *Nursing Reports*, *13*(2), 573-600. http://doi.org/10.3390/nursrep13020052

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Please note: Contributions to each paper by the researcher are detailed in Co-authorship Approvals for Higher Degree by Research Thesis for Examination (refer to *Appendix D2*).

**Research output from the International Medical Informatics Association – Special Interest Group for Students and Emerging Professionals**

Lokmic-Tomkins, Z., Davies, S., Block, L. J., Cochrane, L., Dorin, A., von Gerich, H., Lozada-Perezmitre, E., Reid, L., & Peltonen, L.-M. (2022). Assessing the carbon footprint of digital health interventions: a scoping review. *Journal of the American Medical Informatics Association*, *29*(12), 2128-2139. http://doi.org/10.1093/jamia/ocac196

Lokmic-Tomkins, Z., Block, L. J., Davies, S., Reid, L., Ronquillo, C. E., von Gerich, H., & Peltonen, L. M. (2023). Evaluating the representation of disaster hazards in SNOMED CT: gaps and opportunities. *Journal of the American Medical Informatics Association*, *30*(11), 1762-1772. http://doi.org/10.1093/jamia/ocad153

Block, L. J., Lozada-Perezmitre, E., Cho, H., Davies, S., Lee, J., Lokmic-Tomkins, Z., Peltonen, L. M., Pruinelli, L., Reid, L., Song, J., Topaz, M., von Gerich, H., & Vyas, P. (2023). Representation of Environmental Concepts Associated with Health Impacts in Computer Standardized Clinical Terminologies. *Yearbook of Medical Informatics*, *32*(1), 36-47. http://doi.org/10.1055/s-0043-1768746

Please note: the researcher was not the primary or corresponding author. These publications are shared to demonstrate the graduate attribute of *engagement and impact*.

**Professional groups**

Australasian Institute of Digital Health

Australian College of Nursing – Nurse Informatics and Digital Health Faculty

Australian Nurse Teachers Society

International Medical Informatics Association – Special Interest Group for Students and Emerging Professionals

## 1.12 Conclusion

This chapter has summarised the history of nursing education and nursing education today, the history of nursing informatics, the genesis of this study, the scope, aims and questions, the research format, the significant original contribution to knowledge, the thesis structure and the researcher. The purpose of this discussion was to provide a background to the exploration of nursing informatics, its relevance in professional practice and current integration into undergraduate nursing education. Chapter 2 provides a literature review and identifies the current gaps in workforce preparedness of nurses due to a lack of consensus on Informatics terminology, a lack of informatics-based competencies worldwide, limited undergraduate nursing education regarding nursing informatics, and a lack of university faculty with nursing informatics' expertise.

# Chapter 2 Literature Review

## 2.1 Introduction

Health care has experienced rapid transformation with the development of digital technologies. In response to these changes, informatics fields have evolved, including nursing informatics, which seeks to link technology with nursing practice and to provide more cost effective, efficient, accessible and safer care. However, nurses, despite being the largest workforce within health care, are still not being adequately prepared to use this technology due to a lack of consensus on Informatics terminology, a lack of informatics-based competencies worldwide, limited undergraduate nursing education regarding nursing informatics, a lack of university faculty with Nursing Informatics' expertise, and a workforce who is not adequately prepared to work within the digital health sphere. This chapter is divided into: 1) Health informatics, 2) Nursing informatics, 3) The Australian Government's response to health informatics, 4) International and Australian health informatics organisations, 5) Nursing informatics competency standards, and 6) How nurses are educated. The current gaps in nursing Informatics education for undergraduate nursing students are then linked with the rationale for research.

## 2.2 Health informatics

Despite the slow transformation from paper-based data to digital data within the healthcare sector (Abernethy et al., 2022; McCool et al., 2020; van Kessel et al., 2022), there has been a change in the way in which health care is delivered in Australia (Rowlands, Digital Health Workforce Academy (DHWA), & HISA, 2019; Mahoney et al., 2021; Papavasiliou, Reaiche, & Papavasiliou, 2021) and globally (Benjamin & Potts, 2018; Stern et al., 2022; Whitelaw et al., 2021). The use of information and communication technologies (ICT) have developed to include electronic health records (Hambleton & Aloizos, 2019; Kutney-Lee et al., 2019; Rathert et al., 2019), e-learning (Kim & Park, 2021; Logan, Johnson, & Worsham, 2021; Maheu-Cadotte et al., 2020), e-simulation (Coffey, McTier, & Phillips, 2022; Plotzky et al., 2021; Shorey & Ng, 2021) and telehealth (Mataxen & Webb, 2019; Rutledge & Gustin, 2021; Rutledge et al., 2021). *Health informatics* evolved from medical and nursing informatics in the 1970s, in response to the newer and less expensive computer technology (Cesnik & Kidd, 2010). In 1974, the first world congress on *Medical Informatics* was held in Stockholm, Sweden (Hovenga et al., 2010) and by the 1980s, computers were being used to support medical decision-making (Cesnik & Kidd, 2010). In 2001, the World Health Organization (Al-Shorbaji, 2001, as cited in Miah et al., 2019) defined health informatics as:

> An umbrella term used to encompass the rapidly evolving discipline of using computing, networking and communications – methodology and technology –to

> support the health related fields, such as medicine, nursing, pharmacy and dentistry. (p. 2)

In the field of health informatics there remain a broad range of definitions. In a report by the Health Informatics Society of Australia (HISA) and Legg (2009, p. 9), health informatics was identified as an emerging field and defined as “the science and practice around information in health that leads to informed and assisted healthcare”, with eHealth defined as a sub-discipline of health informatics. Issues identified in consultation with key stakeholders, included lack of understanding about health informatics by the clinical workforce, limited workplace induction and training, no competency recognition and inadequate continuing professional education. COACH: Canada’s Health Informatics Association (2012, p. 8) defined health informatics as “the intersection of clinical, IM/IT and management services to achieve better health” and noted that the term health informatics had been used to describe the creation, facilitation and use of health-related data, knowledge and technologies. Coiera (2015) expanded this definition to include understanding the nature of communication and information systems, the principles which inform these systems and the evaluation of these systems with the goal of improving system design.

The evolution of digital health technologies has resulted in “an expanding cloud of chaos” surrounding the word *informatics* (Friedman, 2012, p. 224), with the lack of a consistent taxonomy for health informatics and associated domains identified as an ongoing issue (Benis et al., 2022; Chevan et al., 2023; Reid, Maeder, Button, et al., 2021), and the current heterogeneity in definitions resulting in uncertainty and confusion (Otto et al., 2018). Morawski, Fanberg and Pitts (2021), in *Responding to the need to curate global informatics definitions*, noted that the exponential growth of health data, computer science and data science, associated with health informatics, required a contemporary global database containing health informatics definitions.

## 2.3 Nursing informatics

Within health informatics, the specialised field of *Nursing Informatics* has developed; with IMIA-NI (International Medical Informatics Association - Nursing Informatics (IMIA-NI), 2024) stating that:

> Nursing Informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families and communities worldwide.

As with the issues surrounding the use of terminologies in health informatics, nursing informatics has also struggled with a consistent taxonomy, with “at least 14 definitions of nursing informatics” emerging over the past four decades (Hussey & Kennedy, 2016, p. 1034). Reid, Maeder, Button, et al. (2021), in *Defining Nursing Informatics: A Narrative Review*, noted that:

> If the purpose of nursing informatics is to improve the safety and quality of patient care, then as a profession, nurses need to be provided with a clearer understanding

> of nursing informatics. This will only benefit nursing by leading to a consolidated body of knowledge, a clear education mandate and a digital ready workforce. (p. 111)

Despite these challenges, digital health and nursing informatics provide an opportunity to improve patient care, reduce errors, improve efficiency and to detect the deteriorating patient (Bichel-Findlay, Dixon, & Alexander, 2020).

### 2.3.1 Digital health applications relevant to nursing

There is a growing need for nurses to engage with digital technologies and develop digital proficiency and competency, thereby having the capacity to meet contemporary healthcare challenges (Brommeyer et al., 2023; Kleib et al., 2022; Reid, Button, et al., 2022). These technologies include electronic health records, telenursing and eHealth applications.

#### *2.3.1.1 Electronic Health Records*

*Electronic Health Records (EHRs)* or *Electronic Medical Records (EMRs)* have changed the ways in which nurses practice. The adoption of electronic health records aimed to reduce costs, enable new models of healthcare delivery and increase the efficiency and quality of health care (Australian Digital Health Agency (ADHA), 2017). In Australia in 2012, the *Personally Controlled Electronic Health Record* (PCEHR) was launched with the purpose of allowing patients to become more involved in their digital health record (Hambleton & Aloizos, 2019). In 2016, the PCEHR was renamed *My Health Record*, initially with an opt-in requirement, which due to poor uptake, was changed to an opt-out model in 2019 (Hambleton & Aloizos, 2019). Internationally, different digital health records have been implemented (ADHA, 2019), with an OECD (Organisation for Economic Co-operation and Development) working paper, *Progress on implementing and using electronic health record systems: Developments in OECD countries as of 2021*, noting the continued progression and use of electronic health records across 27 OECD countries, but highlighting concerns regarding record-keeping fragmentation and a lack of unified systems (Slawomirski et al., 2023). Replacing traditional paper-based documentation systems, Electronic health records provide a means of improving nursing workflow with clinical decision support (Jedwab et al., 2019; Yoshida et al., 2018), better coordination of care (McKay & Vanaskie, 2018; Watterson et al., 2020), increased quality of care (Ayaad et al., 2019; Kutney-Lee et al., 2019) and access to real-time patient data (McCarthy et al., 2019; Rathert et al., 2019). In addition, access to electronic health record data sets is being increasingly used in nursing research (Bjarnadottir & Lucero, 2018; Nordo et al., 2019).

#### *2.3.1.2 Telenursing*

The use of telecommunication services for the provision of health care services, including health education, medical education and telemedicine, aim to improve access to healthcare services for those who live in regional, rural and remote areas (Department of Health and Aged Care (DHAC), 2022). Applications for *telenursing* include home monitoring (Abraham et al., 2023; Park & Lee, 2023), video consultations (Koivunen & Saranto, 2018; Mataxen & Webb, 2019), post-operative care (Afik & Glorino Rumambo Pandin, 2021; Topal Hançer & Demir, 2023), wound care (Mahoney, 2020; Takahashi et al., 2023) and trauma care in disasters (Nejadshafiee et al., 2020b, 2020a). Telenursing applications include the use of drones for emergency triage (Mohammed, El-Said, & El-Sol, 2020), the delivery of emergency supplies (Sharma et al., 2022) and portable mobile healthcare devices which allow patients to have ongoing nursing assessment and monitoring, including Bluetooth stethoscopes (Rutledge & Gustin, 2021) and sphygmomanometers (Lu, Chen, & Hsu, 2017).

#### *2.3.1.3 Health applications*

*Mobile applications (apps)* are now a mainstay of digital technologies (Callinici, 2017), and can be defined as "any application that runs on or is accessed from a device designed to be portable" (Sturm, Pollard, & Craig, 2017, p. 72). *eHealth applications* have made healthcare more accessible and cost effective, (Stevens et al., 2019) but they have the potential to replace interactions between patients and healthcare professionals (Wattanapisit et al., 2020); it is therefore essential for nurses to be familiar with their use (Mayer, Rodríguez Blanco, & Torrejon, 2019). eHealth applications are currently used in professional development for nurses (García-Martín et al., 2021; Nezamdoust et al., 2022), patient education (Timmers et al., 2020; Veazie et al., 2018), pre-operative care (De La Cruz Monroy & Mosahebi, 2019) and medication management (Morrissey et al., 2018; Tabi et al., 2019). eHealth applications have also been used in COVID-19 contact tracing and symptom monitoring (Singh, Couch, & Yap, 2020), disease management programs (Ng, Alexander, & Frith, 2018), and clinical research (Sharma et al., 2018).

#### *2.3.1.4 Barriers to the use of digital health applications*

The development of knowledge and skills in the use of information systems, communication technologies and the use of mobile applications, is strongly aligned with safe clinical practice (American Association of Colleges of Nursing (AACN), 2008). However, the use of *digital health applications*, by nurses, are impacted by barriers reported in the literature. Barriers for the use of electronic health records include the lack of user-friendly interface (Arikan et al., 2021), insufficient nursing education (Tsai et al., 2020), technical issues and a lack of resources (Srivastava, 2018), with Melnick et al. (2021) noting the strong association between nurse-perceived electronic health record usability and nursing burnout. Barriers to telenursing include a lack of existing infrastructure (Kord et al., 2021), inadequate organisational resources (Koivunen & Saranto, 2018), a lack of nursing education and relevant competencies (Mahoney, 2020; Mohammed, El-Said, & El-Sol, 2020; Rutledge & Gustin, 2021) and a lack of computer and digital literacy (Koivunen & Saranto, 2018). Implementation of eHealth applications into nursing practice are impacted by a lack of education (De La Cruz Monroy & Mosahebi, 2019; Ferguson & Jackson, 2017), a lack of knowledge about the available applications (Mayer, Rodríguez Blanco, & Torrejon, 2019), limited ease of use (Nezamdoust et al., 2022), concerns regarding privacy and confidentiality of patient data (Ng, Alexander, & Frith, 2018), and an inability to assess the credibility of information, with (Callinici, 2017).

### 2.3.2 Technology acceptance

In an integrative review of *Nurse's attitudes to EHRs and other meaningful technologies*, Scott (2017) concluded that the effective implementation of technology is closely aligned with nurses' positive perceptions, and that acceptance of changes in nursing workflow and adoption of new technologies are influenced by clinical communication, peer support and education. Recent studies in nurses' uptake of digital technologies have used the *Technology Acceptance Model (TAM)* to identify factors which influence technology acceptance and adoption (Bagot et al., 2020; Brown, Pope, et al., 2020; Warshawski, Itzhaki, & Barnoy, 2019). The Technology Acceptance Model was developed by Davis (1989) to understand the factors which cause people to either accept or reject technology, and to measure the behaviours associated with technology acceptance and adoption. Davis identified two factors which influenced technology acceptance – perceived usefulness and perceived ease of use, and theorised that these two factors were influence by social, cultural and political factors (external factors) (Davis, 1989; Lin, 2017). Nurses are recognised as the primary group of healthcare professionals who are critical in implementing and utilising digital health technologies; however, barriers to technology acceptance have been identified, including systems which do not align with nursing practice and that are not designed "with the nurse end user in mind" (Brown, Pope, et al., 2020, p. 2817), a lack of system interoperability (Gaughan et al., 2022), perceptions of an increased workload (Bagot et al., 2020), a lack of organisational support (Kuek & Hakkennes, 2019), and digital education which is fragmented and limited (De Leeuw, Woltjer, & Kool, 2020).

## 2.4 The Australian Government's response to health informatics

In response to the changing nature of health care and the increasing use of information technologies, the Australian Ministers' Advisory Council was established in 2003 to develop a national digital action plan (Hambleton & Aloizos, 2019). In 2005, COAG (The Council of Australian Governments) established the *National E-Health Transition Authority (NEHTA).* NEHTA established the foundations for a more interconnected health care system through the development of a common health communication language and unique health care identification numbers (Hambleton & Aloizos, 2019). In 2008, the *National E-Health Strategy* was developed by key stakeholders to guide the ongoing development of eHealth in Australia (Australian Health Ministers' Conference, 2008).

### 2.4.1 Australian Digital Health Agency (ADHA)

In 2016, NEHTA disbanded and the Australian Digital Health Agency was established by the Australian Federal Government as a statutory authority responsible for the national digital health strategy and reporting to the State and Territory Health Ministers through the COAG Health Council (ADHA, 2024b). In 2017, ADHA (2017) released a key strategic plan document called *Safe, seamless and secure: evolving health and care to meet the needs of modern Australia – Australia's National Digital Health Strategy* with Statement 6 stating that by 2022 a collaboration between the agency and other key parties would develop digital health resources to support the development of a digitally literate healthcare workforce. The Strategy also noted that health professional education curricula would need to be developed "to ensure all healthcare practitioners are exposed to and trained in digital technologies and their use during training and upskilling" (ADHA, 2017, p. 44).

Workforce capability has been a requirement for the success of the digital health strategy for Australia. In 2020, the *National Nursing and Midwifery Digital Health Capability Framework*, was released by ADHA (2020, p. 8), with the intention of outlining "the capabilities required to support individuals and organisations in extending their digital health development rather than providing a rigid set of competencies". The *Australian Digital Health Agency's Workforce Strategy 2021-2026* (ADHA, 2021) captured the vision for the healthcare workforce of having:

> The right people in the right roles with the right skills and attributes to lead and deliver together the Agency's strategic priorities, supported to grow personally and professionally in a safe, flexible and agile work environment. (p. 7)

Subsequently, *The National Digital Health Capability Action Plan* (ADHA, 2022), was published with a set of key priority areas to be addressed to build digital health capability across the Australian Healthcare workforce. And in late 2023, the Department of Health and Aged Care (2023, p. 4), published the *Action Plan for the Digital Health Blueprint 2023–2033*, to "complement existing state and territory frameworks and the National Digital Health Strategy and align with the Australian Government's broader digital transformation agenda". As is evidenced by this brief review of the Australian Government's response to health informatics, there have been many strategies and recommendations put forward to inform the development of a digitally capable health workforce in Australia, with the most recent report from ADHA (2023a, p. 16), noting that "the Agency will continue to work with the Australasian Institute for Digital Health (AIDH) to support the health workforce in Australia and deliver the priorities identified in the workforce Capability Action Plan".

## 2.5 International health informatics organisations

Following the development of health and nursing informatics, professional organisations have been formed both internationally and nationally.

### 2.5.1 International Medical Informatics Association (IMIA)

The International Medical Informatics Association (IMIA, 2024b) was initially established in 1967 in Switzerland. The Association was established as a technical committee for the International Federation for Information Processing and subsequently evolved into an independent organisation in 1989. It is the world body for health and biomedical informatics. In 2010, the IMIA (Mantas et al., 2010) identified the need for health care professionals to develop knowledge and skills in the use of ICT, and recommended a three-dimensional educational framework focusing on professionals in health care, specialisation and career progression. Currently, IMIA has 25 working groups, including IMIA – NI, that is responsible for accrediting health informatics education programs globally, and organises the biennial World Congress on Medical and Health Informatics, also known as MedInfo (IMIA, 2024a).

### 2.5.2 American Medical Informatics Association (AMIA)

The American Medical Informatics Association (AMIA, 2024) was formed in 1988 with the merger of the Symposium on Computer Applications in Medical Care, the American College of Medical Informatics and the American Association for Medical Systems and Informatics. In 2012, the AMIA Academic Forum (Kulikowski et al., 2012) identified the essential informatics competencies that should be inherent within informatics education; these included a fundamental understanding of scientific principles and skills, foundational knowledge of the informatics discipline and the recognition of the importance of integrating social and behavioural sciences into informatics design, Currently, AMIA support the domains of translational bioinformatics, clinical research informatics, consumer health informatics, clinical informatics and public health informatics; in addition, they provide informatics courses for healthcare professionals, an annual symposium on the research and practice of biomedical and health informatics, and an annual informatics Summit (AMIA, 2024).

### 2.5.3 Digital Health Canada – Formerly COACH

Digital Health Canada (formerly COACH) was founded in 1976 to support health care organisations in the adoption of digital technologies (Digital Health Canada, 2024). The Canadian Organization for the Advancement of Computers in Health soon became known by its acronym as COACH and in 2010 merged with the Canadian Society for Telehealth. In 2017, the new name of Digital Health Canada was adopted to reflect the organisation’s focus on educating and inspiring digital health professionals in Canada. In 2012, COACH (Canada's Health Informatics Association, 2012) described the minimum requirements for health informatics professionals including knowledge, skills, attitudes and judgments in the key domains of information management, information technology, clinical and health services, the Canadian health system, organisational and behavioural management, project management and analysis and evaluation. Digital Health

Canada provide online education resources, education programs and host in coordination with Canada Health Infoway and the Canadian Institute for Health Information to E-Health, an annual digital health conference (Digital Health Canada, 2024).

## 2.6 Australian health informatics organisations

In Australia, health informatics is represented by a number of organisations:

### 2.6.1 Health Informatics Society of Australia (HISA)

The Health Informatics Society of Australia (HISA et al., 2018) was formed in 1993, as part of the first health informatics Conference, with the purpose of creating a national focus to promote health informatics in Australia. The organisation was a national affiliate of IMIA and in 2017 released the *Nursing Informatics Position Statement*, in collaboration with Nursing Informatics Australia and the Australian College of Nursing (2017b) and noted the requirements for nursing informatics to be included in all nursing education programs at an undergraduate and post-graduate level. HISA also released *Leadership in Clinical Informatics: A HISA White Paper* (HISA, 2018), focusing on the need to recognise clinical informatics as a specialty and the importance of change leadership to create a cohesive solution to digital health needs aligned with the National Digital Health Strategy.

### 2.6.2 Australasian College of Health Informatics (ACHI)

By 2001, Australia had a number of health informatics organisations, including: a research and education unit for medical informatics under the leadership of Cesnik, a group at Central Queensland University (CQU) founded by Hovenga, The Centre for Health Informatics at the University of New South Wales founded by Celler and Coiera, and the Centre for Online Health at the University of Queensland established by Yellowlees (Australasian College of Health Informatics (ACHI), n.d.). Despite these organisations, there remained limited recognition of health informatics, no recognised training pathway, no accreditation process and no workforce readiness strategy (ACHI, n.d.). In response to these needs, the Australasian College of Health Informatics (ACHI, n.d.) was established in 2001, and served as the first professional body for digital health in the Asia-Pacific region. In 2017, ACHI established the Australasian Health Informatics Fellowship Program as a training pathway “to prepare individuals for leadership roles in the health informatics workforce and to address demands for experienced and qualified health informatics specialists” (Australasian Institute of Digital Health (AIDH), 2024a).

### 2.6.3 Australasian Institute of Digital Health (AIDH)

In 2019, HISA and ACHI amalgamated to form the Australasian Institute of Digital Health (AIDH, 2024a; Reid, Maeder, Button, et al., 2021). HISA and ACHI had worked together on initiatives, including the ACHI Fellowship by Training program, HIC (Health Informatics Conference) and

Certified Health Informatician Australia (CHIA) (Australasian Institute of Digital Health (AIDH), 2024a). Following the amalgamation, the AIDH published *Healthier lives, digitally enabled – Strategic Plan 2021-2025* (AIDH, 2021) which focused on four key areas – workforce advancement, leadership and advocacy, community engagement and organisation excellence. Most recently, the AIDH has partnered with the Australian Digital Health Agency to launch the *Workforce Capability + The Hub*, which aims to provide a single resource site with tools to assess individual digital health capabilities and organisational readiness (ADHA & AIDH, 2023a).

### 2.6.4 Health Information Management Association of Australia (HIMAA)

The Health Information Management Association of Australia (HIMAA, 2024) evolved from the New South Wales Association of Medical Records Librarians and the Victorian Association of Medical Librarians which were founded in 1953. In 1996, the association became the Health Information Management Association of Australia Limited. The role of the organisation is to support health information management and to recognise the role of information management professionals and has developed career pathways and competency standards for health information management (HIMAA, 2024).

### 2.6.5 Certified Health Informatician Australasia (CHIA)

Certified Health Informatician Australasia (CHIA, 2024) was developed by HISA, ACHI and HIMAA in response to the lack of recognition of health informatics in Australia and is managed by the AIDH. In 2014, CHIA (2013) published the *Health Informatics Competencies Framework* to provide a clear set of requirements for the knowledge, skills and capabilities health informaticians are required to demonstrate. The organisation acknowledged that the framework only sought to define those competencies related to health and bioinformatics disciplines and that further frameworks related to sub-specialisations would also need to be developed. The AIDH (2022) has since built on the original CHIA credentialling from 2013, with the publication of the *Australian Health Informatics Competency Framework for Health Informaticians – 2nd Edition in 2022*.

### 2.6.6 Nursing Informatics Australia (NIA)

Nursing Informatics Australia (NIA) was formed in 1991, following the IMIA Nursing Informatics Conference in Melbourne, Australia, with the objective of bringing together nursing informatics groups from across Australia (HISA et al., 2018). The group aimed to promote Nursing Informatics priorities, including education and research (Australian College of Nursing (ACN), HISA & NIA, 2017a). A joint statement by ACN, HISA and NIA identified the need for undergraduate and postgraduate informatics education, informatics teams with nurses in key roles, the development of senior nurse informatician roles and the development of competency standards. These elements were viewed as key aspects to the effective application of digital health technologies within Australian healthcare. In 2019, NIA (2019) released the *Nursing Informatics Australia (NIA)*

*Informatics for Nurses and Midwives Strategic Plan 2015-2019 Version 2*. The plan identified the mission of developing a digitally competent nursing and midwifery workforce and emphasised the importance of educational programs to develop and strengthen digital competency in nursing (NIA, 2019). In 2019, with the move to the amalgamation of HISA and ACHI, Nursing Informatics Australia became a special interest group of HISA (HISA et al., 2018), and renamed the *Nursing and Midwifery Digital Health Network* (AIDH, 2024b).

## 2.7 Nursing informatics competency standards

In response to the emergence of nursing informatics and the need for digital literacy and competency standards, nursing organisations, both globally and in Australia, have developed nursing informatics competency standards. The Nursing and Midwifery Board of Australia (NMBA) (2021, p. 8) defined *competence* as “the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/ or superior performance in a profession/occupational area”, with competency frameworks serving to detail the desired characteristics of a competent workforce (Batt, Tavares, & Williams, 2020). Nursing informatics competency standards are therefore “the knowledge, skills, and attitudes to integrate nursing science, computer, and information science to identify, collect, process, manage, communicate, and expand data, information, knowledge, and wisdom in nursing practice” (Chung & Staggers, 2014, p. 597).

The following discussion outlines some of the significant contributions to nursing informatics competency standards.

### 2.7.1 International nursing informatics competency standards

Kavanagh and Sharpnack (2021) in *Crisis in Competency: A Defining Moment in Nursing Education*, highlighted the need for competency-based education with integration of technology into curricula and preparation for a digital healthcare environment. Approaches to competency standards, education requirements and education vary globally, and there is currently no systematic approach for the implementation of nursing informatics education, leading to potential threats to safe nursing practice (Lozada-Perezmitre, Ali, & Peltonen, 2022). The push to improve nursing informatics skills started in 1995 with the publication of the American Nurses Association’s *Standards of Practice for Nursing Informatics* (American Nurses Association (ANA), 1995; Bickford, 2009, 2017). Since this time, initiatives for nursing informatics frameworks have included Technology Informatics Guiding Education Reform Initiative (TIGER) competencies, the American Nurses Association (ANA) competencies, the Quality and Safety Education for Nurses (QSEN) competencies and the Canadian Association of Nursing Schools (CASN) competencies.

#### 2.7.1.1 Technology Informatics Guiding Education Reform (TIGER)

The *Technology Informatics Guiding Education Reform (TIGER) Initiative* was established in 2006 in the United States of America, in response to the need for nursing to be represented in health informatics' education and application (Hübner et al., 2018). In 2009, the TIGER Informatics Competency Collaborative team formed to develop competency standards for nurses (Rawda Abdullah et al., 2018), identifying foundational informatics' competencies for all nurses to ensure the provision of safe patient care; these included basic computer competencies, information literacy and information management (TIGER, Shaw et al., 2020; 2009). And in 2014, TIGER transitioned to HIMSS (Health Information and Management Systems Society) with a focus on interprofessional and global growth (Shaw et al., 2020), and the goal of enabling:

> Nurses to use informatics tools, principles, theories, and practices to make health care safer, more effective, efficient, patient-centered, timely, and equitable by interweaving enabling technologies transparently into nursing practice and education, making information technology the stethoscope for the 21st century (TIGER, n.d.).

#### 2.7.1.2 American Nurses Association (ANA)

The American Nurses Association (ANA), formally recognised nursing informatics as a speciality in 1992, and developed *Scope of Practice for Nursing Informatics* in 1994 (Bickford, 2017). In 1995, *Standards of Nursing Informatics Practice* was released (Arakawa & Bader, 2022; Bickford, 2017) and in 2008, *Nursing Informatics: Scope and Standards of Practice* was published (ANA, 2008; Nelson, 2018), followed by two subsequent editions (ANA, 2015, 2022). The third edition of Nursing Informatics: Scope and Standards of Practice, published in 2022, defined nursing informatics as "the specialty that transforms data into needed information and leverages technologies to improve health and health care equity, safety, quality, and outcomes" (ANA, 2022, p. 3), and contained seventeen standards for nursing informatics practice (ANA, 2022; Bickford, 2021).

#### 2.7.1.3 Quality and Safety Education for Nurses Institute (QSEN)

In 2005, the *Quality and Safety Education for Nurses Institute (QSEN) Project* commenced, with the AACN and The University of California, aiming to prepare new graduates with the necessary competencies for nursing (QSEN Project, 2023). The QSEN Project developed six competencies for pre-licensure programs, including Informatics (Cronenwett et al., 2007), based of the Institute of Medicine competencies (Institute of Medicine (US) Committee on the Health Professions Education Summit, 2003); these competencies were defined, integrated into nursing programs in a pilot program, and incorporated into undergraduate nursing programs (QSEN Institute, 2023). In 2009, the QSEN Competencies were further developed to include *Graduate QSEN Competencies* (Cronenwett et al., 2009; QSEN, 2009, 2022).

#### *2.7.1.4 Canadian Association of Schools of Nursing (CASN)*

In 2012, the Canadian Association of Schools of Nursing (CASN, 2012b) released a key document, *Nursing Informatics: Entry-to-Practice Competencies for Registered Nurses* following the first consensus on nursing informatics competencies in Canada (Chauvette & Paul, 2016). These competencies identified the minimum requirements for Registered Nurses to effectively work within the digital health care environment, and included three domains - information and knowledge management, professional and regulatory accountability, and the use of information and communication technologies. In 2012, CASN (2012a, p. 3) published the *Nursing Informatics Inventory: Existing teaching and learning resources*, to increase the nursing informatics competency levels of Canadian nurse educators in undergraduate nursing education and to identify existing nursing informatics educational resources. In 2013, the *Nursing Informatics Teaching Toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula* (CASN, 2013), was released with the goal of addressing the gaps in available teaching resources.

### 2.7.2 Australian nursing informatics competency standards

In 2007, the *Australian Nursing Federation's Nurses and Information Technology Project* explored the use of information technologies by Australian Nurses (Hegney et al., 2007). The authors noted that nurses felt poorly prepared and ill-informed about information technology and recommended the development of national competency standards in nursing informatics. In 2009, the *Australian Nursing Informatics Competency Project* (Foster & Bryce, 2009, p. 556) identified Australian nurses as being cognisant of the benefits of information technology despite "a gross deficit in the capacity of the nursing workforce to engage in the digital processing of information" The authors concluded that there was clear evidence for the need for Australian nurses to receive further Informatics training to upskill and meet the demands of the future. Eley et al. (2009, p. 1157) subsequently identified a lack of education and training as being a significant barrier to the use of ICT and recommended that a national competency standard in regards to computer usage was essential. In 2012, ANMAC (2012) identified the need for Registered Nurse education providers to support education in health informatics and health technology. However, the continuing absence of nursing competencies relating to informatics skills and digital literacy was later identified by the Australian Nursing and Midwifery Federation (ANMF, 2015), which found that the minimum standards for registration did not address the need for Registered Nurses to have basic informatics skills on completion of undergraduate education. Despite the release of the *Registered Nurse standards for practice* in 2016 (2016a), there has continued to be a lack of specific Informatics competencies in Australia for nurses, with Raghunathan, McKenna and Peddle (2023a, p. 9) noting that the continuing "absence of national entry-to-practice informatics competency guidelines complicates efforts in standardisation of curricula to ensure consistent graduate preparation".

## 2.8 Digital literacy

The evolution of digital media and technological innovation have affected how individuals engage with information, the media and each other (World Economic Forum (WEF), comScore, & McKinsey & Company, 2017). The concept of digital literacy has developed as new digital technologies have evolved; however, there has been an ongoing lack of consensus on a definition of digital literacy; with some definitions considered ambiguous (Alexander, Adams Becker, & Cummins, 2016). In 2012, Ng (2012b; 2012a) developed a digital literacy framework which included technical dimensions, cognitive dimensions and emotional dimensions. *Technical dimensions* include technical digital skills used in everyday life; *cognitive dimensions* require the ability to critique digital sources and understand the legal and ethical implications of digital technologies; and socio-*emotional dimensions* entail the ethical use of the Internet with privacy and safety considerations (Ng, 2012b; Ng, 2012a; Reid, Button, & Brommeyer, 2023). Alexander et al. (2016) suggested three models of digital literacy. *Universal literacy* was defined as the rudimentary skill level, where the individual is able to effectively use digital devices and understands the functioning and use of specific programs. *Creative literacy* builds on this foundational knowledge and encompasses the development of more technical skills including the ability to produce digital content and understand the social imperatives associated with copyright and digital citizenship. *Literacy across disciplines* was defined as the use of digital technologies across disciplines in a way that recognises the unique learning contexts of each discipline. These models demonstrate the broader understanding of digital literacy as looking "beyond functional IT skills to describe a richer set of digital behaviours, practices and identities" (Jisc (formerly Joint Information Systems Committee), 2014).

Within the Australian context, digital literacy has been defined, by the Department of Education, Skills and Employment (DESE, 2020, p. 4) as "the ability to search and navigate, create, communicate and collaborate, think critically, analyse information, and address safety and wellbeing using a variety of digital technologies". More recently, Jobs and Skills Australia (JSA, 2023), in the *Foundation Skills Discussion Paper*, have proposed two different definitions of digital literacy:

> Digital literacy is the ability to use digital technologies—both hardware and software—safely and appropriately, while also using digital information to solve problems and handle security and safety challenges created by technology…(and)…to participate fully in learning, work and life, digital literacies required need to reflect application of skills and knowledge of using digital technology tools. (p. 5)

As part of the OECD's (2013b) *Programme for the International Assessment of Adult Competencies (PIAAC)*, the foundational literacies of (text) literacy, numeracy and problem-solving skills (in a technology rich environments) were evaluated; with the Australian report (OECD, 2013a,

p. 3) noting that “as in most participating countries, relatively large proportions of the adult population in Australia have poor literacy, numeracy and problem-solving skills” In particular, 7.5% of Australian adults had no or limited experience with computers and 38.1% could only use widely available applications, such as email and web browsers, with only simple reasoning and limited or no navigation across platforms (OECD, 2013a). A decade after this report, the *Foundation Skills Study*, will survey the current language, literacy, numeracy and digital foundational skills, with the aim of determining the best way to support Aboriginal and Torres Strait Islander peoples and other priority populations (JSA, 2023). In response to the need for Australians to have increased access to language, literacy, numeracy and digital literacy education, the Australian Government allocated $436.4 million to improve these foundational skills through the *Skills for Education and Employment* program (DESE, 2023).

### 2.8.1 Digital literacy and nursing

The advancement of digital technologies has transformed and changed the way in which health care is delivered (Barbosa, Abbott, & Dal Sasso, 2021; Holt et al., 2020; Reid, Button, & Brommeyer, 2023). The ability to live, work, participate and thrive in a digital world, is imperative for nurses because increasingly nurses' work and patient outcomes are influenced by technology (Brown, Pope, et al., 2020, p. 2801). Therefore, nurses must develop specific skills in digital health (Lapão, 2020).

In 2014, the Australian Nursing and Midwifery Accreditation Council (2014) stated that

> The guiding principle for all learning and teaching strategies related to informatics and technology in health is that being technically competent is a fundamental element of caring. However to achieve this, learning and teaching informatics and technology requires a broader focus than the simple transfer of knowledge. Ideally health informatics and health technology content is embedded across the curriculum (p. 4).

The authors identified that an inherent requirement for nursing informatics was the effective use of information and communication technologies. Brown, Morgan, et al. (2020) noted that to effectively use these technologies, nurses required digital literacy and that nurses with digital literacy skills were more likely to accept and use digital technologies.

#### *2.8.1.1 Barriers to digital literacy for nurses*

Digital literacy has been identified as a “survival skill for the profession” (Callinici, 2017, p. 1); however, everyday digital literacy does not necessarily translate to digital competence in the clinical setting (Brown, Morgan, et al., 2020; Reid, Button, & Brommeyer, 2023) or in education (Kirschner & De Bruyckere, 2017; Lokmic-Tomkins, Choo, et al., 2022).

In a study, *Challenging the Myth of the Digital Native: A Narrative Review*, Reid, Button and Brommeyer (2023) noted that:

> The myth of the Digital Native presents a challenge to educators and curricula alike, as exposure to digital technologies does not necessarily equate with digital literacy. This assumption must be continually tested to ensure that nursing education programs are reflective of required practice in a digital world. (p. 584)

The concept of the *digital native*, was coined by Prensky (2001b, 2001a, 2006), and used to describe “young people born after 1980 who have been surrounded by mobile phones, computers, and other digital devices their entire lives” and who were (therefore) more adept with the use of digital technologies (Reid, Button, & Brommeyer, 2023, p. 573). This false assumption, which Kirschner and De Bruyckere (2017, p. 140) describe as “imaginary generational differences” of “non-existent cognitive capacities”, has the potential to harm, rather than aid, the learning of students. In relation to nurses, van Houwelingen et al. (2017) identified the rhetoric regarding ‘digital natives’ and their skill sets, but noted that *internet-generation nurses* did not naturally view digital health technologies positively and required further education to transition these existing skills to the use of telehealth nursing activities. For nursing students, there is also a growing need digital literacy education prior to clinical placement (Lokmic-Tomkins, Choo, et al., 2022).

## 2.9 Adult learning

Changing nurses’ digital literacy and competency requires learning to take place. Knowles (1975), in *Self-Directed Learning: A Guide for Learners and Teachers*, defined learning as:

> A process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing an implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Considered one of the key proponents of adult learning, Knowles’ (1973) *Assumptions of Adult Learners* asserted that adult learners have changes in self-concept; that they bring past experiences into the classroom; that they have a readiness to learn; and that they typically seek practical and problem-centred approaches to learning. Subsequently, Knowles added the assumptions - that the adult learner is intrinsically motivated and has a need to know (Knowles, 1984). Based on these assumptions, Knowles (Knowles, 1984) then described *four key principles of andragogy*, identifying that adults need to be involved in the planning and evaluation of their learning; that experience is the foundation for the learning; that immediate relevance to either their occupation or personal life is important; and that the focus is on problem-centred rather than context-centred learning.

### 2.9.1 How nurses are educated

Nurses and midwives in Australia must be registered with the Nursing and Midwifery Board of Australia and meet the registration standards to practice in Australia (NMBA, 2019). To meet the requirements for registration as a Registered Nurse, in Australia, individuals are required to complete a Bachelor of Nursing program at a university (Australian Qualifications Framework Level 7) as defined by the Australian Qualifications Framework Council (AQFC, 2013). These registration requirements establish the mandatory requirements for nurses and midwives in Australia and include the requirement for ongoing education, with the NMBA (2016b, n.p.) defining continuing professional development as the means by which members of the profession "maintain, improve and broaden their knowledge, expertise and competence, and develop the personal and professional qualities required throughout their professional lives". The NMBA (2016c) *Registration Standard: Continuing professional development* establishes the minimum requirements for continuous professional development for all Australian nurses; for Registered Nurses 20 hours of education that is relevant to their area of professional practice.

#### *2.9.1.1 Knowledge sharing*

Closely aligned with professional development, is the ability of the nurse to identify gaps in their current knowledge through the processes of clinical reasoning and critical reflection. The process of clinical reasoning requires that the nurse critically review their nursing practice and identify needs for improvements and change (Griffits et al., 2017; Hong et al., 2021; Levett-Jones, 2013). The ability to bridge the gap between theory and practice aids in the development of evidence-based care and is further assisted by knowledge sharing practices (Eftekhar & Shakeryari, 2018; Mlambo, Silén, & McGrath, 2021; Yoo, Zhang, & Yun, 2019); particularly between experienced nurses (Shehab et al., 2023; Xu, Yang, et al., 2022). *Knowledge sharing* "uses formal, informal, and systematic methods to impart information to others that increases organizational effectiveness" (National Institutes of Health (NIH), n.d.). Within the context of nursing practice, knowledge sharing involves the sharing of *explicit knowledge*, including the sharing of information through reports, procedure manuals and knowledge of organisational structures and *tacit knowledge,* which refers to embedded, experiential knowledge that is not easily articulated (Yoo, Zhang, & Yun, 2019). This tacit knowledge is developed and shared intuitively and often unconsciously (Pérez-Fuillerat, Solano-Ruiz, & Amezcua, 2019), and can lead to the development of nursing competences (Kim & Kim, 2018; Sayar et al., 2018). Tacit knowledge, nurse's capacity to make sense of their work processes, is also a strong predictor of work engagement (Hendriks, Ligthart, & Schouteten, 2016).

#### 2.9.1.2 Barriers to learning

Continuing professional development (CPD) is “a key factor in improving and broadening nursing capacity, skill development, and adaptability” (Pracilio, Cashin, & Wilson Nathan, 2023, p. 405), but is also about lifelong learning that fosters staff retention and personal development (Jackson & Manley, 2022; Redwood et al., 2024). Nurses in Australia are required to be registered with the NMBA (2019) and to complete continuing professional development of 20 hours per year to demonstrate maintaining, improving and broadening their professional knowledge and skills (NMBA, 2016c). However, professional development is often ad hoc with no clear requirements for the type and quality of education undertaken (Teekens, Wiechula, & Cusack, 2018), and a focus on individual and team goals, rather than the development of the capability and capacity of the workforce (Jackson & Manley, 2022). In addition, professional development is perceived as not being prioritised by employers (Mlambo, Silén, & McGrath, 2021; Summers, 2015), resulting heavier work commitments (King et al., 2021; McAuliffe & Gledhill, 2022), and the inherent expectation that much of continuing professional development will occur during the nurses’ own time (McAuliffe & Gledhill, 2022; Suliman, Kruger, & Pienaar, 2020) and at their own expense (Walter & Terry, 2021). The lack of easily accessible and equitable education resources (Dagne & Beshah, 2021; McArthur et al., 2021; Rogers, 2019) means that nurses typically rely on knowledge sharing processes in the clinical setting (Mlambo, Silén, & McGrath, 2021; Ricks & ten Ham, 2015). Nibbelink and Brewer (2018, p. 926), in *Decision-making in nursing practice: An integrative literature review*, cautioned that the reliance on nursing colleagues as decision support resources “creates concerns related to the incorporation of bias in clinical decision-making” and a lack of evidence-based care, which may ultimately impact patient outcomes.

## 2.10 Tertiary education in Australia

To become a Registered Nurse in Australia, individuals must complete a relevant program of study which is accredited by ANMAC and approved by the NMBA. ANMAC (2012, p. 11) states that “the purpose of the ANMAC accreditation process is to ensure the quality of the profession and its work on behalf of public interest and public safety” and to ensure that university graduates from nursing programs are able to practice safely and effectively. Approved programs of study, for general registration as a Registered Nurse, are undertaken at Universities and include a full-time program of 36 months and equivalent for part-time studies (NMBA, 2023). “The academic content of accredited courses must cover knowledge and skills in critical thinking, analysis and problem solving, quality improvement methods, research, legal and ethical issues, and health informatics and health technology” (Lewis et al., 2020, p. 4). On completion of a Bachelor’s degree, students can apply to be registered on the general register of nurses as Registered Nurses (ANMF, n.d.; 2020).

### 2.10.1 Digital literacy and tertiary education

Digital literacy is one of the foundational literacies which are used to describe how students apply core skills to everyday tasks (WEF, 2015). The World Economic Forum (2015) identified foundational literacies, student competencies and character qualities as being integral requirements for lifelong learning but found that these requirements vary widely across countries and were indicative of significant skills gaps in teacher education and technological infrastructure. This issue is reflected in tertiary institutions, where "digital literacy is either taken for granted or assumed to be at an adequate level rather than being assessed, remediated and amplified" (Murray & Perez, 2014, p. 85). This deficit is worsened by the apparent disparity between institutional responses to digital literacy requirements (Alexander, Adams Becker, & Cummins, 2016) and the prevailing belief that students' increased exposure and use of technology correlates with digital literacy (Coldwell-Neilson, 2020; Kirschner & De Bruyckere, 2017). The myth of the *digital native*, a term created by Prensky (2001b, p. 1) to describe students who have grown up with digital technology and "think and process information fundamentally differently from their predecessors", is still in evidence within the tertiary sector (Janschitz & Penker, 2022; Press, Arumugam, & Ashford-Rowe, 2019; Reid, Button, & Brommeyer, 2023).

While the term 'digital literacy' is widely used in curriculum and strategy, research indicates that "universities still do not have a clear understanding of the types of digital literacy skills that would enable students to be job ready" (Press, Arumugam, & Ashford-Rowe, 2019, p. 260). This demonstrates an urgent need for the minimum standards of digital literacy to be clearly articulated, for the opportunity to develop these skills to be made available during orientation programs, and for additional digital learning to appropriately scaffolded throughout educational programs (Coldwell-Neilson, 2020).

### 2.10.2 Australian university curricula

The *Higher Education Standards Framework (Threshold Standards) 2021* (Cth) passed by the Australian Federal Government, requires that all students have equitable access and education in electronic learning management systems and support services to meet their learning requirements. The Framework states the requirement for students to "have equivalent opportunities for successful transition into and progression through their course of study, irrespective of their educational background, entry pathway, mode or place of study" (s.1.3.6). However, for Australian university students there is a lack of information regarding digital literacy requirements, indicating that "digital literacy is still an ill-defined and misunderstood term, particularly in regards to university graduates and their digital capabilities" (Coldwell-Neilson, 2017a, p. 79). This lack of a shared understanding of digital literacy requirements has resulted in the misalignment of expectations for educators and students. While most Australian institutions make broad statements about promoting digital literacy, there is an inferred expectation that students are already digitally literate prior to commencing studies and this presents a significant challenge for both students and educators (Coldwell-Neilson, 2017a; Reid, Button, & Brommeyer, 2023; Stunden et al., 2024). In order for curriculum to be transformed to meet industry's digital needs, a consensus understanding and benchmark of digital literacy is required, allowing graduate skills to be built from common foundations to be contextualised and understood further within disciplines (Coldwell-Neilson, 2017a; 2017b).

### 2.10.3 Australian undergraduate nursing curricula

Undergraduate nursing students and new graduate nurses are not being adequately prepared to engage with evolving digital health technologies (Kleib et al., 2022; Mollart et al., 2021; Raghunathan, McKenna, & Peddle, 2023a), with graduates, perceived by clinical educators, as being ill-prepared for the use of nursing informatics in the workplace (Shin, Cummings, & Ford, 2018). Research has also indicated that undergraduate nursing students and new graduate nurses feel underprepared for the use of digital health technologies due to limited digital literacy and exposure to digital health technologies in education (Chipps et al., 2022; Lokmic-Tomkins, Choo, et al., 2022; Martzoukou et al., 2024). This lack of workforce readiness is expressed throughout healthcare, with Cham et al. (2022), in a study of digital skills and competencies in Australian health profession courses*,* stating:

> The potential benefits of digital transformation for patient care across the health sector demand a continued focus on how health education can evolve to equip the next generation of health professionals with the digital skills and competencies they need to work effectively, safely and productively in e-health. (p. 76)

In response to the need for workplace readiness and competency in digital health technologies, some universities have addressed the role of digital health in nursing practice. The University of South Australia (2024), in a third year topic, address both technology and health informatics. The University of Technology Sydney (2024) addresses professional practitioner competencies in the final year of its three year Bachelor of Nursing program. Similarly, the University of Queensland (2024) also explores the use of health informatics in practice environments in the final year of its three year Bachelor of Nursing program. However, the lack of national Informatics competency standards for nurses in Australia, including entry-to-practice standards, is a complicating factor (Harerimana et al., 2022; Reid et al., 2024), and "until such national initiatives are available to drive comprehensive curriculum reform, informatics integration is likely to remain fragmentary within undergraduate curricula" (Raghunathan, McKenna, & Peddle, 2023a, pp. 8-9). As previously discussed, the *National Nursing and Midwifery Digital Health Capability Framework* (ADHA, 2020) aims to outline digital health capabilities for individuals and organisation but is not intended to be a professional standard; instead it aims to be "a practical guide for nurses and midwives to benchmark their current digital health knowledge and skills, and provide a pathway to further their development in this context" (Woods et al., 2021). Therefore, national standards, such as the Registered Nurse standards for practice (NMBA, 2016a, p. 2) which aim to "inform the development of the scopes of practice and aspirations of RNs", should reflect the integration of nursing informatics into nursing practice.

## 2.11 Conclusion

Health care has experienced a rapid change and transformation with the development of digital technologies aimed at making health care delivery more cost effective, more efficient, more accessible and safer. In response to these changes, informatics fields have evolved, including nursing informatics, which seeks to link technology with nursing care to provide optimal patient outcomes. This period of rapid change has resulted in new language to describe health information technologies and the associated processes; however, this terminology has often been poorly defined and understood. In addition, nurses, despite being the largest workforce within health care, are still not being adequately prepared to use information technology in a way that benefits the profession and improves patient care. Current gaps include a lack of consensus on Informatics terminology, a lack of informatics-based competencies worldwide, limited undergraduate nursing education regarding nursing informatics, a lack of university faculty with nursing informatics' expertise, and a workforce who is not adequately prepared to work within the digital health sphere.

## 2.12 Rationale for research

This literature review has identified that the current gaps in nursing informatics education for undergraduate nursing students and the need for new graduate nurses to be ready to work in an increasingly digital workforce. In response, this study addressed whether a distinct body of knowledge on nursing informatics could be further developed to be used to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula.

# Chapter 3 Study Methodology

## 3.1 Introduction

This study used a mixed-methods approach, which combined both qualitative and quantitative data. “Mixed methods research offers powerful tools for investigating complex processes and systems in health and health care” (Fetters et al., 2013, p. 2134). This approach draws on the strengths of each methodology and is underpinned by the assumption that by combining quantitative and qualitative paradigms, a richer and more in-depth understanding of the research problem can be achieved (Creswell & Plano Clark, 2018; Fetters, Curry, & Creswell, 2013; Whitehead, Dilworth, & Higgins, 2016). This chapter is divided into five distinct sections: 1) Research paradigm – The Mixed-methods approach, 2) Theoretical framework, 3) Phase 1 – Scoping review, 4) Phase 2 – Delphi study, and 5) Addressing the challenges in using mixed-methods.

## 3.2 Research paradigm – The mixed-methods approach

Historically, research has been separated into two distinct paradigms – quantitative and qualitative research; with these paradigms shaping a researcher’s approach to data collection, data analysis and interpretation (Francis, Chapman, & Whitehead, 2016; Teddlie & Tashakkori, 2009). Quantitative research has been closely aligned with the positivist approach, which asserts that there is a single reality or truth and that reality is measurable using reliable and valid tools (Francis, Chapman, & Whitehead, 2016). However, in response to this rigid philosophical position, the post-positivist approach developed, which acknowledged that all observation is fallible and therefore total objectivity is unachievable (Francis, Chapman, & Whitehead, 2016). The qualitative paradigm is underpinned by the assumption that multiple realities exist and seeks to explore why or how a phenomenon occurs, to describe an individual's experience or to develop a theory and “has proven invaluable in the disciplines of nursing and midwifery“ (Whitehead, Dilworth, & Higgins, 2016, p. 94). For this reason, a post-positivist approach may also be aligned with the qualitative paradigm.

“The main purpose of research is to discover a reality that is believed to exist through exposition and discussion” (Al-Motlaq & Chapman, 2012, p. 31) and the reason for choosing a particular paradigm is based on the purpose of the study and the research question (Francis, Chapman, & Whitehead, 2016). In recognising the inherent advantages and disadvantages in the two dominant paradigms, Al-Motlaq and Chapman (2012, p. 35) suggested that a mixed-methods approach may be viewed as “a feasible solution for tempering the debate” of the appropriate paradigm for nursing research. Mixed-methods research studies draw upon the strengths of both quantitative and qualitative approaches (Creswell, 2015; Creswell & Plano Clark, 2018; Whitehead & Day, 2016) and provides an innovative approach for addressing contemporary issues in nursing. This approach most closely resembles nursing practice as it integrates both quantitative and qualitative data, in the same way nurses integrate clinical data obtained in the form of numbers and words (Fawcett, 2015).

Using a mixed-methods approach, this study addressed the following three (3) research questions:

1. Can a distinct body of knowledge of nursing informatics be developed?
2. Can operational definitions for nursing informatics be achieved through consensus?
3. Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?

## 3.3 Theoretical framework

This study was underpinned by a pragmatic theoretical framework. Pragmatism focuses on the problem to be researched and practical outcomes, and offers the potential to effectively integrate research, practice and policy (Glasgow, 2013). It does not seek to find an absolute truth or reality but aims to facilitate problem solving applicable to the human experience (Powell, 2001). In this context, pragmatism moves beyond 'what works' and provides a coherent paradigm in which pragmatism "insists on treating research as a human experience that is based on the beliefs and actions of actual researchers" (Morgan, 2014, p. 1051). The framework uses abductive reasoning, alternating between deductive and inductive reasoning approaches, to convert observations of the data into theories and then evaluate these theories through further investigation (Morgan, 2007). In, *Pragmatism and integrated knowledge translation: exploring the compatibilities and tensions*, Nowell (2015, p. 143) noted the inherent links between nursing research and pragmatic philosophy, stating that "a pragmatic viewpoint offers epistemological justification for bringing together multiple sources of knowledge with the goals of finding workable solutions". So too, the philosophy underpinning the study was to bring together multiple sources of knowledge to find workable solutions to integrating nursing informatics education into undergraduate nursing curricula.

### 3.3.1 Pragmatism

Pragmatism is a philosophical tradition which began in the United States in the 1870s, based on the early work of Charles Sanders Peirce, William James, John Dewey (Margolis, 2002; Nungesser, 2017; Plowright, 2016), Herbert Mead (Elkjaer & Simpson, 2011; Lorino, 2018), Oliver Wendell Homes (Lorino, 2018; Ormerod, 2006), Nicholas St. John Green and Chauncey Wright

(Lorino, 2018).The origins of pragmatism and some of the key figures in pragmatic philosophy will now be discussed.

### 3.3.2 Historical origins of pragmatism – Classical pragmatists

Pragmatism emerged following the American Civil War, within the context of industrialisation and rapid economic growth, and the influence of the Darwinian theory of evolution (Aikin & Talisse, 2023; Ayer, 1968; Misak, 2023). Some of the earliest proponents of pragmatism, including Peirce, James and Holmes, met in a philosophical discussion group coined the *Metaphysical Club* from 1871-1872, and held debates on both philosophical and scientific topics (Behrens, 2005; Menand, 2001; Misak, 2023). This was one of the many philosophical discussion groups which emerged during this time, particularly in response to the dominant Cartesian philosophy (Lorino, 2018). The work of René Descartes (1596–1650), Cartesian philosophy was a form of rationalism in which "universal doubt initiates inquiry, intuition and deduction constitute the method of knowing, and these yield absolutely certain claims" (Anderson, 2006, p. 155). Descartes, considered by many to be the father of modern philosophy, used an *a priori* method of methodological doubt to establish irrefutable truth (Meyers, 1967). The intent of the Metaphysical Club was to move away from Cartesian philosophy, with Peirce (1868) stating:

> In some, or all of these respects, most modern philosophers have been, in effect, Cartesians. Now without wishing to return to scholasticism, it seems to me that modern science and modern logic require us to stand upon a very different platform from this. (p. 140)

These early origins are considered by many to be the birthplace of pragmatism (Behrens, 2005; Menand, 2001; Misak, 2023; Nungesser, 2017), as following these philosophical debates, Peirce published his foundational documents on pragmatism – *The Fixation of Belief* published in 1877 (Peirce, 1877/2009) and *How to Make Our Ideas Clear* published in 1878 (Peirce, 1878/2011).

#### *3.3.2.1 Charles Sanders Peirce*

Charles Sanders Peirce (1839-1914) believed that ideas and theories must be grounded in experience and have practical applications and his *pragmatic maxim* can be described as anchoring the concepts we use within practical action; that is, that a concept or inquiry is meaningless if it has no practical impact on the way we live our lives (Plowright, 2016). Peirce's (1878/2011, p. 57) *Pragmatic Maxim* invites us to "Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object". As Plowright (2016) later observed, there is an irony in the difficulty in grasping Peirce's meaning; however, Peirce's pragmatism was founded on connecting meaning to the practical consequences of actions, abductive reasoning and semiotic meaning-making (Elkjaer & Simpson, 2011; Ormerod, 2006).

Considered the father of pragmatism, Peirce introduced the use of the term pragmatism into philosophical discussions (Ayer, 1968; Dewey, 1916), and his work provided the foundations for later iterations of pragmatism, including those of James and Dewey. However, by 1905, Peirce sought to distance himself from pragmatic philosophy, as he believed that the term had been misappropriated by others and coined the term pragmaticism, which he described as “ugly enough to be safe from kidnappers” (Peirce, 1905/2015, p. 166). This schism between the work of Peirce and James (and others) was highlighted by Dewey (1916), who noted the marked differences between the pragmaticism of Peirce and the pragmatism of James. These philosophical debates regarding pragmatism, evident during the time of the Peirce, James and Dewey, remain evident within contemporary literature (Gabriel & Crick, 2006; Schwartz, 2021; Taylor, 2012).

#### *3.3.2.2 William James*

William James (1842-1910) was a contemporary of Peirce and has been credited with popularising the term pragmatism during the presentation of a paper, *Philosophical Conceptions and Practical Results,* delivered at the University of California (Berkeley) Philosophical Union in 1898 (Houser, 2017; James, 1898/2011). James (1898/2011, p. 67) identified Peirce as the founder of pragmatism and provided an interpretation of Peirce’s pragmatic maxim, stating “The ultimate test for us of what a truth means is indeed the conduct it dictates or inspires”. James and Peirce had a history of critiquing each other’s ideas (Houser, 2017); therefore, it is unsurprising that James’ interpretation of pragmatism, differed from Peirce’s theory of meaning for society, and emphasised the experience of the individual, with the assertion that truth varied from individual to individual (James, 1907/2010; Misak, 2013, 2023).

James’ humanist perspective provided a more subjective meaning to truth; for him the efficacy of pragmatism did not lay in the abstract scientific community but in actual flesh and blood individuals, with truth consisting in useful ideas (Niu, 2023; Ormerod, 2006); his earlier academic studies in medicine (Ayer, 1968; Houser, 2017; Taylor, 2012) may have influenced his beliefs. He identified that pragmatism was, in fact, a familiar empiricist philosophy, but one which looks towards consequences, facts and results (James, 1907/2010). In *Pragmatism: A New Name for Some Old Ways of Thinking*, James (1907/2010) stated:

> I fully expect to see the pragmatist view of truth run through the classic stages of a theory's career. First, you know, a new theory is attacked as absurd; then it is admitted to be true, but obvious and insignificant; finally it is seen to be so important that its adversaries claim that they themselves discovered it. (pp. 135-136)

This wry observation has been borne out by the ongoing debate regarding James’ philosophy of pragmatism (Dickstein, 1998; Margolis, 2002, 2004).

### *3.3.2.3 John Dewey*

John Dewey (1859-1952) was an American philosopher, famous for his theory on the social and interactive nature of education, and the assertion of education and schooling as an instrumental aspect of social reform (Fott, 2009; Garrison, Neubert, & Reich, 2012; Pavlis & Gkiosos, 2017). He was one of the earliest proponents of pedagogy; believing that children are not passive recipients of education but need to be active participants in their learning (Ormerod, 2006), and much of his work continues to influence learning theories in education today (Garrison, Neubert, & Reich, 2012; Holt, 2020; Sadovnik et al., 2017). Similarly, his type of pragmatism emphasised the cognitive experiences of knowing and thinking (Neubert, 2009; Pavlis & Gkiosos, 2017; Talisse & Aikin, 2011).

Like Peirce and James, Dewey's philosophy of pragmatism was focused on meaning-making within the practical context of human conduct (Elkjaer & Simpson, 2011). Dewey built on the work of these earlier pragmatists and developed a philosophy that "frames inquiry as a continuously unfolding social process in which meanings are constructed as people engage with each other" (Elkjaer & Simpson, 2011, p. 61). As Ormerod (2006), in *The history and ideas of pragmatism*, explains – for Peirce pragmatism was a scientific endeavour, for James the focus was embedded in personalism and for Dewey, pragmatism was democratically populist, reflecting his focus on the social issues of the time. This focus on social issues was reflected by Dewey's role in the founding of the National Association for the Advancement of Colored People (NAACP), a civil rights organisation formed in 1909; the League for Independent Political Action, an attempt to coordinate an alternative political party in America in the late 1920s; and the American Federation of Negro College Students, for which Dewey encouraged Eleanor Roosevelt to be the chair of its advisory council (Martin, 2002; Stack, 2009). Dewey's activism, linked to social reform and public policy continued throughout his life, with his involvement in many volunteer organisations (Martin, 2002).

Dewey's philosophy of pragmatism, (which Dewey referred to as instrumentalism, radical empiricism, naturalism, humanism, experimentalism and operationalism), was more than a means of gathering knowledge, and was deeply rooted in both a moralistic and humanistic approach which sought to better the world (Hildebrand, 2013; Jackson, 2006; Kadlec, 2006). Dewey's (Dewey, Boydston, & Murphey, 1922/2008, p. 77) instrumentalism was concerned with being an instrument "to furnishing points of view and working ideas which may clarify and illuminate the actual and concrete course of life". Noting the gap between scientific theory and practice, Dewey sought to overcome this dualism, stating that "all ideas are worthless except as they pass into actions which re-arrange and reconstruct in some way, be it little or large, the world in which we live" (Dewey, 1930, p. 133). He argued that classical philosophers, had separated reason from lived experience, creating a false dichotomy which viewed experience as lacking legitimacy for critical reflection (Kadlec, 2006). Dewey asserted that this false dualism, with the failure to acknowledge lived experience, reflected the inherent inequities in Ancient Greek society (Dewey, 1920; Dewey, Boydston, & Murphey, 1922/2008; Kadlec, 2006), with lived experience viewed as "matters of belief rather than of knowledge" (Dewey, 1930, p. 28).

This challenge to dualistic thought was addressed, according to Dewey (1905), through pragmatism which allows us to:

> Think freely and naively in terms of things-because things are no longer entities in a world set over against another world called 'mind' or 'consciousness,' with some sort of mysterious ontological tie between them. Again, pragmatism has learned that the true meaning of subjectivism is just anti-dualism. (p. 326)

### 3.3.3 Modern pragmatism – Contemporary pragmatists

Pragmatism fell out of favour in the middle of the twentieth century, with the view that it lacked the rigor required of serious philosophy (Bernstein, 1992; Dickstein, 1998; Ormerod, 2006) and that "the Pragmatists' positions were implausible, incoherent, or trivial" (Schwartz, 2012, p. 2). However, in the mid 1970s, pragmatism experienced a resurgence (Schwartz, 2012), due to the work of well-known philosophers, including Richard Rorty (Rorty, 1967, 1980, 1982, 1991, 1996b, 1996a, 1998, 1999, 2006, 2012; Rorty, Bromwich, & Williams, 2009), Hilary Putnam (Putnam, 1971, 1981, 1992, 1995d, 1995a, 1995b, 1995c, 2002, 2004, 2009; Putnam & Putnam, 2017), and Susan Haack (Haack, 1976, 1979, 1998, 2004, 2005, 2008, 2009a, 2009b, 2014, 2017, 2018, 2021).

Similar to the disputes which existed between the classical pragmatists, contemporary pragmatists have also demonstrated clear differences in their pragmatic philosophies (Misak, 2007). Misak (2007), in *New Pragmatists*, noted two distinct groups – the new pragmatists, and the neopragmatists, with *new pragmatists* aligned with the work of classical pragmatists and *neopragmatists* described as a "revisionist movement in contemporary pragmatism" (Stout, 2007, p. 8). Hildebrand (2005, pp. 346-347) sought to identify the key differences between classical pragmatism and neopragmatism, defining neopragmatism as a "reformulation" of classical pragmatism which negated "the use of language as a tool in experience", saw "no specific pattern of inquiry or method" as discoverable, and viewed philosophical systems as hindrances to renewal. It is important to note, that neopragmatism, like classical pragmatism is not a unified school of thought, with Richard Rorty and Hilary Putnam both identified as neopragmatists, despite disagreements about the nature of pragmatism (Webb, 2012).

#### *3.3.3.1 Richard Rorty*

Richard Rorty (1931-2007) was an American philosopher and a neopragmatist, with a significant role in reinvigorating the discussion surrounding pragmatism in the late 1970s and was particularly influenced by the work of Dewey (Gross, 2003; Müller-Staub, Waar, & Paans, 2016). Rorty has also been described as a postmodern relativist; with postmodernism linked with pragmatism through the rejection of grand philosophical ideologies, narratives or frameworks, but differing through the perspective that “all truths are relative and that science is but one among many equally valid narratives” (Ormerod, 2006, p. 903). Rorty has been critiqued for changing interpretations of pragmatism (Bernstein, 1992; Brodsky, 1982; Kulikowski et al., 2012), misreading the classical pragmatists (Allen et al., 2022), “fundamentally misrepresenting pragmatism historical aims, values, and tenets” (Gross, 2003, p. 93), and with his pragmatism “very far removed from Peirce” (Haack, 2004, p. 31).

In, *Pragmatism, Relativism, and Irrationalism*, a Presidential Address to the American Philosophical Association, Rorty (1980, p. 719) stated "Pragmatism" is a vague, ambiguous, and overworked word”, but identified it as a means of radically changing the future from the past. He described pragmatism as having three characterisations (Brodsky, 1982; Rorty, 1980). Firstly, he linked James’ definition of truth with anti-essentialism (Brodsky, 1982) and noted that the pragmatic approach employed the “vocabulary of practice rather than theory” when applied to concepts like truth, knowledge and other philosophical domains (Rorty, 1980, p. 722). The second characterisation focused on the *is-ought debate* (Brodsky, 1982), with rationality only found through the "the ordinary, retail, detailed, concrete, reasons which have brought one to one's present view”, as opposed to the Platonic epistemological approach (Rorty, 1980, p. 725). The final characterisation was the pragmatic requirement for no constraints on inquiry, except those from fellow inquirers, and no way of knowing when the truth was reached (Brodsky, 1982; Rorty, 1980).

Identifying language, communication and history with fellow human-beings as the only source of guidance, Rorty (1980, p. 727) stated “In the end, the pragmatists tell us, what matters is our loyalty to other human beings clinging together against the dark, not our hope of getting things right”. This reflected Rorty’s (1967) adoption of the *linguistic turn*, with the focus on language, as opposed to the classical pragmatists focus on experience (Hildebrand, 2005; Koopman, 2011; Müller, 2022). In his later work, *Philosophy and Social Hope*, Rorty (1999) encapsulated his pragmatism, stating:

> We pragmatists cannot make sense of the idea that we should pursue truth for its own sake. We cannot regard truth as a goal of inquiry. The purpose of inquiry is to achieve agreement among human beings about what to do, to bring about consensus on the ends to be achieved and the means to be used to achieve those ends. (p. xxiv)

#### ***3.3.3.2 Hilary Putnam***

Hilary Putnam (1926-2016) was an American philosopher, mathematician and computer scientist (Baghramian & Shields, 2023). Putnam (1995b, p. xi) viewed pragmatism “as a way of thinking that I find of lasting importance, and an option (or at least an "open question") that should figure in present-day philosophical thought”. A contemporary of Rorty, Putnam rejected many of Rorty’s revisionist views, including that his views reflected a pragmatic philosophy (Baghramian & Shields, 2023; Malachowski, 2014; Putnam, 1992, 2009), and noted Rorty’s inconsistency and incoherency and refusal to reflect on pragmatic epistemology (Rockwell, 2003). Margolis (2018) credited the disputes between Putnam and Rorty, centred around relativism, realism, historicism, truth and values, as the impetus for the revival of pragmatism.

The theses that underpinned Putnam’s pragmatism were described in *Words and Life* and included *antiscepticism* – the assertion “that doubt requires justification just as much as belief”; *fallibilism* – that there is no guarantee that beliefs will never need to be revised; the lack of a dichotomy between facts and values; and that “in a certain sense, practice is primary in philosophy” (Putnam, 1995c, p. 152). Putnam, like the classical pragmatists, identified the disconnect between philosophy and social issues, stating “we should see philosophy as a reflection on how human beings can resolve the various sorts of problematical situations that they encounter, whether in science, in ethics, in politics, in education, or wherever” (Putnam, 1992, pp. 2-3).

#### *3.3.3.3 Susan Haack*

Susan Haack (1945- ) is a philosopher whose work reflects the classical pragmatist tradition, in particular Peirce’s pragmatism, including his central tenets of use of terminology, fallibilism and realism (De Waal, 2022; Haack, 2014). Haack (2004, p. 5), in *Pragmatism, Old and New*, noted that the history of pragmatism was “both confusing and disturbing”; confusing due to the varying philosophical views described as pragmatism and disturbing due to the work of neopragmatists (like Rorty) who distorted the work of the classical pragmatists. In response to these issues, Haack (2004, p. 34) emphasised the importance of borrowing “from the riches of the classical pragmatist tradition…and (considering) what we can salvage from the intellectual shipwreck of radical contemporary neo- and neo-neo-pragmatisms”.

In, *Why I’m a Peirce Person*, Haack (2014, pp. 86-87) addressed her alignment with classical pragmatism and the work of Peirce; namely, the requirement for “exactitude in philosophical terminology”, the need for commonsense, the growth of meaning, the requirement for genuine inquiry, the necessity to avoid fragmentation of philosophy and the significance of fallibilism. These central tenets of Haack’s pragmatism are evident throughout her work. For example, the importance of clear language in contemporary philosophy (Haack, 1998, 2009b), is linked with Peirce’s requirement for agreement over terminology and his statement that “the first rule of good taste in writing is to use words whose meanings will not be misunderstood” (Peirce, 1902/1998, p. 265). So to, Peirce’s fallibilism is reflected with Haack (2014, p. 88) stating “all through my work you will see the influence of the “contrite fallibilism, combined with high faith in the reality of knowledge” of which Peirce speaks”. And Haack’s (1998, p. 106) distinctions between sham reasoning, fake reasoning and genuine inquiry argue that “an empirical proposition is more or less warranted depending on how well it is supported by experiential evidence and background beliefs”, reflecting the classical pragmatism of Peirce (Driggers & Boyles, 2023).

### 3.3.4 Critiques of pragmatism

In *Whatever Happened to Pragmatism?*, Schwartz (2020) posits a variety of reasons for the decline in pragmatism, following the work of Peirce, James and Dewey (amongst others), including the rise of logical empiricism, the search for rational certainties and the inherent work associated with following pragmatic philosophy (as described by James and Dewey). Whilst originating in response to formalism and Cartesian thought, and with inherent principles and ideas, the different interpretations of pragmatism have also posed problems for the philosophy with Rockmore (1993, p. 279) noting that “a wide, if somewhat disparate group of thinkers has begun to invoke the same term to describe rather different views”. Lovejoy (1963), in *The Thirteen Pragmatisms and Other Essays*, highlighted this issue, noting that, at the time in 1908, there existed at least thirteen different pragmatisms which were separate and imbued with different logic, resulting in confusion regarding its legacy (Dunn, 2018) and questions regarding whether the label of *pragmatism* served any purpose (Haack, 2004).

So to, the common misconception that pragmatism is based on “what works” and is utilitarian (Hesse-Biber, 2015), has reduced pragmatism to a simplistic caricature (Dunn, 2018; Morgan, 2014). This misrepresentation of pragmatic philosophy has been highlighted in the work of Clarke (2012), who noted that this misuse has been prefaced on financial expediency and capitalism, rather than driven by philosophical underpinnings. The partnership between *practical pragmatism* and mixed-methods research has been viewed as a means of addressing “the paradigm wars”. However, Hesse-Biber (2015, p. 784) has cautioned that this approach leaves “no room for consideration of a more nuanced and subjectivist understanding of the social world, and it is these concerns, in contrast, that reside as a fundamental tenet of any qualitatively driven approach” and recommends a return to the work of the classical pragmatists with a focus on using methods that best meet the needs and purpose of the research.

### 3.3.5 Pragmatism and mixed-methods research

As a research paradigm, pragmatism “is based on the proposition that researchers should use the philosophical and/or methodological approach that works best for the particular research problem that is being investigated” (Kaushik & Walsh, 2019, p. 2). Pragmatism is considered, by many researchers, to be the primary philosophy for mixed-methods research (Feilzer, 2010; Florczak, 2014; Johnson et al., 2016; Johnson, Onwuegbuzie, & Turner, 2007; Johnson & Romanello, 2005; Maarouf, 2019); however, mixed-methods research has tended to use pragmatism from a practical standpoint, rather than considering and applying its philosophical foundations (Morgan, 2014). In, *Unpacking Pragmatism for Mixed Methods Research*, Johnson et al. (2016) identified three specific types of mixed-methods research and aligned these approaches with specific forms of pragmatism. Quantitatively driven mixed-methods research is aligned with the pragmatism of Peirce, qualitative driven mixed-methods research with the pragmatism of James and Rorty, and equal status mixed-methods research with the pragmatism of Dewey (Johnson et al., 2016).

#### *3.3.5.1 Dewey's pragmatism and mixed-methods research*

Johnson et al. (2016) aligned Dewey with an equal status mixed-methods design because:

> He famously attacked dualisms and dualistic argumentation, showing that, most often, one is not faced with an either/or logic but often with a both/and logic, and that oftentimes some truth content is found in the poles of dualisms and different perspectives. (p. 260)

Morgan (2014, p. 1051) argued that John Dewey's concept of inquiry moves pragmatism beyond what works and provides a coherent paradigm in which pragmatism "insists on treating research as a human experience that is based on the beliefs and actions of actual researchers". In this way, Dewey's philosophy of pragmatism provides a clear shift from the search for absolute truth and towards what Dewey termed *warranted assertions*, in which a proposition is viewed as potential, rather than actual, and is subject to constant review and critique (Morgan, 2014). Dewey's Model of Inquiry is a systematic approach which requires recognition of problem, defining the problem, hypothesis of a possible solution, consideration of the consequences of potential actions and taking an action which is most likely to address the problem (Hildebrand, 2008; Morgan, 2014).

#### *3.3.5.2 Dewey, mixed-method's research and the current study*

Dewey's philosophy is aligned with the philosophical underpinnings of mixed-methods research and this study, as the study engaged in the process of self-correcting and revision, with the understanding that the aim of the study was not the search for an absolute truth but to achieve a strong body of evidence which could be used to structure educational reforms for undergraduate nursing students and nurses. This study was underpinned by a pragmatic theoretical framework in which singular and multiple realities were explored to provide a real-world perspective of the current understanding of nursing informatics. The study investigated whether a distinct body of knowledge on nursing informatics could be developed, and whether this body of knowledge could be used to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula.

## 3.4 Study design

A convergent design was used to provide a deeper understanding of contemporary knowledge of nursing informatics. This design allowed for the collection and analysis of data separately, and then enabled results to be merged to "examine to what extent the quantitative results are confirmed by the qualitative results (or vice versa)" (Creswell, 2015, p. 36). This approach is useful in researching phenomena from different angles and perspectives (Creswell, 2015) and can lead to further exploration of the literature as new findings emerge (Creswell & Plano Clark, 2018). The strengths of this design include efficiency as data is roughly collected at the same time, data can be collected and analysed separately and independently using the techniques traditionally associated with qualitative and quantitative paradigms, and the design means researchers can 'give voice' to participants as well as reporting statistical trends.

### 3.4.1 Phases of the mixed-methods design

The first phase involved the scoping review in which both qualitative and quantitative data was collected. The second phase involved the collection and analysis of qualitative and quantitative data using the Delphi technique with domain experts.

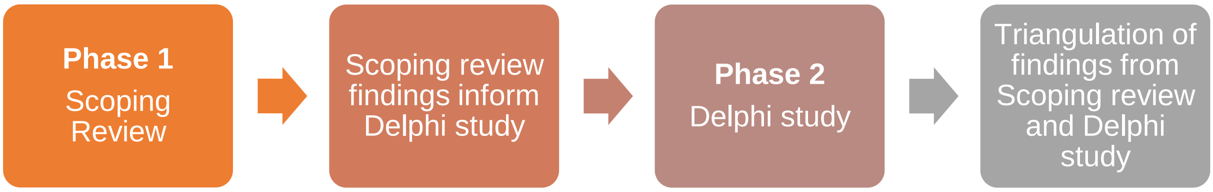



**Figure 3.1 Phases of the Research Study 1**

## 3.5 Phase 1 – Scoping review

The first phase of this study used a scoping review procedure to obtain objective data, on the phenomenon of interest, to inform the Delphi study phase. Scoping reviews are a relatively recent approach to reviewing literature (Pham et al., 2014; Raitskaya & Tikhonova, 2019; Verdejo et al., 2021) and "follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps" (Tricco et al., 2018, p. 467). Scoping reviews are useful for examining emerging evidence when it may be unclear what additional research questions may be posed and may also be used to identify and map evidence relating to policy that seek to guide practice in a specific field (Peters et al., 2021).

### 3.5.1 The purpose of scoping reviews

Scoping reviews can be undertaken with the objective of providing an overview of existing evidence, mapping key concepts, defining working definitions, and providing a broad overview of a topic (Peters et al., 2020). They are useful for examining emerging evidence, when it may be unclear what additional research questions may be posed and may also be used to identify and map evidence relating to policy that seek to guide practice in a specific field (Peters et al., 2020). Scoping reviews provide a means of gathering literature in a specific policy or clinical area “where the aims are to accumulate as much evidence as possible and map the results to provide an overview of the type, extent and quantity of research available on a given topic” (University of South Australia (UniSA) & Peters, 2024). In *A scoping review of scoping reviews,* Pham et al. (2014) found that the most common reasons for conducting a scoping review were for exploring the breadth, extent and range of literature, mapping and summarising the evidence, and informing future research.

In this study, the purpose of the scoping review was to explore the extent of literature on embedding nursing informatics into undergraduate nursing curricula and to inform the Delphi study phase of the study.

### 3.5.2 How does a scoping review differ from a systematic review

Systematic reviews and scoping reviews follow a similar structured process; however, the purpose of these reviews is different and there are key differences in methodology (Munn, Stern, et al., 2018). Systematic reviews “seek to collate evidence that fits pre-specified eligibility criteria in order to answer a specific research question. They aim to minimize bias by using explicit, systematic methods documented in advance with a protocol” (Lasserson, Thomas, & Higgins, 2019, p. 4). Indications for a systematic review include confirming current clinical practices, identifying new clinical practices, identifying and analysing conflicting results, developing decision-making statements, identifying future areas for research and identifying new evidence (Liberati et al., 2009; Munn, Peters, et al., 2018; Munn, Stern, et al., 2018).

Scoping reviews tend to use a broader range of studies and are “commonly used for ‘reconnaissance’ – to clarify working definitions and conceptual boundaries of a topic or field” (Peters, Godfrey, McInerney, Baldini Soare, et al., 2015, p. 141). They are useful when the literature has not been meticulously reviewed or with literature of a heterogeneous nature (Khalil et al., 2016; Munn, Peters, et al., 2018; Peters, Godfrey, McInerney, Baldini Soare, et al., 2015). Indications for a scoping review include identification and analysis of current knowledge gaps, clarifying working definitions, key characteristics and concepts in the literature, identification of available evidence in a specific field, examination of types of research in a specific field and as a foundation for a systematic review (Munn, Peters, et al., 2018).

The stages of a scoping review are similar to those of a systematic review; however, a systematic review typically focuses on a well-defined research question, whereas a scoping review seeks to examine broader topics of interest where many different study approaches may be relevant (Arksey & O'Malley, 2005). In developing the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Scoping Reviews (PRISMA-ScR)*, Tricco et al. (2018) identified the key methodological differences when comparing the PRISMA ScR to the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA*) (Moher et al., 2009). The summary measures are not applicable due to meta-analysis not being performed; risk of bias across studies and risk of bias across study results are not applicable due to scoping reviews providing an overview of evidence without critically appraising a cumulative body of knowledge; and additional analyses, including meta-regression and sensitivity or sub-group analyses, are not performed. Two optional items included in the PRISMA-ScR are critical appraisal of individual sources of evidence and critical appraisal within sources of evidence, both of which present data on the rationale for the critical appraisal and the data obtained.

In this study, a scoping review was selected as being most appropriate method to answer the research questions, because of the heterogenous nature of the contemporary literature and the need to identify knowledge gaps, clarify working definitions and identify the available evidence in the field of nursing informatics and undergraduate nursing education.

### 3.5.3 History of scoping review methodology

#### *3.5.3.1 Arksey and O'Malley – 2005*

Arksey and O'Malley (2005) published the seminal paper *Scoping studies: towards a methodological framework* and identified that a scoping review may be used to evaluate the nature and range of available research on a topic, determine whether a systematic review should be undertaken, disseminate research findings or identify gaps in the literature. The authors asserted, that at the time, there were inconsistent terminology and definitions used to describe types of literature reviews and no definitive scoping review procedure. They recommended that "greater clarity regarding the terminology and methods that surround literature reviews will assist researchers in identifying when and how such reviews might be undertaken" (Arksey & O'Malley, 2005, p. 20).

The authors developed a five-step methodological framework for scoping reviews to enhance transparency, rigour and replicability. Stage 1: identifying the research question, required that a research question be identified to guide the development of search terms with clear inclusion and exclusion criteria. Very broad search terms could result in unmanageable numbers of sources, whereas limited search terms could exclude valuable data. Stage 2: identifying relevant studies, required that the scoping review was to be as comprehensive as practicable in searching for both published and non-published literature. Therefore, the authors recommended searching electronic databases, reference lists, key journals, and professional sources, such as organisations, conferences and existing networks. Stage 3: study selection, required the ongoing process of developing inclusion and exclusion criteria as the studies were reviewed. This reiterative process evolved as the researchers became more familiar with the literature. These inclusion and exclusion criteria were clearly identified and justified. Stage 4: charting the data, required a uniform approach to all studies included in the scoping review and was charted on a document. Examples of required information included the author(s), year published, study population, interventions, study design and important results. It was noted, however, that not all information was evident in the reviewed studies. Finally, Stage 5: collating, summarising and reporting the results, required that, in contrast to a systematic review, where only a few of the reviewed studies may be reported, the scoping review aimed to report all the reviewed material. It was therefore essential to develop a template which was used in structuring the narrative, so that the reader could determine any underlying bias or subjective opinions.

In this study, a *Scoping review protocol* (refer to *Appendix A1*), a *Data Extraction Template* and a *Data Extraction Spreadsheet* (refer to *Appendix A3*) were developed to enhance transparency, rigour and replicability of the study. (Please note: the Data Extraction Spreadsheet was modified for the purpose on inclusion in this thesis – a full version is available on request).

#### *3.5.3.2 Davis, Drey and Gould - 2009*

In 2009, Davis, Drey and Gould (2009, p. 1387) explored the use of scoping reviews in nursing research and noted that (at the time) “Scoping as a *stand alone* (sic) activity in relation to the field of nursing has not been extensively examined”. The authors cautioned that there was inconsistency regarding the intent and expectations of scoping reviews, and that a more standardised approach was needed. Using the Arksey and O’Malley’s (2005) framework, Davis, Drey and Gould (2009) found that scoping reviews varied significantly in procedural and methodological rigour. Recommendations to enhance the rigour of scoping reviews included – a hierarchy of levels of inquiry, from elementary descriptive surveys to substantial conceptual studies, a clear statement of the purpose of the scoping study through descriptive statements, greater transparency in the scoping review process and clear acknowledgement of the limitations of the approach.

#### *3.5.3.3 Levac, Colquhoun & O’Brien – 2010*

Levac, Colquhoun and O'Brien (2010) provided a series of recommendations to enhance and clarify Arksey and O’Malley’s (2005) scoping study framework. In Stage 1, the research question(s) needed to be broad but could lack the clarity required to inform the research process; therefore, Levac et al. (2010) recommended combining a broad research question with a scope of inquiry to clarify and link the purpose of the study and the research question. In Stage 2, inherent tensions between a comprehensive search of the literature and the feasibility of the review were noted;

therefore, clearly justifying inclusion and exclusion criteria and stating the limitations of the review was emphasised. In Stage 3, the authors noted that study selection required a more iterative process and was best served by a team approach to limit the bias of one reviewer. In Stage 4, the need for continuous development of the data document and repeated review of some studies, to achieve a more comprehensive data set, was identified. Stage 5 was identified as lacking sufficient detail but being the most important stage; therefore it was recommended to divide this final stage into three distinct processes: 1) analysis of data through both a numerical summary and thematic analysis, 2) reporting of results including clearly defining how the study findings will be disseminated to readers, and 3) meaning of results by identifying the practical implications of the study findings. Arksey and O'Malley (2005) had also provided an optional sixth stage of consultation with key stakeholders. Levac, Colquhoun and O'Brien (2010) asserted that this final ‘optional’ step should be considered a required component to enhance methodological rigour by sharing preliminary findings with stakeholders thereby validating findings and informing future research. This study used the optional sixth stage of consultation to enhance the reliability and trustworthiness of the data collection and analysis.

### 3.5.4 Recent developments

Following the publication of Arksey and O’Malley’s framework (2005), scoping reviews continued to suffer from “a lack of consensus on scoping review terminology, definition, methodology, and reporting” (Colquhoun et al., 2014, p. 1291). In response, further recommendations for scoping reviews were proposed (Khalil et al., 2016; Pham et al., 2014; Tricco et al., 2016). In 2013, the JBI (Joanna Briggs Institute) Scoping Review Methodology Group was formed to develop a comprehensive guide for the conduct of scoping reviews, which built on the seminal work of Arksey and O’Malley (2005) and Levac, Colquhoun and O'Brien (2010). The scoping review framework was further refined and published as part of the Joanna Briggs Institute Reviewer’s Manual and later the JBI Manual for Evidence Synthesis (Peters et al., 2017; Peters, Godfrey, McInerney, Soares, et al., 2015; Peters et al., 2020) (refer to *Table 3.1*). In 2018, the Preferred Reporting Items for Systematic Reviews (PRISMA) Statement for Scoping Reviews – PRISMA-ScR was developed by the JBI Scoping Review Methodology Groups and other experts in scoping reviews (Tricco et al., 2018).

The current version of Chapter 11: Scoping reviews (Peters et al., 2020) incorporates the Prisma-ScR into the JBI scoping review methodology. Reporting guidelines are designed to provide a means of reporting and enhancing methodological transparency (Altman et al., 2008; McGowan et al., 2020; Tricco et al., 2018). The Enhancing the QUAlity and Transparency Of health Research (EQUATOR) Network defines guidelines as providing a “a minimum set of items for reporting can improve the accuracy and transparency of publications, thus facilitating easier and more reliable appraisal of quality and relevance” (Altman et al., 2008, p. 1149). The PRISMA-ScR consists of 20 essential reporting items and 2 optional items and aims to improve methodological transparency (Tricco et al., 2018). The Prisma-SCR has recently been used in nursing research on nursing documentation (Muinga et al., 2021), virtual reality simulations in education (Plotzky et al., 2021), cardiovascular health behaviour (Mueller, 2021), and the impact of COVID-19 on the Latinx population (Moore, 2021). In the study, the researcher used these reporting guidelines to enhance the transparency, rigour and replicability of the study.

**Table 3-1 Scoping Review Frameworks**

**Table 11.2: Scoping review frameworks**

| | **Arksey and O' Malley framework (2005, p. 22-23)** | **Enhancements proposed by Levac et al. (2010, p. 4-8)** | ***Enhancements proposed by Peters et al (2015, 2017, 2020).** |
|---|---|---|---|
| 1. | Identifying the research question | Clarifying and linking the purpose and research question | Defining and aligning the objective/s and question/s |
| 2. | Identifying relevant studies | Balancing feasibility with breadth and comprehensiveness of the scoping process | Developing and aligning the inclusion criteria with the objective/s and question/s |
| 3. | Study selection | Using an iterative team approach to selecting studies and extracting data | Describing the planned approach to evidence searching, selection, data extraction, and presentation of the evidence. |
| 4. | Charting the data | Incorporating a numerical summary and qualitative thematic analysis | Searching for the evidence |
| 5. | Collating, summarizing and reporting the results | Identifying the implications of the study findings for policy, practice or research | Selecting the evidence |
| 6. | Consultation (optional) | Adopting consultation as a required component of scoping study methodology | Extracting the evidence |
| 7. | | | Analysis of the evidence |
| 8. | | | Presentation of the results |
| 9. | | | Summarizing the evidence in relation to the purpose of the review, making conclusions and noting any implications of the findings |

*Consultation of information scientists, stakeholders and/or experts throughout, including in the topic prioritization, planning, execution and dissemination

*Note:* Reprinted from Peters, M. D. J., Godfrey, C., McInerney, P., Tricco, A. C., & Khalil, H. (2020). Chapter 11: Scoping reviews (2020 version). In E. Aromataris. & Z. Munn (Eds.), *JBI Manual for Evidence Synthesis*. https://doi.org/10.46658/JBIMES-20-12. Reprinted with permission. (Refer to *Appendix B1*)

## 3.6 Phase 2 – Delphi Study

The second phase of this study used the Delphi technique to obtain qualitative and quantitative data, on the phenomenon of interest, and was underpinned by the findings of the scoping review.

### 3.6.1 The purpose of Delphi studies

The Delphi study method is "a useful strategy for examining an area with a limited empirical research base and/or for where there are questions for which there may be no definitive answers" and is useful in determining best practice in academic and clinical settings (Whitehead & Day, 2016, p. 247). Whilst there is some debate regarding the paradigm that best aligns with this method (Keeney, Hasson, & McKenna, 2011; Naisola-Ruiter, 2022), it can be a mixed-methods approach with both qualitative and quantitative elements (Emerson, 2021; Massaroli et al., 2017; Skulmoski, Hartman, & Krahn, 2007; Whitehead & Day, 2016). The four key features of a Delphi study are the use of a panel of experts to address the phenomenon of interest, anonymity of expert responses to reduce conforming to the dominant view, multiple rounds of enquiry in an iterative approach, and the use of expert responses to inform the development of subsequent rounds of enquiry (Jünger et al., 2017).

### 3.6.2 How does a Delphi technique vary from other consensus approaches

The Delphi technique is "a well-established approach to answering a research question through the identification of a consensus view across subject experts"  and aims to generate expert opinion through the use of anonymity and multiple rounds of discussion (Beiderbeck et al., 2021; Chalmers & Armour, 2019; Jünger et al., 2017). Consensus development methods combine existing evidence with expert opinion to explore a phenomenon of interest (Arakawa & Bader, 2022). The most common methods of consensus in research include the consensus development conference, nominal group technique, and the Delphi technique, with each method differing in the required time frames, the number of participants, the use of anonymity, and the use of face-to-face meetings (Arakawa & Bader, 2022). The Delphi technique overcomes the limitations associated with other consensus development methods (Whitehead & Day, 2016), including the expense and time limits associated with the face-to-face consensus development conference and lower rates of consensus associated with the nominal group technique (Arakawa & Bader, 2022; Keeney, Hasson, & McKenna, 2011).

### 3.6.3 History of the Delphi technique

The Delphi technique was developed by the RAND Corporation in the 1950s (RAND Corporation, n.d.-a, n.d.-b). The acronym RAND originated from the contraction of *research and development*, with Project RAND being established in 1945 to connect military strategy and planning with research and development (RAND Corporation, n.d.-a). Named after the Oracle of Delphi, an ancient priestess believed to deliver messages from the Greek god Apollo, the Delphi technique was developed to establish expert predictions for the future and appraise alternative courses of action (Barrett & Heale, 2020; Drumm, Bradley, & Moriarty, 2022; Williamson, 2002). Whilst the Delphi technique was originally for use in military research, it has since been applied to other research areas (RAND Corporation, n.d.-b), including nursing (Barrett & Heale, 2020; Chen et al., 2023; Rutledge et al., 2021), and, in particular, nursing informatics (Golz, Hahn, & Zwakhalen, 2023; Jedwab et al., 2023; Zareshahi, Mirzaei, & Nasiriani, 2022).

### 3.6.4 Recent developments

One of the criticisms of the Delphi technique has been a lack of rigor, with limited methodological guidance, including the wide variation in types of Delphi techniques (Hasson & Keeney, 2011), the concept of the expert (Keeney, Hasson, & McKenna, 2011; Niederberger & Spranger, 2020), poor questionnaire design (Drumm, Bradley, & Moriarty, 2022), whether consensus is authentic, realistic and clearly defined (Donohoe, Stellefson, & Tennant, 2012; Humphrey-Murto & de Wit, 2019), the analysis methods (Barrett & Heale, 2020; Fink-Hafner et al., 2019), and rate of attrition due to the extended data collection process (Fink-Hafner et al., 2019; Keeney, Hasson, & McKenna, 2011). These inherent weaknesses were notably identified by Sackman (1974, p. 73), in *Delphi Assessment: Expert Opinion, Forecasting and Group Process*, who cautioned against neglecting scientific methods and guidelines for “fortune tellers using new versions of old crystal ball”.

In response to critiques of the Delphi study method, and concerns regarding the methodological rigor of the Delphi study approach, Drumm, Bradley and Moriarty (2022, p. 2235) advised that “it is important that decisions on the design choices are made at the planning stage to ensure the reliability and validity of the Delphi”, with Spranger et al. (2022) noting the lack of Delphi technique reporting guidelines, with only one initial recommendation published – *Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review* (Jünger et al., 2017; Niederberger & Köberich, 2021). The lack of reporting guidelines was also identified by Gattrell et al. (2022, p. 3), who stated that “to the best of our knowledge, the only reporting guidance in healthcare using consensus research is the CREDES (Guidance on Conducting and REporting DElphi Studies)”. It important to note, that ACCORD (ACcurate COnsensus Reporting Document) (Gattrell et al., 2024), a guide to the reporting of biomedical studies using consensus development methods, was in development at the time of the study.

In this study, the researcher used the CREDES (Guidance on Conducting and REporting DElphi Studies) to address some of the criticisms regarding methodological rigor. Thick descriptions of data analysis – both thematic analysis and descriptive statistical analysis were provided to enhance the trustworthiness of the method (refer to *Chapter 6: Research methods - Phase 2 – Delphi Study*)**.**

## 3.7 Addressing the challenges in using mixed methods

Creswell and Plano Clark (2018, p. 14), in *Designing and conducting mixed-methods research*, noted that mixed-methods research is not "the answer for every researcher or every research problem" and identified challenges in using mixed-methods, including researcher skills, time and resources, challenges in mixed-methods design, and threats to validity. These challenges will now be addressed.

### 3.7.1 Researcher skills

As with all research, mixed-methods research requires familiarity with a set of pre-requisite skills; however, unlike studies using a single approach, mixed-methods requires understanding of both quantitative and qualitative approaches (Creswell, 2015; Creswell & Creswell, 2018; Creswell & Plano Clark, 2018). Quantitative skills include collection of quantitative data, statistical analysis, and issues surrounding the rigor of the research, which include reliability, validity, bias control and generalisability (Creswell & Plano Clark, 2018). Qualitative skills include collection of qualitative data, analysis of text data, developing themes and issues surrounding the rigor of the research, which include credibility, trustworthiness, and transferability (Creswell & Plano Clark, 2018). Creswell and Plano Clark (2018) recommend working with someone who is familiar with mixed-methods and undertaking further education to enhance mixed-methods knowledge.

The researcher has a background in education in nursing research, as part of a Bachelor of Health Sciences program, and completed a research study as part of the requirements for a Bachelor of Nursing (Honours) undertaken at the University of Western Sydney, Australia. To address gaps in knowledge, the researcher worked with the PhD supervisors to develop a deeper understanding of mixed-methods and to develop the required skills. The researcher also completed internal and external education sessions offered by Flinders University, including the *Research and Employability Skills Training (REST) Program*. A significant aspect of the development of the required research skills emerged as a result of the study.

### 3.7.2 Time and resources

Mixed-methods research requires collecting (at least) two types of data and analysing significantly more information than a single method study (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021); consequently, considerations regarding time and resources must be made (Bowers et al., 2013; dos Santos et al., 2017). Creswell & Plano Clark (2018) advised that researchers must consider the feasibility of a mixed-methods study, including the time commitments and resource requirements and that these judgements must be underpinned by a clear justification of the value of the method for the particular phenomenon of interest. If progressing with a mixed-methods study, Bowers et al. (2013, p. 2173) recommended the use of regular meetings, despite competing demands, to progress the mixed-methods study, noting that “If not well coordinated and streamlined at the subject-level, these research projects carry the potential to overburden participating research sites and subjects”.

In this study, a mixed-methods approach was used to explore the phenomenon of interest, nursing informatics in undergraduate nursing curricula. The decision to choose a mixed-methods approach was based on the premise that a mixed-methods research design draws upon the strengths of quantitative and qualitative research and triangulation (or convergence) of data sets provides a richer understanding of the phenomenon of interest (Creswell & Creswell, 2018; Tashakkori & Newman, 2010; Whitehead & Day, 2016). The researcher was aware of the associated time commitments, and in response, developed an intensive series of meetings with the PhD supervisors to address questions or concerns as they arose.

### 3.7.3 Challenges in mixed-methods design

Challenges in mixed-methods design can include differing sample sizes , merging numbers and text (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021), the requirement to explain divergence of data sets (Salehi & Golafshani, 2010), whether assumptions in the selected paradigms are given equal consideration (dos Santos et al., 2017), and selection of the appropriate mixed-method design (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021). These challenges will now be addressed with a focus on convergent design which was used in this study.

#### *3.7.3.1 Sample size*

Sampling procedures in mixed-method research studies influence the quality of inferences emerging from the study, the justification of generalisability to other populations and “meaning making in the context of understanding the phenomenon under investigation” (Onwuegbuzie & Collins, 2017, p. 135). Creswell and Plano Clark (2018) noted, that in the use of a convergent design, issues may arise regarding different samples and different sample sizes during the convergence or triangulation of data sets. Quantitative studies use large, often representative samples, with the need for the sample to be large enough to allow for statistical analyses and to reduce sampling errors (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021; Onwuegbuzie & Collins, 2017), with the representativeness and size of the sample supporting generalisability to other populations (Onwuegbuzie & Collins, 2017). Qualitative studies typically recruit a smaller sample of participants for an in-depth study of multiple meanings (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021), with a focus on transferability to similar contexts and fittingness established by the similarity of the contexts supporting application of findings to both contexts (Lincoln & Guba, 1985).

In this study, the first phase was a scoping review, which did not require a sampling procedure; however, the second phase was a Delphi Study and required purposive sampling of experts on the phenomenon of nursing informatics (refer to *Chapter 7: Phase 2 - Delphi study findings*). As a consequence of the study design, the issue of different samples and different sample sizes, the challenge described by Creswell & Plano Clark (2018), did not arise.

#### *3.7.3.2 Merging numbers and text*

The requirement to merge different data sets can be challenging due to the typical collection of numerical and text data to explore the same phenomenon (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021). Data integration procedures include narrative discussion or joint displays (Creswell & Plano Clark, 2018; Fetters, Curry, & Creswell, 2013; Fetters & Tajima, 2022). Guetterman, Fetters and Creswell (2015, p. 554) recommended the use of joint displays, which provide “a structure to discuss the integrated analysis and assist both researchers and readers in understanding how mixed methods provides new insights.” This approach also makes explicit any divergence in data sets which may require review of the databases to resolve the discrepancy and further data collection or analysis (Creswell & Plano Clark, 2018; Guetterman, Fetters, & Creswell, 2015).

This study used qualitative and quantitative text and statistical analysis tables to provide a joint display, where the qualitative and quantitative results were described. This allowed the researcher to make explicit results that were concordant or divergent, thereby allowing the strength of mixed-methods to be realised. Areas of divergence were identified as areas for further research (refer to *Chapter 8: Integration of findings* and *Chapter 9: Conclusions and recommendations*).

#### *3.7.3.3 Divergence of data sets*

One of the challenges associated with mixed-methods research using a convergent design is addressing divergence when comparing results from the data sets; this divergence may provide new insights but also must be clearly addressed and may require further collection of data (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021). Disconfirming results are defined by Creswell & Plano Clark (2018, p. 217) as “information that presents a perspective that is contrary to the one indicated by the established evidence” but can strengthen and confirm the accuracy of the data analysis. It is important that these discrepancies are clearly identified, investigated and explained (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021). Methods for dealing with divergent data sets include a statement by the researcher regarding which data set is most trustworthy (in their opinion) with statements included as limitations and the re-examination of the data sets to identify discrepancies and additional insights (Creswell & Plano Clark, 2018). In this study, divergence of data sets was clearly identified, investigated and explained (refer to *Chapter 8 - Integration of findings*).

#### *3.7.3.4 Paradigm considerations*

Dawadi, Shrestha and Giri (2021) identify one of the challenges of mixed-methods research as the philosophical and epistemological frameworks which underpin quantitative and qualitative paradigms, with debates continuing regarding the incompatibility of the two methodologies (Fàbregues et al., 2021; Östlund et al., 2011; Teddlie & Tashakkori, 2012). A major challenge with mixed-methods is the differing priorities given to quantitative and qualitative approaches (dos Santos et al., 2017; Salehi & Golafshani, 2010), with concerns raised regarding the dominance of the positivist paradigm in many mixed-methods studies (Flick, 2017; Hesse-Biber, 2010). It is therefore essential that the researcher ensures that "different methods are suitably combined so that there is no compromise on the robustness and reliability of the research" (Dawadi, Shrestha, & Giri, 2021, p. 32). In the study, recognition of the differences between the quantitative and qualitative paradigms and the philosophical assumptions underpinning mixed-methods was demonstrated through thick descriptions of sampling, data collection and data analysis.

#### *3.7.3.5 Selection of mixed-methods design*

Mixed-methods research designs include explanatory sequential design (also known as explanatory design), exploratory sequential design and convergent design (also known as convergent parallel design) (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021; Guetterman, Fetters, & Creswell, 2015).

The *explanatory sequential design* has two distinct phases, starting with the collection and analysis of quantitative data and the subsequent collection and analysis of qualitative data to explain the findings from the initial phase (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021; Guetterman, Fetters, & Creswell, 2015). The choice of the explanatory sequential design is useful when the researcher and the phenomenon of interest are quantitatively oriented, variables are known to the researcher, there is the ability to revisit the participants for further qualitative data collection, there is adequate time for a study using two phases, and resources are limited (Creswell & Plano Clark, 2018).

The *exploratory sequential design* involves three phases, typically commencing with qualitative data collection and analysis, followed by a quantitative phase building on the findings of the first phase, and with a final quantitative phase to test a variable (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021; Guetterman, Fetters, & Creswell, 2015).The choice of the exploratory sequential design is useful when the researcher and the phenomenon of interest are qualitatively oriented, the development of a relevant and culturally sensitive product is needed, there is adequate time for a study using three phases, the researcher wishes to have a generalisable and transferable product, and new research questions from a small sample group can be most effectively tested using a larger quantitative sample (Creswell & Plano Clark, 2018).

The *convergent design*, is a popular mixed-methods design, and involves the collection of two data sets, typically qualitative and quantitative, with independent analysis of both data sets and convergence of findings (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021; Guetterman, Fetters, & Creswell, 2015). The choice of the convergent design is useful when there is limited time for collecting data in the field, the researcher requires quantitative and qualitative data from all participants, and the researcher and the team has knowledge and skills in quantitative and qualitative research approaches. It is important to note, that some authors have also addressed the use of mixed-methods designs using only qualitative research methods or quantitative research methods (Flick, 2017; Hesse-Biber, 2010; Morse & Cheek, 2015).

The selection of a mixed-methods research design should be made based on the design which best matches the intent for mixing data sets, the intent of the design, familiarity with designs used within a given field, expertise of the researcher, the available time, the complexity of the design (Creswell & Plano Clark, 2018) and the sequence of phases (Tashakkori & Newman, 2010).

For this study, a convergent design was used to provide a deeper understanding of nursing informatics and undergraduate nursing education. The design was selected, as it is an intuitive and efficient design, with separate data collection and analysis using qualitative and quantitative techniques and allowed the researchers to give a voice to the experiences of the participants (Creswell & Plano Clark, 2018). Typical challenges associated with the use of a convergent design include issues of different sample sizes, the need to merge text and numerical data and the need to explain divergence (Creswell & Plano Clark, 2018): these challenges have been addressed above.

### 3.7.4 Threats to validity

One of the major issues in mixed-methods research has been concerns about validity (Creswell & Plano Clark, 2018; Flick, 2017). Whilst the use of both quantitative and qualitative methods should involve complementary strengths with disparate weaknesses (Krawczyk et al., 2019; Onwuegbuzie & Johnson, 2006), threats to validity in a convergent design, can include not using parallel concepts for data collection in quantitative and qualitative phases, unequal sample sizes in quantitative and qualitative phases, keeping results separate, failing to identify and resolve divergence or disconfirming results in data sets (Creswell, 2015; Creswell & Plano Clark, 2018). Strategies to minimise threats to validity, include the creation of parallel methods which address the same concept, explicit statements regarding sample sizes, convergent data analysis and seeking new strategies to address disconfirming results (Creswell, 2015; Creswell & Plano Clark, 2018).

Methodological triangulation is inherent within a mixed-methods approach in which qualitative and quantitative methods/approaches are integrated “to gain a fuller understanding of the phenomenon under investigation” (Tashakkori & Newman, 2010, p. 514). Triangulation describes a study in which various research approaches, methodologies and/or methods are used to increase the trustworthiness of the study finding (Flick, 2011; Heale & Forbes, 2013; Williamson, 2005). Rather than being a precise concept, it describes strategies systematically used to overcome issues of validity or biases throughout the research process, including triangulation of theories, data sources, investigators and methods (Flick, 2011; Heale & Forbes, 2013). Methodological triangulation can aid researchers in addressing possible biases in a single methodology approach (Whitehead & Day, 2016), and can be helpful in providing validation of findings, comprehensive data and enhancing understanding of the phenomenon (Bekhet & Zauszniewski, 2012).

In this study, the literature scoping and Delphi phases related to the same phenomenon of interest and an iterative process of data collection and analysis was used. In this way, the findings from the scoping review phase influenced data collection in the Delphi phase; thereby addressing the issues of a lack of parallel concepts and isolating data sets, identified by Creswell and Plano Clark (2018). Strategies to address disconfirming results were addressed throughout the study with thick descriptions, of both the scoping review and Delphi study phases, enhancing the methodological rigor and the trustworthiness of the findings. Following separate data analysis of the two data sets, the findings were combined to form a third data set from which to draw conclusions (refer to *Chapter 8: Integration of findings*).

## 3.8 Conclusion

This chapter has presented the theoretical framework that underpinned this study. The philosophical tradition of pragmatism and the work of John Dewey has been described, with justification for the researcher’s alignments with these philosophies. The paradigm of the mixed-methods approach has been explored and the two phases of the study, the scoping review and the Delphi study, have been justified with a focus on addressing the challenges associated with the mixed-methods approach. *Chapter 4: Research Methods – Phase 1: Scoping review* will discuss the scoping review and the use of reporting guidelines to enhance trustworthiness of the findings.

# Chapter 4 Research Methods

## 4.1 Introduction

A scoping review was conducted using the *PRISMA-ScR Checklist* (Tricco et al., 2018) and the *JBI Manual for Evidence Synthesis* (Aromataris & Munn, 2020), in particular Chapter 11 of the JBI Manual for Evidence Synthesis: Scoping Reviews (Peters et al., 2020), to inform development of the scoping review framework. Additional sources of evidence were used to further inform the scoping review method, including *Scoping studies: towards a methodological framework* (Arksey & O'Malley, 2005), *What are scoping studies? A review of the nursing literature* (Davis, Drey, & Gould, 2009), *conducting high quality scoping reviews-challenges and solutions* (Khalil et al., 2021), *Scoping studies: advancing the methodology* (Levac, Colquhoun, & O'Brien, 2010), *Updated methodological guidance for the conduct of scoping reviews* (Peters et al., 2021), and *Undertaking a scoping review: A practical guide for nursing and midwifery students, clinicians, researchers, and academics* (Pollock et al., 2021). This chapter addresses the development of a scoping review protocol and the data collection, data extraction and data analysis of the scoping review.

## 4.2 Reporting guidelines

Reporting guidelines are designed to provide a means of reporting and enhancing methodological transparency (Altman et al., 2008; Tricco et al., 2018). The EQUATOR (Enhancing the QUAlity and Transparency Of health Research) Network defines guidelines as providing a “a minimum set of items for reporting (that) can improve the accuracy and transparency of publications, thus facilitating easier and more reliable appraisal of quality and relevance” (Altman et al., 2008, p. 1149). The current version of Chapter 11: Scoping reviews (Peters et al., 2020) incorporates the Prisma-ScR into the JBI scoping review methodology. The PRISMA-ScR consists of 20 essential reporting items and 2 optional items and aims to improve methodological transparency (Tricco et al., 2018). The Prisma-SCR has recently been used in nursing research on nursing documentation (Muinga et al., 2021), virtual reality simulations in education (Plotzky et al., 2021), cardiovascular health behaviour (Mueller, 2021) and the impact of COVID-19 on the Latinx population (Moore, 2021). To adhere to the reporting guideline requirements, the development of the scoping review protocol, data collection, data extraction and data analysis are described below.

## 4.3 Development of a scoping review protocol

Underpinned by the seminal work of Arksey and O’Malley (2005), Levac et al. (2010), Peters, Godfrey, McInerney, et al. (2015), Peters et al. (2017), Chapter 11 of the JBI Manual for Evidence Synthesis: Scoping Reviews (Peters et al., 2020, p. 413) requires the development of an *a priori* protocol prior to the commencement of the scoping review, and states “as with all well-conducted systematic reviews, an *a priori* protocol must be developed before undertaking the scoping review”. This requirement is also stated in the PRISMA-ScR Checklist (Tricco et al., 2018). The scoping review protocol “pre-defines the objectives, methods, and reporting of the review and allows for transparency of the process” and is an important requirement in limiting reporting bias (Peters et al., 2020, p. 413). “The advantage of developing a scoping review protocol is that it minimizes the potential for ad hoc decision-making that may reduce the methodological rigour of the scoping review” (Pollock et al., 2021, p. 2105). A scoping review protocol (refer to *Appendix A1*) was developed using both sources, as “The JBI approach to conducting and reporting scoping reviews…is congruent with the PRISMA-ScR checklist” (Peters et al., 2020, p. 413).

### 4.3.1 The title of the scoping review protocol

*Item 1* of The PRISMA-ScR checklist (Tricco et al., 2018, p. 471) requires that the title “identify the report as a scoping review”. Peters et al. (2021, p. 6) state that “it is also useful to ensure that key elements of the inclusion criteria are reflected in the title to enable easy identification by readers”. The title of the scoping review protocol was *Nursing Informatics and undergraduate nursing curricula: a scoping review protocol* (Reid, Button, et al., 2022). (Please note: information pertaining to the scoping review protocol has been cited in the publication - Reid, L., Button, D., Breaden, K., & Brommeyer, M. (2022). Nursing informatics and undergraduate nursing curricula: A scoping review protocol. *Nurse Education in Practice*, *65*, 1-6. https://doi.org/10.1016/j.nepr.2022.103476).

### 4.3.2 Abstract

*Item 2* of the PRISMA-ScR checklist (Tricco et al., 2018, p. 471) requires a structured summary of the report be provided, including the “background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives”. The scoping review protocol included a brief introduction providing the background to the deficit in nursing informatics education in undergraduate nursing programs, the methods and analysis, ethics and dissemination and keywords.

### 4.3.3 Introduction

*Items 3 and 4* of the PRISMA-ScR checklist (Tricco et al., 2018) identify the need to describe the rationale for the scoping review based on current gaps in knowledge and justification of why the research questions or objectives are best addressed using the scoping review methodology. In addition, the scoping review objectives or research questions must be stated (Peters et al., 2020; Tricco et al., 2018). The introduction should also provide sufficient information to justify the inclusion criteria, including the sources of evidence to be included in the search of the literature (Peters et al., 2020). The introduction section of the scoping review protocol provided a detailed description of the nursing workforce, the significance of nursing informatics, the digital health technologies used in nursing practice, the barriers to the use of nursing informatics (including a lack of undergraduate informatics education) and the inclusion criteria.

#### 4.3.3.1 Rationale for scoping review

*Item 3* of the PRISMA-ScR (Tricco et al., 2018) requires that the rationale for the scoping review must be clearly stated, with the inclusion of what is already known about the phenomenon of interest and how the scoping review will inform this understanding. However, due to the exploratory nature of scoping reviews, it is not anticipated that all existing knowledge be described (Peters et al., 2020). The scoping review protocol (Reid, Button, et al., 2022) provided a detailed description of the current situation regarding nursing informatics education in undergraduate nursing programs, stating, in part:

> "Historically, there has been a lack of consensus on health informatics and digital health terminologies (Boogerd et al., 2015; Fatehi, Samadbeik, & Kazemi, 2020; Friedman, 2012), a lack of consistent nursing informatics competencies worldwide (Cummings et al., 2016; Honey et al., 2016), disparate undergraduate nursing education regarding nursing informatics (Honey et al., 2016), a lack of university faculty with nursing informatics' competence and expertise (Kinnunen et al., 2017), and a healthcare workforce not adequately prepared to work within the digital health sphere (Rowlands, Digital Health Workforce Academy (DHWA), & Health Informatics Society of Australia (HISA), 2019). Therefore, this scoping review addressed whether a distinct body of knowledge on nursing informatics could be further developed to be used to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula. (p. 2)

#### 4.3.3.2 Objectives of the scoping review

*Item 4* of the PRISMA-ScR (Tricco et al., 2018) also includes the requirement for a statement of the objectives of the scoping review. Scoping review questions provide clear direction for the inclusion criteria for the scoping review and provide structure for the literature search and the development of the scoping review (Peters et al., 2020; Peters et al., 2021).

The questions identified in the scoping review protocol were:

1. Can a distinct body of knowledge of nursing informatics be developed?
2. Can operational definitions for nursing informatics be achieved through consensus?
3. Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses in regard to nursing informatics?"

The overarching question was: Can a distinct body of knowledge on nursing informatics be further developed to be used to structure education for university faculty and nurses in the clinical setting, to inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula? The scoping review protocol identified the purpose of the scoping review as the basis for a Delphi study, in which nursing informatics and its integration into undergraduate nursing curricula was explored and described in collaboration with domain experts.

### 4.3.4 Methods

The methods section describes any existing review protocols, eligibility criteria, information sources, search strategy, method of data charting, appraisal of individual sources and synthesis of results (Tricco et al., 2018). This scoping review protocol was developed in adherence with Chapter 11 of the JBI Manual for Evidence Synthesis: Scoping Reviews (Peters et al., 2020) and the PRISMA-ScR Checklist (Tricco et al., 2018) for the purpose of undertaking a scoping review of nursing informatics and undergraduate nursing curricula. A description of the planned search of protocols and registrations, inclusion criteria, search strategy, source of evidence selection, data extraction, analysis of the evidence and presentation of the results was provided in the scoping review protocol.

#### *4.3.4.1 Protocol and registrations*

*Item 5* of the PRISMA ScR (Tricco et al., 2018, p. 471) identifies the requirement to “indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number”. The *Protocols and registration* section of the scoping review protocol stated: A search of both Cochrane and the JBI databases were performed in December 2020 and no existing review protocols were identified.

Registration of an *a priori* scoping review protocol is recommended, particularly if publication of the completed scoping review is intended (Pollock et al., 2021). *Nursing Informatics and undergraduate nursing curricula: a scoping review protocol*, was developed in conjunction with the PhD supervisors was published in Nurse Education in Practice in October 2022 (Reid, Button, et al., 2022) and was uploaded to OSF (Open Science Frameworks) on 10 August 2022 (Reid, Button, et al., 2022).

#### *4.3.4.2 Inclusion criteria*

*Item 6* of the PRISMA ScR (Tricco et al., 2018) requires an explicit statement and justification of the eligibility criteria and types of sources of evidence to be included. Tricco et al. (2018) use the term eligibility criteria, which identifies specific characteristics of the sources of evidence and provides a clear rationale; this is to ensure the reader can understand the types of evidence sources used in the review. Peters et al. (2020) use the term *inclusion criteria* to describe this aspect of the scoping review protocol. For this study and the protocol, the term *inclusion criteria* was used. Peters et al (2020) recommend the use of the PCC mnemonic (population, concept and context) to identify the focus and context of the review.

The population of this scoping review was *undergraduate nursing students,* the concept was *nursing informatics* and the context was *education*. To be included in this scoping review, papers needed to include nursing informatics' education for undergraduate nursing students at any time during a Bachelor of Nursing program (or equivalent). Sources of evidence were included if they were published between 2015-2022 and described curriculum recommendations (including barriers to implementing nursing informatics education). The purpose of the identified timespan was to reflect the rapidly evolving nature of health informatics and digital technologies. The requirement for curriculum recommendations was to reflect the purpose of the scoping review as the basis for a Delphi study, in which nursing informatics and its integration into undergraduate nursing curricula will be explored and described in collaboration with domain experts.

Further information was required to further define the term undergraduate nursing students and was added to the scoping review protocol. To be included in this scoping review, papers needed to include nursing informatics' education for undergraduate nursing students in a Bachelor of Nursing program. Undergraduate nursing students are defined by the ANMF (2020) as individuals enrolled in a recognised nursing program leading to registration as a Nurse. To meet the requirements for registration as a Registered Nurse, in Australia, individuals are required to complete a Bachelor of Nursing program at a university (Australian Qualifications Framework Level 7) as defined by the Australian Qualifications Framework Council (2013). For this scoping review, undergraduate nursing students were defined as those individuals undertaking a three-year Bachelor of Nursing program at a university. Equivalent international definitions were also used in the scoping review procedure.

#### *4.3.4.3 Information sources*

*Item 7* of the PRISMA ScR (Tricco et al., 2018) requires a description of the databases used to search for sources of evidence and the date of the most recent search. "For the purposes of a scoping review, the "source" of information can include any existing literature, e.g. primary research studies, systematic reviews, meta-analyses, letters, guidelines, websites, blogs, etc." (Peters et al., 2020, p. 417). To identify potentially relevant sources, Ovid, ProQuest, PubMed and Scopus were searched and scholarly journals, books, reports, conference papers and proceedings were included. A search of the grey literature and a search of bibliography sources was performed following the review of databases.

#### 4.3.4.4 Search strategy

*Item 8* of the PRISMA ScR (Tricco et al., 2018, p. 471) requires "the full electronic search strategy for at least 1 database. Including any limits used". Peters et al. (2020, p. 418) state that "the search strategy for a scoping review should ideally aim to be as comprehensive as possible within the constraints of time and resources in order to identify both published and unpublished (grey or difficult to locate literature) primary sources of evidence, as well as reviews". A three-step strategy should be utilised (Peters et al., 2020) – the first step requires an initial limited search of two databases and analysis of text words in the title and abstract. The second step requires that all identified keywords be used across all included databases. The final step requires that the reference lists of selected full-text sources should be examined and included in the review (if relevant to the phenomenon of interest). In addition, the search strategy for at least one database should be described, so that it could be repeated if required (Peters et al., 2021). Following searches of the database using the *a priori* protocol and the removal of duplicate sources, the results were screened using the Covidence™ platform. Covidence™ is "a web-based collaboration software platform that streamlines the production of systematic and other literature reviews" and aids in the uploading of search results, the screening of abstracts and full text, completing data collection, review by two or more reviewers and exporting of data (Veritas Health Innovation, 2022) (refer to *Appendix A1*).

#### 4.3.4.5 Source of evidence selection

*Item 9* of the PRISMA ScR (Tricco et al., 2018) requires the process for evidence selection be explicitly stated. The screening process will determine whether each article meets the inclusion criteria and will be included in the scoping review. A narrative description and a flowchart should be provided, and the software used for these processes clearly identified. Pilot testing of the source of evidence selection procedure is also strongly recommended. This process involves two specific stages: *First Pass* or *Title and Abstract Screening* and *Second Pass* or *Full-Text Screening*.

##### 4.3.4.5.1 First Pass – Title and Abstract Screening

This stage identified as *First Pass* or *Title and Abstract Screening* involves examining titles and abstracts and removing sources using exclusion and inclusion criteria (Peters et al., 2021; UniSA & Peters, 2024). The evidence screening process is "usually conducted by a minimum of two reviewers, and any disagreements should be resolved by either consensus or with a third reviewer" (Peters et al., 2021, p. 7). During Title and Abstract Screening, the PhD candidate screened sources using the Covidence™ platform in consultation with the PhD supervisors in weekly meetings and each source was reviewed and discussed. To enhance trustworthiness of the screening process, an Excel spreadsheet was developed, and each excluded source was categorised and identified in the *Figure 6.1 Delphi Study Flow Chart.*

##### *4.3.4.5.2 Inclusion of additional sources*

Peters et al. (2020, p. 418) notes that the scoping review search can "be quite iterative as reviewers become more familiar with the evidence base, additional keywords and sources, and potentially useful search terms may be discovered and incorporated into the search strategy". Therefore, additional sources should be considered to ensure a comprehensive literature search is performed; these can include grey literature and sources from the reference lists of selected articles. Following the First Pass – Title and Abstract Screening, every reference list from the included sources of evidence was reviewed for inclusion of additional relevant sources of evidence. The identified additional sources were then added to Covidence™ for screening and possible inclusion.

Tricco et al. (2018) advises that a detailed account of the search for grey literature should be documented. *Grey Matters: a practical tool for searching health-related grey literature* (Canadian Agency for Drugs and Technologies in Health (CADTH), 2019) is identified in the PRISMA-SCR as providing an approach to search for grey literature. A search of grey literature was conducted using this tool. Identified additional sources were then added to Covidence™ for screening and possible inclusion.

##### *4.3.4.5.3 Second Pass – Full-Text Screening*

This stage, identified as *Second Pass* or *Full-Text Screening* requires examining the full text of each source and determining if it meets the inclusion criteria and providing coherent reasons for exclusion of sources (University of South Australia (UniSA) & Peters, 2024). During the second screening process, two reviewers read the full text of articles for potentially relevant sources. Disagreements on study selection were discussed in weekly PhD meetings with the PhD supervisors to arrive at a consensus.

#### *4.3.4.6 Data charting process*

*Item 10* of the PRISMA ScR (Tricco et al., 2018) requires that data charting methods be described; this includes forms used to document study selection and the processes of obtaining data from the investigators. The Covidence™ platform was used to screen the selected sources and to enhance the trustworthiness of the screening process, an Excel spreadsheet was developed, and each excluded source was categorised. The Covidence™ platform was also used for data extractions and following completion of the data extraction process, the extracted data was exported as an Excel spreadsheet and titled the Data Extraction Spreadsheet (refer to *Appendix A3*).

#### *4.3.4.7 Data items*

*Item 11* of the PRISMA ScR (Tricco et al., 2018, p. 471) requires "all variables for which data were sought and any assumptions and simplifications made". To enhance the trustworthiness of the findings, all key terms and variables were defined in the results section of the scoping review (refer to *Chapter 5: Phase 1 – Scoping review findings*).

#### *4.3.4.8 Critical appraisal of individual sources of evidence*

*Item 12* of the PRISMA ScR (Tricco et al., 2018) is identified as being an optional item. Peters et al. (2020) state “Critical appraisal is not mandatory, however, reviewers may decide to assess and report the risk of bias in scoping reviews depending on the purpose of the review. The use of statistical meta-analysis (for effectiveness, prevalence or incidence, diagnostic accuracy, aetiology or risk, prognostic or psychometric data), or meta-synthesis (experiential or expert opinion data) or both in mixed methods reviews is typically not conducted in a scoping review”. Critical appraisal of individual sources of evidence was not performed.

#### *4.3.4.9 Summary items*

*Item 13* of the PRISMA ScR (Tricco et al., 2018) is not applicable for scoping reviews as meta-analyses are not performed.

#### *4.3.4.10 Synthesis of results*

*Item 14* of the PRISMA ScR (Tricco et al., 2018) requires that a description of how data is handled and summarised be provided. “Methods of data analysis in a scoping review may include descriptive qualitative content analysis, frequency counts of the population, concepts and context or basic coding” (Peters et al., 2020; Peters et al., 2021; Pollock et al., 2021), with results presented “in a logical, diagrammatic or tabular form, or in a descriptive format that aligns to the objectives and scope of the review” (Khalil et al., 2016, p. 121). The way in which data is analysed and presented, predominantly depends on the purpose of the scoping review and the authors’ judgment and it is therefore essential that the authors use a transparent and explicit approach which justifies the methodological decisions made (Peters et al., 2020). The scoping review data was analysed using a qualitative content analysis approach with frequency counts.

#### *4.3.4.11 Risk of bias across studies and additional analyses*

*Items 15 and 16* of the PRISMA ScR (Tricco et al., 2018) are not applicable for scoping reviews as scoping reviews are not intended to provide critical appraisal of a body of evidence and additional analyses are not performed.

### 4.3.5 Results

The results section describes selection of sources of evidence, characteristics of sources of evidence, critical appraisal within sources of evidence, results of individual sources of evidence, results of individual sources of evidence and synthesis of results (Tricco et al., 2018). A description of the selection of sources of evidence and synthesis of these sources were provided in the scoping review protocol (Reid, Button, et al., 2022).

#### *4.3.5.1 Selection of sources of evidence*

*Item 17* of the PRISMA ScR (Tricco et al., 2018) requires that the numbers of sources of evidence screened and assessed for inclusion and exclusion criteria should ideally presented in a flow diagram. The reasons sources have been excluded should ideally be presented for each stage (Tricco et al., 2018), this requires a narrative description of the source of evidence selection process, including how disagreements between reviewers were resolved (Duffett et al., 2013; Tricco et al., 2018). To enhance trustworthiness of the screening process, an Excel spreadsheet was developed, each excluded source was categorised and a PRISMA flow diagram was developed.

#### *4.3.5.2 Characteristics of sources of evidence*

*Item 18* of the PRISMA ScR (Tricco et al., 2018) requires that the characteristics of each source of evidence be provided and the inclusion of citations. The data analysis process aimed to provide the reader with a logical, descriptive summary of the data which was aligned with the previously established objectives and questions of the scoping review. Full citations of each source of evidence were provided and characteristics clearly identified.

#### *4.3.5.3 Critical appraisal within source of information*

*Item 19* of the PRISMA ScR (Tricco et al., 2018) is related to Item 12 (refer to *4.3.4.8 Critical appraisal of individual sources of evidence*).

#### *4.3.5.4 Results of individual sources of evidence*

*Item 20* of the PRISMA ScR (Tricco et al., 2018) requires that relevant data, relating to the research questions, is identified for each selected source of evidence. Khalil et al. (2016) state that the presentation of the results should identify the implications for policy, practice and research, with the conclusion reflecting the objective of the scoping review. Peters et al. (2021) suggest the use of a description of the search strategy results with the inclusion of the PRISMA flow diagram and a discussion of the key information relevant to the scoping review questions. Results were presented with a description of the search strategy including the PRISMA flow diagram. Findings were synthesised in narrative and tabular formats with recommendations for policy, practice and research reflecting the objective of the scoping review.

#### *4.3.5.5 Synthesis of results*

*Item 21* of the PRISMA ScR (Tricco et al., 2018) requires that a summary or presentation of results, as they relate to the scoping review, be presented. Each source’s summary included key information including the authors, the reference, the year of publication, the country of origin, the aim and purpose of the study, the population and any undergraduate curricula recommendations. The findings were classified as conceptual groups, for example: basic computer literacy, implementation strategies, barriers to implementation and benefits of implementation. A narrative summary was provided which reflected the three scoping review questions and the overarching research question.

#### *4.3.5.6 Risk of bias across studies and Additional analyses*

*Items 22 and 23* of the PRISMA ScR (Tricco et al., 2018) are not applicable for scoping reviews (refer to *4.3.4.11 Risk of bias across studies and additional analyses*).

### 4.3.6 Discussion

The discussion section provides a summary of the evidence, the limitations of the scoping review process and the conclusions of the scoping review (Tricco et al., 2018). An in-depth discussion of the scoping review protocol finding was provided in *Chapter 5: Phase 1 – Scoping review findings* and integration with the Delphi study findings in *Chapter 9: Integration of findings*.

#### *4.3.6.1 Summary of evidence*

*Item 24* of the PRISMA ScR (Tricco et al., 2018) requires a summary of the main results with links to the research questions and considerations of the relevance to key groups. The discussion section of the scoping review was underpinned by the research questions and reflected the purpose of the scoping review as the basis for a Delphi study, in which nursing informatics and its integration into undergraduate nursing curricula was explored and described in collaboration with domain experts.

#### *4.3.6.2 Limitations*

*Item 25* of the PRISMA ScR (Tricco et al., 2018) identifies the limitations of the scoping review. A discussion of the purpose of scoping reviews and how they differ from systematic reviews is provided in *Chapter 3: Study methodology*. The limitations of both the scoping review process and the limitations of this particular scoping review were explicitly stated (refer to *Chapter 9: Conclusions and recommendations*).

#### *4.3.6.3 Conclusions*

*Item 26* of the PRISMA ScR (Tricco et al., 2018, p. 471) requires that "a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps" be detailed. Collation and presentation of the results aimed to identify the implications for policy, practice and research, with the conclusion reflecting the objective of the scoping review.

### 4.3.7 Funding

*Item 27* of the PRISMA ScR (Tricco et al., 2018) requires the open disclosure of the funding for the included sources of evidence and the scoping review. The scoping review, as part of the requirements for a PhD study, was funded through the Research Training Program (RTP). “The RTP is a single flexible pool of funding to support both domestic and overseas students undertaking Research Doctorate and Research Masters degrees” (Department of Education, 2024)

## 4.4 Scoping review procedure

Following the development of the scoping review protocol, the scoping review procedure commenced in October 2020. This process was closely aligned with the requirements as described by Peters et al. (2020) and Tricco et al. (2018) and adhered to the scoping review protocol. The title of the scoping review was *Nursing Informatics and undergraduate nursing curricula: a scoping review.* As previously stated, the PRISMA-ScR consists of 20 essential reporting items and 2 optional items and aims to improve methodological transparency (Tricco et al., 2018), therefore to enhance the methodological transparency of this scoping review, the PRISMA-ScR Checklist was used (refer to *Appendix A2)* .Please note, that due to the nature of the thesis, the page numbers recorded address where each item was addressed in *4.3 Development of a scoping review protocol* and that these items are further explored throughout this chapter. The scoping review procedure is described below.

### 4.4.1 Data collection

Khalil et al (2016) recommend the use of a three-step literature search literature search to enhance the breadth, depth and comprehensiveness of the search and data collection. The first stage is a limited search of databases (they recommend MEDLINE and CINAHL) with follow-up screening of key words from the title, abstract and article; the second stage applies all identified keywords across all selected databases; and the third stage includes the analysis of all reference lists of the selected articles to identify other (potentially) relevant sources of information. These three steps are detailed in the following sections: *Preliminary search strategy*, *Search of databases*, *Final database search strategy* and *Inclusion of additional sources*.

#### *4.4.1.1 Preliminary search strategy*

Peters et al. (2021, p. 7) advise that “the input of a research librarian or information scientist can be invaluable in designing and refining the search”. A meeting with a Research Librarian was organised to discuss a scoping review search strategy in October 2020. A search strategy was developed by the librarian with key terms for the ProQuest and CINAHL databases. On discussion with the PhD supervisors, it was determined that it would be more rigorous for the researcher to develop a scoping review with search terms successively – rather than one large search with multiple search terms. However, the initial work with the research librarian assisted the researcher develop a better understanding of the literature search process and the search term requirements for various databases.

#### 4.4.1.2 Search of databases

Preliminary searches of PubMed and ProQuest assisted with the development of a string of key search terms. “PubMed® comprises more than 34 million citations for biomedical literature from MEDLINE, life science journals, and online books” (National Library of Medicine (NLM), n.d.). “ProQuest collections span centuries of newspapers, dissertations, journals, primary sources, video, ebooks and more to ensure access to varied content types and deep datasets” (ProQuest, 2024). These two databases were selected to reflect the focus on nursing and nursing education. The first 100 papers in the search were used to identify common terms to include in subsequent searches. Following this initial search, analysis of the titles, abstracts and index terms (subject headings) used to describe the retrieved articles, were analysed. This analysis aided in identifying other key search terms for each domain. Three domains were developed – *nursing informatics*, *education* and *proficiency*, with each domain consisting of a string of key search terms.

##### 4.4.1.2.1 Final database search strategy

Following the development of the string of key search terms, searches were performed on CINAHL, Ovid, ProQuest, PubMed and Scopus. CINAHL (Cumulative Index of Nursing and Allied Health Literature) is one of the largest nursing research databases with more than 770 nursing and allied health journals, Ovid and ProQuest provide access to multiple healthcare databases, PubMed provides a full-text archive of biomedical literature and Scopus provides the largest collection of peer-reviewed literature. *Item 8* of the PRISMA ScR (Tricco et al., 2018, p. 471) requires “the full electronic search strategy for at least 1 database. Including any limits used”. The final search strategy for PubMed, for each of these domains, is described below.

##### 4.4.1.2.2 PubMed search strategy - Domain 1 – Nursing informatics

1. nurs* AND 2015-2020
2. nurs* AND 2015-2020 AND informatics
3. nurs* AND 2015-2020 AND (informatics OR “nursing informatics”)
4. nurs* AND 2015-2020 AND (“nursing informatics” OR “clinical informatics”)
5. nurs* AND 2015-2020 AND (“nursing informatics” OR “clinical informatics” OR “healthcare informatics”)
6. nurs* AND 2015-2020 AND (“nursing informatics” OR “clinical informatics” OR “healthcare informatics” OR eHealth)
7. nurs* AND 2015-2020 AND (“nursing informatics” OR “clinical informatics” OR “healthcare informatics” OR eHealth OR telehealth)

The **Domain 1 – Nursing informatics** search resulted in consistently homogenous results; except when using the key search terms of eHealth or telehealth; these search terms did not elicit sources based on the phenomenon of interest. Following review of the results and discussion with the PhD supervisors, it was decided to use "nursing informatics" as the key search term for Domain 1.

##### *4.4.1.2.3 PubMed search strategy - Domain 2 - Education*

1. "nursing informatics" AND 2015-2020 AND education
2. "nursing informatics" AND 2015-2020 AND curric*
3. "nursing informatics" AND 2015-2020 AND pedagogy
4. "nursing informatics" AND 2015-2020 AND "nursing education
5. "nursing informatics" AND 2015-2020 AND (education OR curric* OR pedagogy OR "nursing education)

The **Domain 2 - Education search** resulted in a wide range of heterogenous results. Following review of the results and discussion with the PhD supervisors, it was decided to use (education OR curric* OR pedagogy OR "nursing education") as the search string of key terms for Domain 2.

##### *4.4.1.2.4 PubMed search strategy - Domain 3 – Proficiency*

1. "nursing informatics" AND 2015-2020 AND profic*
2. "nursing informatics" AND 2015-2020 AND engage*
3. "nursing informatics" AND 2015-2020 AND accept*
4. "nursing informatics" AND 2015-2020 AND capabil*
5. "nursing informatics AND 2015-2020 AND competenc*
6. "nursing informatics" AND 2015-2020 AND knowledge
7. "nursing informatics" AND 2015-2020 AND "core content"
8. "nursing informatics" AND 2015-2020 AND "standards for practice"
9. "nursing informatics" AND 2015-2020 AND standards
10. "nursing informatics" AND 2015-2020 AND practice

11. “nursing informatics” AND 2015-2020 AND (profic* OR engage* OR accept* OR capabil* OR competenc* OR knowledge OR “core content” OR standards OR practice)

The **Domain 3 - Proficiency search** resulted in a wide range of heterogenous results; except when using the search term of “standards for practice” which yielded no additional results. Following review of the results and discussion with the PhD supervisors, it was decided to use (profic* OR engage* OR accept* OR capabil* OR competenc* OR knowledge OR “core content” OR standards OR practice) as the search string of key terms for Domain 3.

##### *4.4.1.2.5 PubMed search strategy – Domain 4 - Combined domains – Dec 2020*

Justification for the inclusion of each key term was evaluated in consultation with the PhD supervisors. Each string of key search terms was then compared to determine the efficacy of the search as detailed above. The final search strategy for PubMed was developed and titled the **Domain 4 - combined domains search** and is described below:

1. “nursing informatics” AND 2015-2020 AND (educat* OR curric* OR pedagog* OR “nursing education) AND (profic* OR engage* OR accept* OR capabil* OR competenc* OR knowledg* OR “core content” OR standards OR practice)

A second systematic search using the combined domains search, was then undertaken across PubMed, ProQuest, CINAHL, Ovid and Scopus. The sources were downloaded to EndNote™, a reference management tool that creates, stores and manages references (EndNote Team, 2013). Following duplicate removal via EndNote™, 2114 sources were uploaded to the Covidence™ program review titled Nursing Informatics: Undergraduate curricula. Covidence™ is a web-based collaboration software platform for screening and data extraction (Veritas Health Innovation, 2022).

##### *4.4.1.2.6 PubMed search strategy – Domain 5 - Combined domains – June 2022*

Due to the passage of time and to maintain the contemporary nature of the scoping review, a determination was reached with the PhD supervisors to repeat the combined domains search in PubMed, ProQuest, CINAHL, Ovid and Scopus with the dates 01/12/2020 – 29/06/2022. The identified sources were then combined with the original Domain 4 - combined domains search and titled **Domain 5 – combined domains search**. A duplicate search was performed in EndNote™ of the Domain 5 – combined domains search. Following duplicate removal via EndNote™, 927 sources were uploaded to the Covidence™ program review titled Nursing Informatics: Undergraduate curricula. Following combining of the Domain 4 - combined domains search and Domain 5 – combined domains search, duplicate removal via Endnote™ was performed and a further 868 sources were uploaded to Covidence™.

### 4.4.2 Removal of duplicate sources

In total, 2982 sources were uploaded to Covidence™. The Covidence™ program scanned for duplicates and 489 duplicates were removed. Following this process, manual removal of duplicate sources removed a further 99 sources, this occurred concurrently with the First Pass – Title and Abstract Screening. It was determined that these sources had not been identified by the Covidence™ program due to different formatting, spelling errors and incorrectly cited sources.

### 4.4.3 Source of evidence screening and selection

Following searches of the database using the *a priori* protocol and the removal of duplicate sources, the results were screened using Covidence™. The screening process determined whether each article met the inclusion criteria and would be included in the scoping review. This process involved two specific stages: *First Pass* or *Title and Abstract Screening* and *Second Pass* or *Full-Text Screening*. *Item 9* of the PRISMA ScR (Tricco et al., 2018) requires a narrative description of the source of evidence selection process and a flow diagram which "details the flow of information through the different phases of the review; maps out the number of records identified, included and excluded, and the reasons for their exclusion" (Tricco et al., 2016, p. 4). The resolution of disagreements between reviewers must also be discussed (Duffett et al., 2013; Tricco et al., 2018). A *PRISMA diagram* reflecting the screening process was developed.

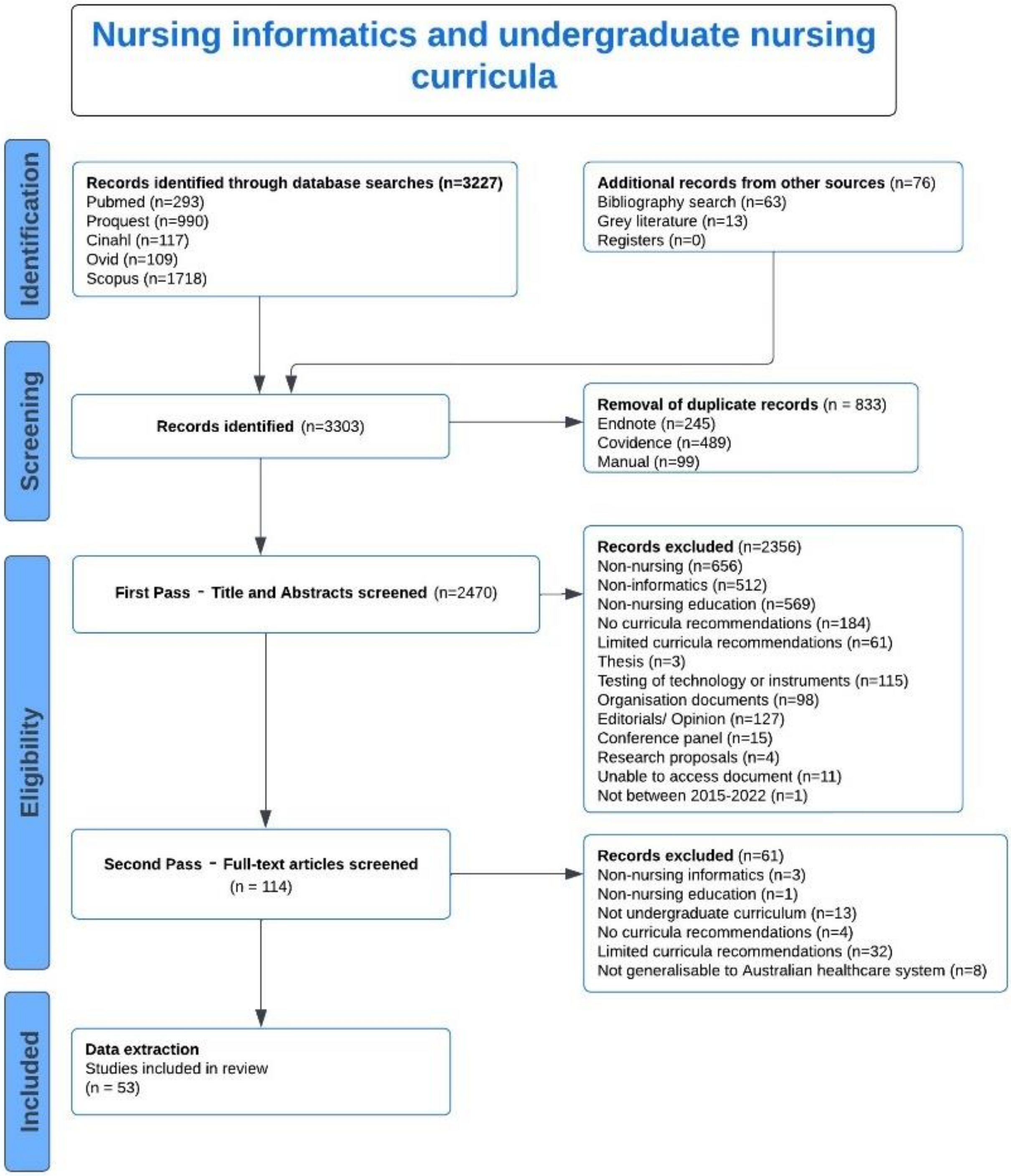



**Figure 4.1 PRISMA Diagram**

The discussion of source of evidence screening and selection, with resolution of disagreements between reviewers, is described below.

#### *4.4.3.1 First Pass – Title and abstract screening*

This stage, identified as First Pass or Title and abstract screening involves examining titles and abstracts and removing sources using exclusion and inclusion criteria (Peters et al., 2021;

University of South Australia (UniSA) & Peters, 2024). The evidence screening process is “usually conducted by a minimum of two reviewers, and any disagreements should be resolved by either consensus or with a third reviewer” (Peters et al., 2021, p. 7). During Title and Abstract Screening, the PhD candidate screened sources using the Covidence™ program, in consultation with the PhD supervisors in weekly meetings, and each source was reviewed and discussed. Where there was a lack of consensus, the screened source was sent out to a third reviewer for evaluation and a group discussion was held via Microsoft Teams. To enhance the trustworthiness of the screening process, an Excel spreadsheet was developed, and each excluded source was categorised.

**Excluded sources** (detailed below) combine both *Domain 4 - Combined domains search* and *Domain 5 – Combined domains search* undertaken as part of the scoping review.

- Non-nursing practice context i.e. medicine, pharmacology, caregiver or patient – n=656
- Non-informatics context i.e. not related to digital technologies – n=512
- Non-nursing education context i.e. does not address learning or teaching – n=569
- No curricula recommendations – n=184
- Limited curricula recommendations – n=61
- Thesis – n=3
- Testing of digital technologies – n=115
- Organisation documents i.e. meeting minutes or reports – n=98
- Editorials, interviews or opinion pieces – n=127
- Conference panel/ presentation – n=15
- Research proposal – n=4
- Unable to access document – n=11
- Not within 2015-2022 time span – n=1

#### *4.4.3.2 Inclusion of additional sources*

The scoping review search can “be quite iterative as reviewers become more familiar with the evidence base, additional keywords and sources, and potentially useful search terms may be discovered and incorporated into the search strategy” (Peters et al., 2020, p. 418). Therefore, other sources, from both grey literature and scanning reference lists of included sources, should be considered to ensure a comprehensive literature search is performed (Tricco et al., 2018).

Following the First Pass – Title and Abstract Screening, every reference list from the included sources of information was reviewed for inclusion of additional relevant sources of information. Additional sources were then added to Covidence for screening and possible inclusion. In total, 63 sources were identified using this process. These sources were included in the First Pass – Title and Abstract Screening procedure.

Tricco et al. (2018) advises that a detailed account of the search for grey literature should be documented. *Grey Matters: a practical tool for searching health-related grey literature* (Canadian Agency for Drugs and Technologies in Health (CADTH), 2019) is identified in the PRISMA-SCR as providing an approach to search for grey literature. A search of grey literature was conducted using this tool (please note – the completed document can be provided on request). A total of 13 sources were identified and included in the First Pass – Title and Abstract Screening procedure. Following the First Pass – Title and Abstract Screening procedure and inclusion of additional sources, 114 sources remained that met the inclusion criteria and were included in the full screening stage.

#### *4.4.3.3 Second pass– Full-text screening*

This stage involves examining the full text of each source to determine if it meets the eligibility criteria and providing coherent reasons for exclusion of sources (University of South Australia (UniSA) & Peters, 2024). During the second screening process, two reviewers read the full text of 114 articles for potentially relevant sources. Disagreements on study selection were discussed in weekly PhD meetings with the PhD supervisors to arrive at a consensus. Where there was a lack of consensus, the screened source was sent out to a third reviewer for evaluation and a group discussion was held via Microsoft Teams. To enhance the trustworthiness of the screening process, an Excel spreadsheet was developed, and each excluded source was categorised. Those articles excluded by consensus were categorised.

- Non-nursing informatics – 3
- Non-nursing education – 1
- Not undergraduate nursing curriculum – 13
- No curriculum recommendations – 4
- Limited curriculum recommendations – 32
- Not generalisable to Australian healthcare or education - 8

Following this process, 53 sources remained that met the inclusion criteria and were included in the data extraction stage.

### 4.4.4 Data extraction

#### *4.4.4.1 Data Extraction Template*

Data extraction for a scoping review “should include extraction of all data relevant to inform the scoping review objective/s and question/s” (Peters et al., 2020, p. 435). The first requirement is to develop a standardised Data Extraction Template and then pilot test the use of this template with two or more reviewers extracting data from two to three papers (Pollock et al., 2021). The development of the template occurs during the scoping review protocol stage and is tested to ensure consistency and trustworthiness of the data extraction process; however, the template may be refined as the scoping review progresses (Peters et al., 2021; Pollock et al., 2021). The process of data extraction requires two reviewers to limit the risk of errors and researcher bias and “can be an iterative process, often requiring multiple refinements to be able to best meet the objectives and research question(s) of the scoping review” (Peters et al., 2021, p. 8).

Prior to importing the sources to the Covidence™ platform, an Excel spreadsheet was developed in consultation with the PhD supervisors. The Data Extraction Spreadsheet recorded key information including authors, the reference, year of publication, country of origin, the aim and purpose of the study, the population and undergraduate curricula recommendations. This process was used, in conjunction with the development of the search strategy, to ensure that the population (undergraduate nurses), concept (nursing informatics), and context (education) were reflected in the retrieved articles.

#### *4.4.4.2 Covidence™*

Once the sources of information had been imported to the Covidence™ platform, the Data Extraction Template was developed online. The Data Extraction Template replicated the Data Extraction Spreadsheet by recording key information including authors, the reference, year of publication, country of origin, the aim and purpose of the study, the population and undergraduate curricula recommendations. Other information added to the template included sampling procedure, study design, possible conflicts of interest for authors and inclusion and exclusion criteria. To ensure the consistency and trustworthiness of the extraction process, three sources were trialled using the Covidence™ template, with two reviewers completing this process and findings were discussed as part of regular PhD meetings.

The process of data extraction required two reviewers; the PhD candidate completed data extraction of each source, and the PhD supervisors were the second reviewers. A review of some sources was required to achieve consensus, and this was undertaken by the two reviewers with further input by the other PhD supervisors during weekly meetings. Once consensus was achieved, this information was reflected in the Covidence™ Data Extraction Template.

#### *4.4.4.3 Data Extraction Spreadsheet*

Following completion of the data extraction process, the extracted data was exported as an Excel spreadsheet (refer to *Appendix A3*). from Covidence™ and titled the *Data Extraction Spreadsheet*. The spreadsheet included the following headings: study details, study setting, study design, population description/ sampling procedure/total number of participants, data collection, data analysis, theories applied in study, competency frameworks, basic computer literacy, implementation strategies, barriers, benefits, pre-education competency assessment, competency assessment tools, tools/applications and faculty development. These headings reflected the Data Extraction Template in Covidence™. Following this process, the researcher reviewed all extracted data on the spreadsheet and reviewed each article to ensure the accuracy of information, thereby enhancing the validity of the findings. Three articles were returned to the full-text review stage due to discrepancies identified between the original data extractions and the reviewing of these sources. The three articles underwent the full-text screening and data extraction process with two reviewers. The cross-checking of all sources enhanced the trustworthiness of the findings. The Data Extraction Spreadsheet was reviewed by the PhD supervisors, prior to and during the weekly meetings, to meet the established criteria of a logical format in tabular form aligning with the objectives of the scoping review. The criteria of demonstrating a transparent and explicit approach were met through the detailed information provided regarding the data extraction and analysis process. This document was used in the data analysis process.

Pollock et al. (2023), in *Recommendations for the extraction, analysis, and presentation of results in scoping reviews*, provides an example of how a data extraction table may be formatted for use in data extraction. Whilst Covidence™ creates an Excel document with this data, the researcher transcribed the relevant data to a table (refer to *Appendix A3*), similar to the type recommended by Pollock et al. (2023), to increase the accessibility and readability of the document. (Please note - the original Covidence™ template is available on request).

### 4.4.5 Data analysis

Methods of data analysis in a scoping review may include frequency counts of the population, concepts and context, descriptive qualitative content analysis or basic coding (Peters et al., 2021; Pollock et al., 2021); however, Peters et al. (2020, p. 421) caution that thematic analysis is “beyond the scope of a scoping review”. For in-depth qualitative analysis, a descriptive content analysis approach may be used and quantitative data analysis may use either simple frequency counts or a more in-depth approach investigating “the occurrence of concepts, characteristics, population” (Peters et al., 2020, p. 421). The way in which data is analysed and presented, predominantly depends on the purpose of the scoping review and the authors' judgment and it is therefore essential that the authors use a transparent and explicit approach which justifies the methodological decisions made (Peters et al., 2020). A decision was made to use a quantitative approach identifying absolute frequency counts of population, concepts and context and a qualitative content analysis framework with manual coding to describe the key information relevant to the scoping review questions These methods of data analysis are described below.

#### *4.4.5.1 Frequency counts*

As previously stated, methods of data analysis in a scoping review may include frequency counts of the population, concepts and context or basic coding (Peters et al., 2020; Peters et al., 2021; Pollock et al., 2021). Frequency counts are a type of descriptive statistics which seek "to summarise a specific characteristic of a variable or measurement" (Cooksey, 2020). The Australian Bureau of Statistics (ABS, n.d.-b) defines frequency as "the number of times a particular value for a variable (data item) has been observed to occur". Absolute frequency refers to "the number of times a particular value for a variable (data item) has been observed to occur" (ABS, n.d.-b), as opposed to relative frequency which reflects "the ratio of the frequency to the total frequency of all variate values" (OECD, 2008, p. 11). Absolute frequency counts are the simplest and most basic form of descriptive statistics; however, they provide a clear and concise summary of data points to facilitate interpretation of data (Cooksey, 2020). Absolute frequency counts of all data collection points identified in the Data Extraction Spreadsheet were identified and are described in the following chapter.

#### *4.4.5.2 Qualitative content analysis*

Whilst originally a quantitative analysis method, content analysis has also been adopted into qualitative research studies (Bengtsson, 2016; Kleinheksel et al., 2020) and is used to analyse visual, written and verbal communication (Wilson, 2011). In *Content Analysis: An Introduction to Its Methodology*, Krippendorff (2019, n.p.) stated "content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use". As such, the technique used in content analysis must be reliable, replicable and valid and open to scrutiny (Krippendorff, 2019).

Qualitative content analysis requires the in-depth reading of text, reorganisation of relevant sections into categories and then creating interpretations or narratives (Krippendorff, 2019). In *Methodological challenges in qualitative content analysis: A discussion paper*, Graneheim et al. (2017, pp. 29-30) state that "qualitative content analysis comprises descriptions of the manifest content, close to the text, as well as interpretations of the latent content, distant from the text but still close to the participants' lived experiences". The manifest content is typically coded into categories in the initial stages of the analysis, with the latent content emerging from the researcher's interpretation of the text (Graneheim, Lindgren, & Lundman, 2017; Kleinheksel et al., 2020). Bengtsson (2016) in *How to plan and perform a qualitative study using content analysis*, identifies four distinct processes in the qualitative content analysis approach – decontextualization, recontextualisation, categorisation and compilation (refer to *Figure 4.2*):

*The decontextualization process* requires familiarisation with the data and each "identified meaning unit" being labelled with a code using an open coding process (Bengtsson, 2016, p. 11). These codes may be created deductively with a coding list created prior to analysis or inductively with changes made to codes as the analysis progresses. The coding process should be repeated to increase the reliability of the meaning units, as initial coding may become less apparent as the researcher continues to familiarise themselves with the data.

*The recontextulisation process* occurs after the coding process and requires each source to be reread and compared to the coded meaning units (Bengtsson, 2016). Sections of unmarked text should be considered for meaning with the understanding that some text may not be relevant to the research question and therefore should not be included.

*The categorisation process* first requires extended meaning units to be condensed and combined (Bengtsson, 2016). In this process, the themes or categories are identified through moving meaning units between categories, resulting in the final categorisation.

*The compilation process* is the final stage of the data analysis procedure and involves the analysis and writing up of the findings. In performing qualitative content analysis, the researcher has a choice between manifest or latent level analysis. Manifest analysis requires working through the identified categories and latent analysis requires working through themes. The final requirement is to consider how the emerging findings relate to existing literature and whether the results are therefore logical and reasonable (Bengtsson, 2016).

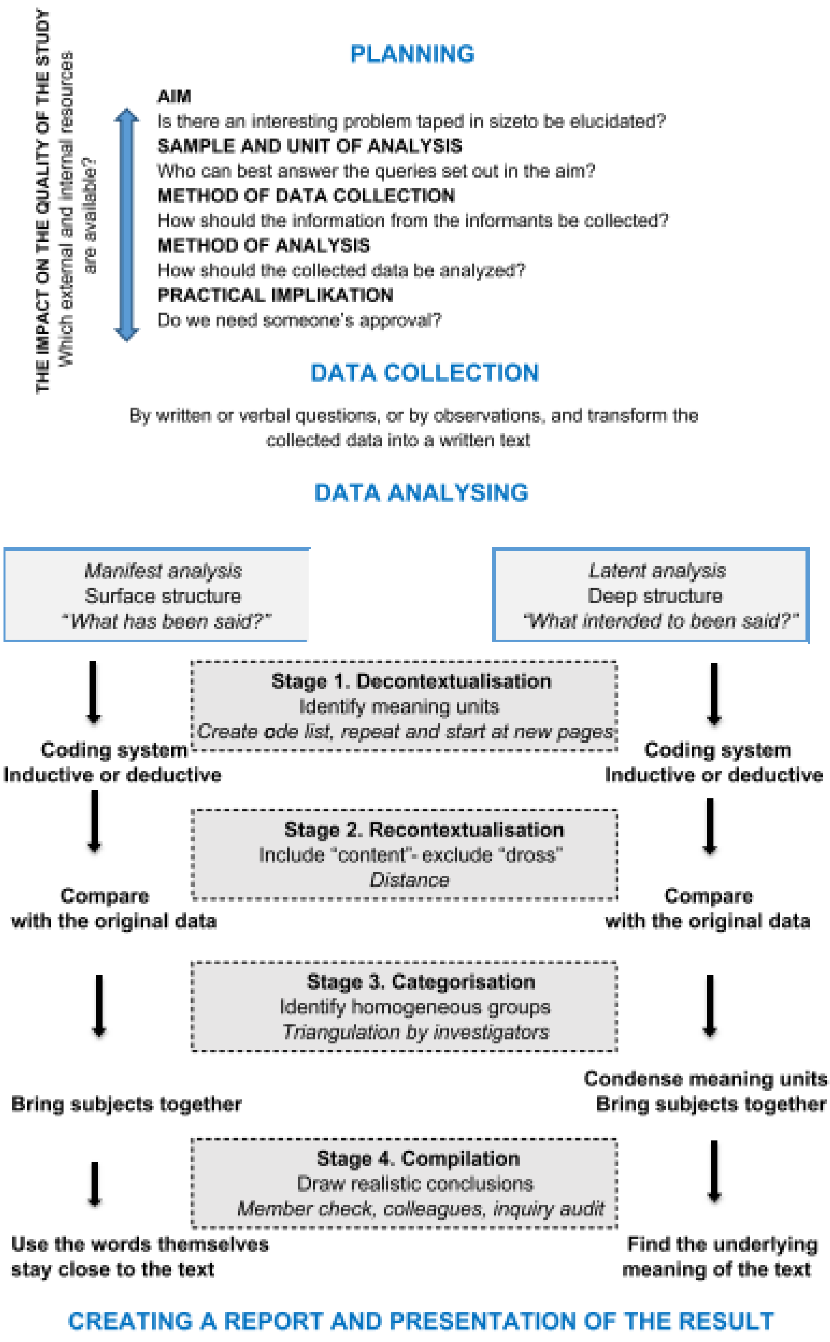



**Fig. 1.** An overview of the process of a qualitative content analysis from planning to presentation.

**Figure 4.2 The Process of Qualitative Content Analysis from Planning to Presentation**

*Note*: From Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, *2*, 8-14. http://doi.org/10.1016/j.npls.2016.01.001 https://creativecommons.org/licenses/by-nc-nd/4.0/

### *4.4.5.3 Deductive, inductive and abductive reasoning*

Graneheim et al. (2017) identifies three types of content analysis approaches – inductive, deductive and abductive; however, Krippendorff (2019, n.p.) states that inductive and deductive approaches are not "central to content analysis" and that most content analysis is abductive in nature. Inductive inference is data driven (Kleinheksel et al., 2020) and is characterised by the search for similarities, differences and patterns in text (Krippendorff, 2019) with the researcher moving from “the data to a theoretical understanding – from the concrete and specific to the abstract and general” (Graneheim, Lindgren, & Lundman, 2017, p. 30). Deductive inference is concept-driven (Kleinheksel et al., 2020) with the researcher moving from the theoretical or abstract to a more concrete understanding (Graneheim, Lindgren, & Lundman, 2017; Krippendorff, 2019) with propositions which are logically implied (Krippendorff, 2019). And abductive inference moves between both inductive and deductive approaches (Graneheim, Lindgren, & Lundman, 2017; Kleinheksel et al., 2020), “abductively inferring contextual phenomena from texts moves an analysis outside their data. It bridges the gap between descriptive accounts of texts and what they mean, refer to, entail, provoke, or cause” (Krippendorff, 2019, n.p.). For the purpose of this scoping review an abductive inference approach has been applied.

### 4.4.6 Presentation of results

The way in which data is analysed and presented, predominantly depends on the purpose of the scoping review and the authors’ judgment and it is therefore essential that the authors use a transparent and explicit approach which justifies the methodological decisions made (Peters et al., 2020). Collation and presentation of the results aims to identify the implications for policy, practice and research, with the conclusion reflecting the objective of the scoping review (Khalil et al., 2016). The method of data presentation should be described in the scoping review protocol (Peters et al., 2021). In the presentation of results, (Peters et al., 2021) suggest the use of two sections; the first section providing a description of the search strategy results (with the inclusion of the PRISMA flow diagram); and the second section detailing the key information relevant to the scoping review questions. “Presenting the results in a suitable and detailed format will allow the reviewers to identify gaps in the literature and map the available evidence” (Peters et al., 2021, p. 2125).

### 4.4.7 Limitations of the scoping review approach

Item 25 of the PRISMA ScR (Tricco et al., 2018) identifies the limitations of the scoping review. A discussion of the purpose of scoping reviews and how they differ from systematic reviews is provided in *Chapter 3: Study methodology*. Arksey and O'Malley (2005, p. 24), in *Scoping studies: towards a methodological framework*, identifies the following limitations – non-appraisal of the quality of evidence and synthesis, large data sets, and requires “high degrees of analytic skill in order to develop frameworks through which large numbers of studies can be described”, with Peters et al. (2021, p. 2123) stating that “any limitations in terms of the breadth and comprehensiveness of the search strategy should be detailed and justified”. In this study, the scoping review method has been addressed in adherence with the PRISMA-ScR Checklist (Tricco et al., 2018) and the JBI Manual for Evidence Synthesis (Aromataris & Munn, 2020), data collection, data extraction and data analysis. The search method and progression through the screening process has been detailed to provide transparency and replicability. It is acknowledged, by the researcher, that the scoping review process was time consuming, particularly as the researcher was developing understanding of the method concurrently with the search process; however, since this time the researcher has assisted in another scoping review - *Assessing the carbon footprint of digital health interventions: a scoping review* (Lokmic-Tomkins, Davies, et al., 2022).

## 4.5 Conclusion

This chapter has presented the scoping review method used in the study. It has addressed the development of a scoping review protocol, in adherence with the *PRISMA-ScR Checklist* (Tricco et al., 2018) and the *JBI Manual for Evidence Synthesis* (Aromataris & Munn, 2020), data collection, data extraction and data analysis. *Chapter 5: Phase 1 – Scoping review findings* discusses the findings from the scoping review and the development of questions to inform the Delphi phase of the study.

# Chapter 5 Phase 1 – Scoping Review Findings

## 5.1 Introduction

Chapter 4 described the scoping review method used in Phase 1 of the study. The reporting guidelines, development of a scoping review protocol and the scoping review procedure were discussed in detail. The findings from the scoping review are presented in this chapter and are divided into two sections – *Frequency count findings* and *Qualitative content analysis*; this is in adherence with the recommendations from Peters et al. (2020), Peters et al. (2021), and Pollock et al. (2021). Peters et al. (2021, p. 2125) state that the "most important consideration regarding extraction and analysis is that the authors are transparent and explicit in the approach they have taken, including providing a rationale for their approach and clearly reporting extracted data and analyses". This chapter provides a transparent and explicit discussion of the scoping review findings.

## 5.2 Frequency counts

As discussed in the previous chapter, scoping reviews may use frequency counts as a means of data analysis (Peters et al., 2020; Peters et al., 2021; Pollock et al., 2021). Frequency counts are a type of descriptive statistics which summarise how many times a particular variable or data point occurs (ABS, n.d.-a; Cooksey, 2020; OECD, 2008). For the purpose of this scoping review, absolute frequency counts were used, which are the simplest and most basic form of descriptive statistics and provide a clear summary of specific data points for interpretation of data (Cooksey, 2020). Cooksey (2020) recommends that the data frequency be listed from lowest value to highest value. The frequency counts discussed in this chapter reflect the data from the *Data Extraction Spreadsheet* (refer to *Appendix A3*). (Please note: the Data Extraction Spreadsheet was modified for the purpose on inclusion in this thesis – a full version is available on request).

### 5.2.1 Study settings

Research or study settings are "the physical, social, and cultural site in which the researcher conducts the study" (Bhattacharya, 2008, n.p.). The selected studies came from multiple sites, including Finland, the United States of America, Canada, Mexico, Kuwait, Brazil, Sweden, Australia, the Republic of Korea, Argentina and Philippines (n=1), Canada, Australia & Denmark (n=1), Austria, Germany & Switzerland (n=1), the United Kingdom, the United States of America & Germany (n=1) and the United Kingdom and Ireland (n=1). Single research setting sites included New Zealand (n=1), Saudi Arabia (n=1), South Korea (n=2), Israel (n=2), the United Kingdom (n=3), Canada (n=8), Australia (n=12) and the United States of America (n=19).

### 5.2.2 Aim/ purpose of the studies

The aim or purpose of a research study, is defined by Thomas & Hodges (2010, p. 38) as "the main goal or overarching purpose of a research project". The aim or purpose of the selected studies included the development and integration of nursing informatics competencies into the undergraduate nursing curricula (n=4) and embedding nursing informatics into the undergraduate nursing curricula (n=5). Other studies addressed teaching strategies, including the use of telehealth (n=1), eHealth (n=1), situated learning approaches (n=1), new software (n=1), smart home healthcare and health informatics laboratories (n=1), digital health assignments (n=2), electronic medication records (n=3), the use of technology in undergraduate nursing education and practicums, including social media, mobile devices and vodcasting (n=7) and electronic health records (n=11). Framework development (n=2), experiences of nurse educators integrating nursing informatics into undergraduate nursing education (n=2), and digital literacy in undergraduate nursing students (n=2) were addressed. Finally, overviews of health informatics and nursing informatics in higher education, including undergraduate nursing education (n=1), workforce readiness for graduate nurses (n=2), future trends in nursing informatics (n=3) and the digital workforce (n=4) were also discussed.

### 5.2.3 Study designs

"The study or research design "refers to the planning of the research, the selection of methodology or design and associated methods for identifying and recruiting the sample/ participants, collecting and analysing data" (Francis, Chapman, & Whitehead, 2016, p. 27). Prior to the data extraction procedure, an agreed list of definitions of study designs was developed to enhance the trustworthiness of the data extraction process. These definitions are described below:

*Scoping reviews*: Scoping reviews can determine "the scope or coverage of a body of literature on a given topic and give clear indication of the volume of literature and studies available as well as an overview (broad or detailed) of its focus" (Munn, Peters, et al., 2018, p. 2).

*Integrative reviews*: "Integrative literature reviews are strongly anchored in a representative description of a field, but add new insights via a critical analysis and synthesis of the field's literature" (Elsbach & Knippenberg, 2020, p. 1277).

*Text and opinion papers*: "Text and opinion-based evidence (which may also be referred to as non-research evidence) is drawn from expert opinions, consensus, current discourse, comments, assumptions or assertions that appear in various journals, magazines, monographs and reports" (McArthur et al., 2020, p. 135).

*Discussion papers*: “Discussion papers are evidence based and are intended to provide balanced information on a particular topic without espousing a particular position” (ACN, 2021).

*Cross-sectional studies*: “A study that collects information on interventions (past or present) and current health outcomes…to examine associations between the outcomes and exposure to interventions” (Reeves et al., 2011, n.p.).

*Teaching innovations*: “In education, innovation can appear as a new pedagogic theory, methodological approach, teaching technique, instructional tool, learning process, or institutional structure that, when implemented, produces a significant change in teaching and learning, which leads to better student learning” (Serdyukov, 2017, p. 8).

*Qualitative research studies*: A method of research that typically involves data “collected in the participant’s setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data” (Creswell & Creswell, 2018, p. 4).

*Cohort studies*: Longitudinal studies typically “used to analyse relationships between exposures and disease by comparing the outcomes between two groups over time”; with one group exposed to a common event or characteristic and the other group are not exposed (Moola et al., 2020, p. 215).

*Capability framework development*: “A capability framework is a set of capabilities that are required of individuals to ensure success in a given role” (Hinman et al., 2020, p. 4).

*Quantitative surveys*: “Quantitative research, by definition, deals with quantities and relationships between attributes; it involves the collection and analysis of highly structured data in the positivist tradition” (Bowling, 2009, p. 214).

*Mixed-methods*: “Mixed methods research is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks” (Creswell & Creswell, 2018, p. 4).

*Action research:* Developing “a concrete procedure for translating evidence into action…most action research is categorised as one of two approaches: as either a social/ community development or an organisational-change process” (Whitehead & Day, 2016, p. 242).

*Implementation of a theoretical model*: “Models can be described as theories with a more narrowly defined scope of explanation; a model is descriptive, whereas a theory is explanatory as well as descriptive “ (Nilsen, 2015, p. 2).

*Course review*: “A course revision involves a process of evaluating the different parts of a course to determine what is effective, educationally relevant, easily understood, and what is not” (McGahan, 2018, n.p.).

*Software tool development*: “The term either refers to tools that enable development of full-fledged applications using compiled / interpreted code or software packages used by developers to author and package multimedia content deliverable to end users”. (Gavalas & Economou, 2012, p. 251).

The selected study designs included software tool development (n=1), quantitative surveys (n=1), action research (n=1), implementation of a theoretical model (n=1), course review (n=2), discussion papers (n=3), cohort studies (n=3), capability framework development (n=3), cross-sectional studies (n=4), teaching innovations (n=4), qualitative research with in-depth interviews, focus groups and questionnaires (n=4), text and opinion (n=5), mixed-methods (n=5), integrative, scoping and literature reviews (n=8) and non-randomised experimental studies (n=9). Please note, that some studies used several study designs, and this is reflected in the provided information.

### 5.2.4 Sampling procedures

The primary purpose of sampling is to select a sample of suitable participants to meet the aims or purpose of a research study (Bhardwaj, 2019; Whitehead & Whitehead, 2016), and is therefore, an important factor in determining the accuracy of a study (Bhardwaj, 2019) and the generalisability of the study findings to a broader population (Onwuegbuzie & Collins, 2017). Population descriptions, sampling procedures and/or the total number of participants were addressed in some of the studies; however, it is to be noted, that sampling of populations were not applicable in a number of studies. Populations included experts in healthcare and informatics (n=3). nurses in clinical practice (n=6), clinical educators and university faculty (n=14) and undergraduate nursing students (n=16). Other health care disciplines were also identified in population descriptions, in addition to nurses, including occupational therapy, physiotherapy, speech pathology, exercise and sports sciences, radiography, and rehabilitation counselling students. Please note, that some studies sampled several populations, and this is reflected in the provided information.

Prior to the data extraction procedure, an agreed list of definitions of sampling procedures was developed to enhance the trustworthiness of the data extraction process. These definitions are described below:

*Purposive sampling*: “Participants are recruited according to pre-selected criteria relevant to the research aims/ questions of a given study” (Whitehead & Whitehead, 2016, p. 112).

*Convenience sampling*: "…occurs when people are invited to participate in the study because they are conveniently (opportunistically) available with regard to access, location, time and willingness" (Whitehead & Whitehead, 2016, p. 112).

Snowball sampling: "…snowball sampling occurs when the researcher starts gathering information from one or a small number of people and then requests they put the researcher in touch with others who may be friends, relatives, colleagues or other significant contacts" (Whitehead & Whitehead, 2016, p. 113).

Sampling procedures for the above populations, included convenience and snowball sampling (n=1), snowball sampling (n=2), purposive sampling (n=6) and convenience sampling (n=17). Sampling procedures were not explicitly stated in some of the studies (n=3).

### 5.2.5 Data collection and analysis

Creswell & Plano Clark (2018, p. 173) state that "the basic idea of collecting data in any research study is to gather information to address the questions being asked in the study". In-depth descriptions of data collection methods were reported in some of the selected studies, including Delphi process (n=1), workshops (n=1), case study evaluations (n=1), document reviews (n=1), simulation debriefing (n=1), ad hoc data collections (n=1), semi-structured interviews (n=2), field visits (n=2), focus group interviews (n=4), database searches (n=10), literature reviews (n=16) and surveys/ questionnaires (n=18). A number of studies did not describe the data collection method (n=13). Please note, that some studies used several data collection methods, and this is reflected in the provided information.

"Researchers go through a similar set of steps for both quantitative and qualitative data analysis: preparing the data for analysis, exploring the data, analysing the data, representing the analysis, interpreting the analysis, and validating the data and interpretations of the results" (Creswell & Plano Clark, 2018, p. 210). In-depth descriptions of data analysis methods were reported in some of the selected studies, included Hawker et al.'s (2002) *method of reviewing disparate data systematically* (n=1), Roper and Shapira's (2000) *steps for thematic analysis of ethnographic data* (n=1), Lichtman's (2006) *data analysis method of codes, categories and concepts* (n=1), Braun et al.'s (2019) *thematic analysis* (n=1), Cruzes and Dyba's (2011) *inductive thematic synthesis approach recommendations*, *numerical summar*y (n=1), *Pearson correlations* (n=1) and *qualitative narrative analysis* (n=1). Other data analysis methods included Melnyk and Fineout-Overholts' (2015) *critical appraisal process* (n=2), *ANOVA (analysis of variance)* (n=2), *Delphi analysis through consensus* (n=3), *content analysis* (n=3), *thematic analysis* (n=5), *SPSS Statistics (Statistical Package for the Social Sciences)* (n=6) and *descriptive statistics* (n=9). Please note, that some studies used a number of data analysis methods, and this is reflected in the provided information.

### 5.2.6 Theories, models and frameworks applied in the sources of evidence

According to Nilsen (2015), in *Making sense of implementation theories, models and frameworks*, a theory can be defined as a set of principles or statements to assist in structuring observation and understanding of our world. "Theories are mental patterns or constructs created to help us understand and find meaning from our experience, organize and articulate our knowing, and ask questions leading to new insights" (Parker, 2005, p. 4). "A model typically involves a deliberate simplification of a phenomenon or a specific aspect of a phenomenon" and is commonly used to translate research into practice (Nilsen, 2015, p. 2), with frameworks providing descriptive categories without explanation of factors influencing the outcome. A number of theories, models and frameworks were applied in the selected studies.

Theories, models and frameworks related to the development of nursing informatics and technology competency included Hwang and Park's (2011) *Nursing Informatics competency recommendations* (n=1), Moody et al.'s *Usability Assessment Survey* (2004) (n=1), and the *Technology Acceptance Model (TAM)* based on the work of Davis (1989) (n=1). Brod's (1984) *Technostress model* (n=1), the *TIGER-based Assessment of Nursing Informatics (TANIC) competencies* (Hill et al., 2014; Hunter et al., 2015) (n=1), the *Triad Model* (Zeffane, A Tipu, & Ryan, 2011) (n=1) and a Likert type scale adapted from the *COLLES (Constructivist On-Line Learning Environment Survey)* (Taylor & Maor, 2000; Taylor & Maor, n.d.) (n=1) were also applied. In addition, the *Skills Framework for the Information Age* (SFIA, 2015) (n=1), *Rogers' Diffusion of Innovation framework* (2003) (n=2), *Self-Assessment of Nursing Informatics Competencies Scale (SANICS)* based on the work of Staggers et al. (2001) and Yoon et al. (2015; Yoon, Yen, & Bakken, 2009) were used (n=2). Finally, *sociotechnical systems theories, including* Sittig and Singh's (2010) *Eight Dimensional Model* (n=2), an adaptation of Rowley et al.'s (2015) *Trust in Online Health Information Scale* (n=2), and Norman and Skinner's (2006) *eHEALS scale* were included (n=2).

Theories, models and frameworks related to learning, included Krathwohl's (2002) *Revision of Bloom's Taxonomy* (n=1), Allee's (1997) *Knowledge Complexity Framework* (n=1), *an experiential learning model* based on the work of Kolb (1984), Bergensteiner et al. (2010), and Konak et al. (2014) (n=1), *transformative and constructivist learning theories* (n=1), and a *modified version of the SPICE (Setting, Perspective, Intervention, Comparison, Evaluation) framework*, proposed by Booth (2004) (n=1). Other learning theories, models and frameworks included *adult learning theories* (not otherwise specified (n=1), *social cognitive theory* (n=1), Heron & Reason's (2001) *Co-operative inquiry* (n=1) and Lave and Wenger's (1991) *Situated Learning Theory* (n=1). Benner's

(2001) *(novice to expert) Practice Development Model* (n=2), the *Spiral Learning Approach* based on the work of Harden (1999) and Stockhausen (1994) (n=2), and *objectivist-constructivist pedagogical frameworks* (n=4) were applied.

Other theories, models and frameworks included Lazarus and Folkman's (1984) *Theory on Stress and Coping* (n=1), King's (1981) *conceptual system and theory of goal attainment* (n=1) and Vygotsky's (1978) *zone of proximal development* (n=1). Please note, that some studies used several theories, models and frameworks and this is reflected in the provided information.

### 5.2.7 Nursing informatics competency standards/ frameworks

Within the context of nursing, competence is defined as "the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/ or superior performance in a profession/occupational area" (NMBA, 2021, p. 8.). "Competency frameworks serve various roles including outlining characteristics of a competent workforce, facilitating mobility, and analysing or assessing expertise" (Batt, Tavares, & Williams, 2020, p. 913). International competency standards or frameworks, reported in the selected studies, were published by HITComp (Health Information Technology Competencies, 2017) (n=1), INACSL (International Nursing Association for Clinical Simulation and Learning Standards, 2016) (n=1), HIMSS (Healthcare Information and Management Systems Society, n.d.) (n=2), Global Health Workforce Council (2015) (n=2), the International Medical Informatics Association (IMIA) (Mantas et al., 2010) (n=4) and TIGER (Technology Informatics Guiding Education Reform) (HIMSS, 2024; Hübner et al., 2018; TIGER, 2008; Technology Informatics Guiding Education Reform (TIGER), 2009, 2010) (n=16).

Competency standards or frameworks from the United Stated of America, reported in the selected studies, were published by AMIA (American Medical Informatics Association) (Kulikowski et al., 2012) (n=3), NLN (National League for Nursing, 2008) (n=5), ANA (2008, 2015) (n=5), AACN (American Association of Colleges of Nursing, 2008) (n=7) and QSEN (Quality and Safety Education for Nurses Institute, 2016; 2022b, 2022b) (n=13). Competency standards or frameworks from Canada, reported in the selected studies, were published by COACH (Canada's Health Informatics Association, 2012) (n=1) and CASN (Canadian Association of Schools of Nursing, 2012b) (n=12). Competency standards or frameworks from the United Kingdom, reported in the selected studies, were published by the NMC (Nursing and Midwifery Council, 2018) (n=1) and NICE (National Institute for Health and Care Excellence, 2019) (n=1). Competency standards or frameworks from Australia, reported in the selected studies, were published by AHIEC (Australian Health Informatics Education Council, 2011) (n=1), NMBA (Nursing and Midwifery Board of Australia & Southern Cross University, Nursing & Midwifery Board of Australia (NMBA), 2016a; 2015) (n=2), ANMF (Australian Nursing and Midwifery Federation, 2015) (n=2) and ANMC/ANMAC (Australian Nursing & Midwifery Accreditation Council, 2012; Australian Nursing and Midwifery

Council (ANMC), 2006) (n=4). Please note, that some studies used a number of competency standards or frameworks, and this is reflected in the provided information. The competency standards or frameworks, described in the selected studies, will be addressed further in the subsequent section of this discussion.

### 5.2.8 Pre-education competency assessment

The use of pre-education competency assessments, to determine the efficacy of teaching strategies or interventions, were identified in very few studies (n=13). Pre-education competency assessments primarily utilised student self-reports (n=8), with Forman et al. (2020a, p. 6) noting that "the lack of a valid informatic competency assessment may have increased bias due to students' different interpretations of their own competency levels". The use of pre-education competency assessments, described in the selected studies, will be addressed further in the subsequent section of this discussion.

### 5.2.9 Competency assessment tools

Competency assessment tools, used to identify an individual's knowledge, attitudes, values and abilities regarding nursing informatics, were identified in very few studies (n=12), with studies identifying the use of the *TIGER-Based Assessment of Nursing Informatics Competencies (TANIC)* (Hill et al., 2014; Hunter et al., 2015) (n=1), the *Canadian Nurse Informatics Competency Assessment Scale* (Kleib & Nagle, 2018a) (n=1), the Canadian Association of School of Nursing (2013) *Nursing informatics teaching toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula* (n=1). the *COLLES (Constructivist On-Line Learning Environment Survey)* (Taylor & Maor, 2000; Taylor & Maor, n.d.) (n=2), the *SANIC (Self-Assessment of Nursing Informatics Competencies Scale* (Staggers, Gassert, & Curran, 2001; Yoon, Shaffer, & Bakken, 2015; Yoon, Yen, & Bakken, 2009) (n=2), established competency standards (n=3) and other self-report surveys and questionnaires (n=3). Brunner et al. (2018), in *An eHealth capabilities framework for graduates and health professionals: Mixed-methods study* recommend focusing on capability, rather than competency, stating that capability moves beyond competence to encompass life-long learning, self-efficacy and adaptability to change and emphasises the importance of continual professional development, rather than the assessment of skill at a fixed point in time. The use of competency assessment tools, described in the selected studies, will be addressed further in the subsequent section of this discussion.

### 5.2.10 Basic computer literacy

"Computer literacy is defined as an understanding of computer characteristics, capabilities, and applications, as well as an ability to implement this knowledge in the skillful, productive use of computers in a personalized manner" (Nawaz & Muhammad Kundi, 2010, p. 20). The issue of basic computer or digital literacy of both students and faculty were addressed in a number of the selected articles (n=24). The computer or digital literacy of undergraduate nursing students and faculty, described in the selected studies, will be addressed further in the subsequent section of this discussion.

### 5.2.11 Interventions

Cremin (1970, as cited in Franklin, 2003, p. 153) defined education as “the deliberate, systematic, and sustained effort to transmit, evoke, or acquire knowledge, attitudes, values, skills, or sensibilities, as well as any outcomes of that effort”. Educational interventions, for the purpose of this scoping review, are defined as “a new program, course, curriculum, or pedagogical technique that seeks to reform an older system or practice” (Berdanier et al., 2015, n.p.). Nursing informatics educational interventions which were addressed, included Bar Coded Medication Administration (BCMAs) or Electronic Medication Administration Records (eMARs) (n=3), mobile technologies (n=4) and the use of Electronic Health Records (EHRs) or Electronic Medical Records (EMRs) (n=15). The development of case studies (n=1), decision-support tools (n=1), technology training protocols (n=1), digital literacy assessments (n=2), capability frameworks (n=2), informatics courses and topics (n=4) and informatics competencies (n=4) were described. Informatics education regarding faculty familiarisation (n=1), digital professionalism (n=1), legal and ethical aspects of informatics (n=1), basic computer training (n=1), data security (n=1), standardised languages (n=2) and social network training (n=3) were also discussed. Specific teaching techniques included blended learning (n=1), online learning (n=1), technology demonstrations (n=1) and clinical simulations (n=4). Please note, that some studies used a number of interventions and this is reflected in the provided information. The nursing informatics education interventions, described in the selected studies, will be addressed further in the subsequent section of this discussion.

### 5.2.12 Barriers

In a study on the integration of informatics into a Doctor of Nursing Practice curricula, Lilly et al. (2015, p. 192) defined barriers as “anything that interferes with the ability to integrate IT into the DNP curriculum”. So too, in this scoping review, barriers were defined as anything preventing the effective integration of nursing informatics into undergraduate nursing education and associated clinical practice. Barriers emerged as a consistent theme throughout most of the selected studies (n=52) and included a belief in the *digital native* (n=3), the constantly evolving nature of nursing informatics and digital technologies (n=7), lack of student access to digital technologies and associated resources (n=14), faculty resistance and technological stress (n=15), lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies (n=21), the lack of understanding of nursing informatics and its role in the profession (n=22) and limited infrastructure and resources (n=24). Please note, that some studies identified a number of barriers to the integration of nursing informatics into undergraduate nursing education and this is reflected in the provided information. The barriers, described in the selected sources, will be addressed further in the subsequent section of this discussion.

### 5.2.13 Benefits

Luo and Kalman (2018, p. 21) noted that “Nurses’ technological knowledge of, skills in, and attitudes toward new technologies in the healthcare setting are critical to improving healthcare outcomes”. The benefits of integrating nursing informatics into the undergraduate nursing education, in the selected studies, addressed several specific areas – the benefits of nursing informatics in clinical care and the benefits of nursing informatics in undergraduate nursing education. The benefits of nursing informatics in clinical care included rapid access to crucial patient data (n=1), systematic patient assessment (n=1), improved time management (n=1), rapid patient assessment (n=1), secure use of information (n=1), patient self-monitoring (n=2), improved data collection (n=2), less clinical errors (n=4), evidence-based practice (n=4), cost-effectiveness (n=4), enhanced nursing practice at point of care (n=5), improved team communication (n=5) and improved patient outcomes and safety (n=8). The benefits of nursing informatics in undergraduate nursing education included practice using telehealth applications (n=1), understanding of the importance of data (n=1), development of assessment skills (n=2), integrating theory and practice (n=2), understanding the role of the nurse (n=2), access to evidence-based materials (n=3), promotion of profound learning, critical thinking and clinical reasoning (n=5), improved digital literacy (n=6), genuine and authentic real life context (n=7), workplace readiness of graduates (n=8), increased recognition of the importance of nursing informatics (n=9) and practice using EHRs, EMRs, BCMAs, EMARs and clinical support tools (n=13). The benefits, described in the selected sources, will be addressed further in the subsequent section of this discussion.

### 5.2.14 Tools and applications

Gavalas and Economou (2012, p. 251) define a tool, in the context of information technology, as enabling the “development of full-fledged applications using compiled / interpreted code or software packages used by developers to author and package multimedia content deliverable to end users”. For the purpose of data extraction, tools and application were defined as digital technologies used in nursing informatics education in classroom and clinical settings. The digital tools and applications, identified in the selected sources, included Microsoft Office applications (n=1), standardised electronic assessment forms (n=1), electronic information management systems (n=1), electronic reports (n=1), Computer Patient Order Entry (n=1), internet (n=2), telehealth applications (n=2), eHealth applications (n=2), BCMAs and eMARs (academic and proprietary) (n=3), social media applications (n=4) and EHRs and EMRs (academic and proprietary) (n=19). Hardware, identified in the selected sources, included innovative smart home laboratories (n=1), bedside computers (n=1), wearable technologies (n=2), clinical simulation virtual tools (n=2) and mobile handheld devices (n=7). Specific educational tools and applications included Learning Management Systems (n=1), Computer-assisted Learning Programs (n=1), NCLEX-RN (National Council Licensure Examination-Registered Nurse) exam preparation apps (n=1), digital learning platforms (n=1) and photography, video, film, streamed content and blended media (n=5). The tools and applications, described in the selected sources, will be addressed further in the subsequent section of this discussion.

### 5.2.15 Faculty development

Gonen, Sharon and Lev-Ari (2016) noted that a significant barrier to the use of information technology and informatics in nursing curricula, is associated with limited faculty knowledge and the misperception of informatics as not being a clinical skill. Overcoming faculty resistance is of paramount importance in embedding nursing informatics into the undergraduate nursing curricula; therefore, some of the selected sources, identified strategies to support faculty in the development of nursing informatics knowledge and skills, and counter technology resistance. These recommendations included training for the use of specific EHRs (n=1), assessment of faculty digital literacy and competency (n=1), nursing informatics competency standards to inform undergraduate nursing curricula (n=1), collaboration with faculty in the development of curricula (n=1), development of nursing informatics competency standards for faculty (n=2), increasing faculty numbers (n=2), increased funding for nursing informatics resources (n=2), multidisciplinary engagement to promote digital and health literacies (n=3), partnerships with clinical facilities to support Nursing Informatics knowledge and application (n=3), the appointment of faculty super users to facilitate education and support faculty (n=5), peer support and mentorship programs (n=5), training materials and access to resources (n=5) and the development of nursing informatics seminars and workshops for faculty (n=12). The recommendations for faculty development, described in the selected sources, will be addressed further in the subsequent section of this discussion.

## 5.3 Key information relevant to the scoping review questions

As discussed in the previous chapter, another method of data analysis typically used in scoping reviews is descriptive qualitative content analysis (Peters et al., 2020; Peters et al., 2021; Pollock et al., 2021). Qualitative content analysis requires in-depth analysis of the text, organisation of data into categories and the creation of narratives (Krippendorff, 2019). Manifest content, which is close to the text, arises earlier in the analysis procedure and emerges from the coding of data into categories (Graneheim, Lindgren, & Lundman, 2017; Kleinheksel et al., 2020). Latent content, which is distant from the text, arises in the later stages of data analysis and emerges from the researcher's interpretation of the text (Graneheim, Lindgren, & Lundman, 2017; Kleinheksel et al., 2020). It is important to note that these processes are not linear and the process of data analysis in qualitative content analysis is typically abductive in nature, moving between both inductive and deductive inferences (Graneheim, Lindgren, & Lundman, 2017; Kleinheksel et al., 2020; Krippendorff, 2019). Using abductive reasoning, descriptions of both manifest and latent content, as they pertain to the sources of evidence, will be discussed in this section.

### 5.3.1 Development of themes

Data extraction of the selected sources of evidence, both in Covidence and the Data Extraction Spreadsheet, was based on the scoping review objectives and questions, as recommended by Peters et al (2020). The development of both of these documents was made in consultation with the PhD supervisors and was tested to ensure the consistency and trustworthiness of the data extraction process. The key terms used, which are to be discussed in this section were *Competency standards and frameworks*, *Pre-education competency assessment*, *Competency assessment tools*, *Basic computer literacy*, *Interventions*, *Barriers*, *Benefits*, *Tools and applications* and *Faculty development*. Emerging from these key terms were five themes which all underpinned nursing informatics in undergraduate Nursing Education – *Barriers to nursing informatics education, Digital and computer literacy in the student cohort*, *Interventions, tools and applications*, *Faculty development in nursing informatics,* and *Competency standards, frameworks and tools.* These themes will now be described.

#### *5.3.1.1 Barriers to nursing informatics education*

As described in Chapter 2, contemporary literature has identified a lack of nursing informatics education in undergraduate nursing programs (Borycki & Foster, 2014; Cummings et al., 2016; Moule, Ward, & Lockyer, 2010; Shin, Cummings, & Ford, 2018). Recommendations have been made for further research into the factors that influence student's acquisition of ICT skills (Levett-Jones et al., 2009) and strategies to improve nursing attitudes to nursing informatics (Booth, Strudwick, McBride, et al., 2021; Foster & Sethares, 2017; Kinnunen et al., 2017; Shin, Cummings, & Ford, 2018). Facilitators to nursing informatics education and uptake, both in tertiary education and in the clinical setting, have been linked with the perceived usefulness and perceived ease of use of technology (Aldosari et al., 2018; Staggers et al., 2018). Whilst formal informatics education is "significantly associated with informatics competency" (Kleib & Nagle, 2018b, p. 412), Australian undergraduate nursing students are not adequately prepared for the effective use of nursing informatics technologies (Bembridge, Levett-Jones, & Jeong, 2011; Dattakumar et al., 2012; Harerimana et al., 2022; Shin, Cummings, & Ford, 2018). The link between ongoing education, ongoing professional development and professional competence, in all aspects of nursing care, remain a high priority for Nurses (Price & Reichert, 2017).

*Barriers to nursing informatics education* emerged as a theme from content analysis of the selected sources of evidence. This theme was underpinned by the sub themes of:

- Understanding of nursing informatics
- Infrastructure and resources
- Student access to digital technologies
- Belief in the digital native
- Evolving nature of nursing informatics
- Faculty responses to nursing informatics
- Nursing informatics competencies and resources

These sub-themes are explored below.

##### *5.3.1.1.1 Understanding of nursing informatics*

The selected sources of evidence for the scoping review highlighted a lack of understanding of nursing and health informatics (Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Gonen et al., 2016; Lam et al., 2016; O'Connor & LaRue, 2021; Raghunathan, McKenna, & Peddle, 2022; Vottero, 2017), limited understanding of the role of nursing informatics in patient care outcomes (Gonen, Sharon, & Lev-Ari, 2016; Kleib & Olson, 2015; Peltonen, Pruinelli, et al., 2019), limited understanding of nursing informatics applications, including electronic health records and handheld devices (Booth, Sinclair, Strudwick, et al., 2017; Choi, Park, & Lee, 2016; Clever Together, 2015; Forman, Flores, & Miller, 2020; O'Connor et al., 2017; Raghunathan, McKenna, & Peddle, 2022), and a lack of consistent taxonomy and language related to nursing informatics (Asiri & Househ, 2017; O'Connor & Andrews, 2015; Risling, 2017), as barriers to the effective integration of nursing informatics into undergraduate nursing programs. Chauvette et al. (2022, p. 7) noted that “faculty perceived level of NIC [nursing informatics competency] was largely based on their ability to work with digital tools to support pedagogical activities”, whilst Kleib and Olson (2015) identified that faculty may attribute online learning skills with the nursing informatics competence.

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with a number of studies identifying a lack of understanding of nursing and health informatics (Dattakumar et al., 2012; Friedman, 2012; Larson, 2017). In particular, a lack of a consistent taxonomy has been inherent in the struggle to define nursing informatics and its relevance to nursing practice (Hussey & Kennedy, 2016; Reid, Maeder, Button, et al., 2021), an issue identified by Staggers & Thompson (2002) and acknowledged as resulting in a lack of consensus for practice, education and research strategies. Similarly, despite evidence of the benefits for patient outcomes (Bove, 2020; Hussey & Kennedy, 2016; Lozada-Perezmitre, Ali, & Peltonen, 2022), previous studies have identified concerns that nursing informatics may intrude on the traditional role of nursing (Agnew, 2022; Al-Rawajfah & Tubaishat, 2019; Booth, Strudwick, McBride, et al., 2021), limit clinical reasoning skills (Kent et al., 2015; Robichaux et al., 2019) and detract from therapeutic communication with patients and their families (Alanazi, Butler-Henderson, & Alanazi, 2020). This demonstrates the challenges in current understanding of nursing informatics and "If the purpose of nursing informatics is to improve the safety and quality of patient care, then as a profession, nurses need to be provided with a clearer understanding of nursing informatics" (Reid, Maeder, Button, et al., 2021, p. 111).

##### *5.3.1.1.2 Infrastructure and resources*

The selected sources of evidence for the scoping review highlighted the significant barriers facing faculty, tertiary institutions, nurses and undergraduate nursing students when accessing nursing informatics education and resources. As previously stated, barriers were defined as anything preventing the effective integration of nursing informatics into undergraduate nursing education and associated clinical practice. Computer crashes, power outages, and hardware and software not working (Angel, Friedman, & Friedman, 2016; Booth, Sinclair, Strudwick, et al., 2017; Clever Together, 2015; Mather & Cummings, 2016; O'Connor & Andrews, 2015; Risling, 2017), a lack of technical support and poor infrastructure (Asiri, 2016; Hamilton, Iradukunda, & Aselton, 2021; Harerimana et al., 2022; Honey, Collins, & Britnell, 2021; Raghunathan, McKenna, & Peddle, 2022), poor internet connectivity (Baxter & Andrew, 2018; Gambo et al., 2017) and the development, cost and maintenance of hardware and software (Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Cummings, Borycki, & Madsen, 2015; Forman, Flores, & Miller, 2020; Honey et al., 2016; O'Connor & Andrews, 2015; Raghunathan, McKenna, & Peddle, 2022; Wilbanks, Watts, & Epps, 2018), were all identified as significant barriers to the effective integration of nursing informatics into undergraduate nursing programs and associated clinical practice.

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with studies identifying a lack of technical support (Al-Rawajfah & Tubaishat, 2019), a lack of adequate infrastructure, including devices and computers (Irinoye et al., 2013), poor functionality and design of systems (Kaihlanen et al., 2021; Shin, Cummings, & Ford, 2018; Staggers et al., 2018), internet connectivity issues (Booth, Strudwick, McBride, et al., 2021; Irinoye et al., 2013) and the associated costs of development, purchase and maintenance of hardware and software (Al-Rawajfah & Tubaishat, 2019) as impacting the effective integration of nursing informatics into undergraduate nursing programs and clinical practice. Booth, Strudwick, McBride, et al. (2021, p.

1) highlighted the disparities “that exist among countries and regions of the world in terms of the digitalization of healthcare processes, access to internet connectivity, and transparency of health information processes” and this was evident throughout the studies included in the scoping review.

##### *5.3.1.1.3 Student access to digital technologies*

The selected sources of evidence for the scoping review also identified the challenges associated with a lack of student access to digital technologies and associated resources. Lack of access to digital technologies in the clinical setting were associated with a lack of access to devices and associated software (Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Chauvette, Kleib, & Paul, 2022; Choi, Park, & Lee, 2016; Hamilton, Iradukunda, & Aselton, 2021; Harerimana et al., 2022; Hern et al., 2015; Honey, Collins, & Britnell, 2021; Kleib & Olson, 2015), university and clinical setting policies on student use of mobile devices (Asiri & Househ, 2017; Chauvette, Kleib, & Paul, 2022; Mather & Cummings, 2016), clinical setting policies regarding student use of digital technologies, including electronic health records (Baxter & Andrew, 2018; Bonnel, Vogel Smith, & Hober, 2018; Cummings, Whetton, & Mather, 2017; Harerimana et al., 2022; Honey, Collins, & Britnell, 2021; Pobocik, 2015), and concerns regarding the legal and ethical implications of undergraduate nursing students accessing patient information (Bonnel, Vogel Smith, & Hober, 2018; Choi, Park, & Lee, 2016; Harerimana et al., 2022; Mather & Cummings, 2016).

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with studies identifying similar challenges for both undergraduate nursing students in the clinical setting and nurses. The lack of access to the required hardware, including computers and handheld devices has been a consistent theme established in previous studies (Arikan et al., 2021; Mollart et al., 2021). Restrictions on undergraduate nursing student access to electronic health records have been identified as a significant issue (Wynn, 2016), with Hansbrough et al. (2020, p. 245) noting “ultimately, restricted access to health information technologies contributes to a nursing student's failure to learn the skills necessary for competent practice on graduation and licensure”. Similarly, concerns regarding privacy and confidentiality have been raised (Arikan et al., 2021; Wallace, 2015), with a need for a more coherent strategy for maintaining electronic health record data integrity emphasised (Bani-Issa et al., 2020). These issues and others have been associated with a correlation between the use of nursing informatics technologies and nurse burnout (Khairat et al., 2020; Melnick et al., 2021; Vehko et al., 2019).

##### *5.3.1.1.4 Belief in the digital native*

The selected sources of evidence for the scoping review identified the concept of the *digital native* as being a barrier to nursing informatics education in undergraduate nursing programs (Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Lam et al., 2016). Prensky (2001b) coined the term *digital native*, to describe students who had grown up with digital technologies, including mobile phones, computers and video games and who “instinctively know how to use digital technologies” (Reid, Button, & Brommeyer, 2023, p. 574). When this belief is applied to healthcare education, there is an assumption that healthcare students “may not require explicit, formal education in ICT, entering university with the knowledge and skills to successfully integrate ICT into the healthcare contexts” (Lam et al., 2016). However, faulty assumptions linking exposure to social media and other digital technologies with competency in health informatics, has resulted in a lack of proficiency in using digital health technologies and has been “compounded by poor information seeking, retrieval, and analysis skills due to limited knowledge and understanding of the underlying concepts of data collection, storage, and retrieval” (Cummings, Whetton, & Mather, 2017, p. 330). Fosters and Sethares (2017), cautioned that whilst undergraduate nursing students may be skilled in the use of technology, this does not take into account the need for information literacy and higher level informatics principles; therefore, there is a need to build on pre-existing student knowledge of digital technologies with a focus on health informatics (Lam et al., 2016).

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with studies identifying the inherent faulty assumptions associated with the concept of the *digital native* (Eynon, 2020; King, 2022; Reid, Button, & Brommeyer, 2023). The belief, that specific generations have differing engagement with digital technologies, has been an ongoing narrative in discussions on digital literacy and tertiary education (Prensky, 2001b, 2001a, 2006; Sorrentino, 2018; Vitvitskaya et al., 2022), including in nursing education (Chicca & Shellenbarger, 2018; Reid, Button, & Brommeyer, 2023). However, the myth of the digital native and the inherent belief in the internet as “a panacea for the issues of increasing costs of higher education and increasing demand by students for authentic and interactive learning opportunities”, has overlooked the complex needs of students (Burton et al., 2015, p. 151). Furthermore, the perpetuation of these assumptions “negates the reality that exposure to digital technologies does not equate (with) digital literacy and has resulted in deficits in nursing education programs” (Reid, Button, & Brommeyer, 2023, p. 573).

##### ***5.3.1.1.5 Evolving nature of nursing informatics***

The selected sources of evidence for the scoping review identified the evolving nature of nursing informatics as being a barrier to nursing informatics education in undergraduate nursing programs (Asiri & Househ, 2017; Bonnel, Vogel Smith, & Hober, 2018; Chauvette, Kleib, & Paul, 2022; Clever Together, 2015; Cummings, Whetton, & Mather, 2017; Honey, Collins, & Britnell, 2021; O'Connor & LaRue, 2021). The rapid introduction of new healthcare technologies was identified as an obstacle in embedding these technologies into nursing education (Asiri & Househ, 2017), with faculty not always understanding definitions of these key concepts or how to apply them to the curriculum (Bonnel, Vogel Smith, & Hober, 2018). This complexity was further highlighted by Chauvette et al. (2022, p. 7), who noted that nursing informatics “is an elusive concept complicated by the evolving complexity of the digital tools that nurses are expected to use in the clinical environment". Rapid changes in digital health technologies continue to create challenges in embedding nursing informatics into undergraduate nursing programs (O'Connor & LaRue, 2021).

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with studies identifying changing definitions of nursing informatics (Reid, Maeder, Button, et al., 2021) and advances in digital health technologies (Button, Harrington, & Belan, 2014), as having implications for nursing education. Kinnunen et al. (2017) highlighted the need for nurse educators to respond to the rapidly evolving nature of nursing informatics to adequately prepare nursing students to use digital technologies, with Shin et al. (2018, p. 73) noting that "inconsistent and poor exposure to specific hospital platforms as undergraduates is a significant barrier to graduates' work readiness for NI practice". These findings correlate with other studies, which have identified the importance of building digital capacity and workplace readiness in the nursing workforce, whilst recognising the associated challenges of the rapidly-changing digital health space (Booth, Strudwick, McBride, et al., 2021; Cummings et al., 2016; Lilly, Fitzpatrick, & Madigan, 2015).

###### *5.3.1.1.6 Faculty responses to nursing informatics*

The selected sources of evidence for the scoping review identified faculty resistance and technological stress as being a barrier to nursing informatics education in undergraduate nursing programs (Asiri & Househ, 2017; Bonnel, Vogel Smith, & Hober, 2018; Booth, Sinclair, Strudwick, et al., 2017; Burke & Ellis, 2016; Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Hamilton, Iradukunda, & Aselton, 2021; Hern et al., 2015; Kleib & Olson, 2015). Changes to traditional modes and methods of teaching (Gonen et al., 2016), a lack of understanding of digital technologies and Informatics (Bonnel, Vogel Smith, & Hober, 2018; Booth, Sinclair, Strudwick, et al., 2017; Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Forman, Armor, & Miller, 2020a; Foster & Sethares, 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Hamilton, Iradukunda, & Aselton, 2021; Hern et al., 2015; Kleib & Olson, 2015), a lack of acceptance of nursing informatics (Asiri & Househ, 2017; Burke & Ellis, 2016), and a lack of digital competence (Foster & Sethares, 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016) were identified as contributors to faculty resistance and technological stress. Burke and Ellis (2016, p. 46) noted that the rapid change of technologies required in clinical settings was correlated with technostress, which was defined as "the inability of an individual to adapt to the use of new technology and to cope effectively with technology", as first described by Brod (1984). The issues of faculty resistance and technological stress were linked with a lack of best practice guidelines for undergraduate nursing informatics education and limited faculty educational opportunities (Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017).

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with studies identifying the increased demands on faculty with integrating nursing informatics into undergraduate nursing programs (Belchez, 2019; Button, Harrington, & Belan, 2014; Kinnunen et al., 2017), and Koch (2014, p. 1385) noting "a new dimension of complexity to teaching" in the move from the traditional classroom setting to the digital education setting. Kinnunen et al. (2017), noted that the development of nursing informatics competence is dependent on the knowledge, skills and abilities of the faculty who teach this information, and that nursing informatics competencies for faculty were needed to guide this development. Inherent within these competency requirements is the need to, more adequately, provide opportunities for faculty to develop a deeper understanding of nursing informatics and its role in patient care (Ghonem, Ibrahim, & Abd elrahman, 2023).

##### *5.3.1.1.7 Nursing informatics competencies and resources*

The selected sources of evidence for the scoping review identified a lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies as being a barrier to nursing informatics education in undergraduate nursing programs. A lack of contemporary informatics competencies, tailored for purpose, was identified as a barrier to learning (Chauvette, Kleib, & Paul, 2022; Cummings, Borycki, & Madsen, 2015; Mather & Cummings, 2015; McGregor et al., 2017; O'Connor & Andrews, 2015), with digital competencies identified as enabling safe, effective and efficient healthcare within the digital healthcare environment (Booth, Sinclair, Strudwick, et al., 2017; Cummings, Whetton, & Mather, 2017). Limited recommendations, guidelines and evidence-based educational strategies for the integration of Informatics content into undergraduate programs were highlighted (Asiri & Househ, 2017; Booth, Sinclair, Strudwick, et al., 2017; Brunner et al., 2018; Clever Together, 2015; Cummings et al., 2016; Egbert et al., 2019; Forman, Armor, & Miller, 2020a; Foster & Sethares, 2017; Harerimana et al., 2022; Mather & Cummings, 2015; O'Connor & Andrews, 2015; O'Connor & LaRue, 2021; Peltonen, Pruinelli, et al., 2019; Pobocik, 2015; Risling, 2017; Vottero, 2017), with Cummings et al. (2017, p. 331), noting that "standards, guidelines, and codes of conduct regarding access and use of digital technology in healthcare environments have been outpaced".

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with Cummings et al. (2016, p. 332) identifying inconsistent nursing informatics competency, in both nurses and undergraduate nursing students, and an over-reliance on "interpersonal information sources, including their colleagues, rather than using the most up-to-date evidence based resources". These deficits have been linked with a lack of nursing informatics competencies embedded into education programs, particularly in Australia, identified as an ongoing priority (Borycki & Foster, 2014; Cummings et al., 2016) and Honey et al. (2016) noting, that whilst competency standards for nursing informatics have been developed globally, these competencies have not been adequately adopted and taught within undergraduate nursing education. In Australia, the lack of national nursing informatics competency standards has resulted in inconsistent and *ad hoc* informatics competency in graduates with a need for workforce entry level competency standards for all nurses (Cummings et al., 2016). Similarly, a lack of nursing informatics competency requirements for faculty has been identified as significantly influencing the quality of nursing informatics education (Kinnunen et al., 2017; Kleib et al., 2019; Kleib et al., 2022), with Kinnunen et al. (2017) recommending that a set of competencies for nursing faculty be developed to enhance faculty confidence and capability in delivering nursing informatics education.

#### *5.3.1.2 Computer and digital literacy in the student cohort*

As described in Chapter 2, computer and digital literacy is a crucial requirement for safe and effective nursing care in today's digital healthcare environment (AACN, 2008; ADHA, 2020; Bembridge, Levett-Jones, & Jeong, 2010; Callinici, 2017; van Houwelingen et al., 2017; Vitvitskaya et al., 2022). As with other digital-related terminologies, there has been a lack of consensus on the term *digital literacy* (Alexander, Adams Becker, & Cummins, 2016; Buckingham, 2015; Ventimiglia & Pullman, 2016). Jisc (formerly Joint Information Systems Committee, 2014), a not-for-profit digital agency providing support for higher education institutions within the United Kingdom has stated, "Digital literacy looks beyond functional IT (information technology) skills to describe a richer set of digital behaviours, practices and identities" and encompasses seven elements – ICT literacy, information literacy, media literacy, learning skills, communications and collaboration, digital scholarship and career and identity management.. Other definitions of digital literacy have included three models of digital literacy, as described by Alexander et al. (2016), which are described as universal literacy, creative literacy and literacy across disciplines and "the skills and competencies needed to use digital technologies to achieve personal goals, enhance employability skills and support education and training" (DESE, 2020, p. 4).

*Digital and computer literacy in the student cohort* emerged as a theme from content analysis of the selected sources of evidence. This theme was underpinned by the sub themes of:

- Computer and digital literacy in the student cohort
- Determining computer and digital literacy
- Enhancing computer and digital literacy

These sub-themes are explored below.

#### *5.3.1.2.1 Computer and digital literacy in the student cohort*

The selected sources of evidence for the scoping review identified the need for computer and digital literacy for both students and faculty (Baxter & Andrew, 2018; Chauvette, Kleib, & Paul, 2022; Clever Together, 2015; Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Gambo et al., 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Harerimana et al., 2022; Hovenga & Grain, 2016; Kleib & Olson, 2015; Lam et al., 2016; Luo & Kalman, 2018; Mather & Cummings, 2015; McGregor et al., 2017; O'Connor et al., 2017; O'Connor & LaRue, 2021; Risling, 2017; Theron, Borycki, & Redmond, 2017; Theron, Redmond, & Borycki, 2017; Theron et al., 2019; Topol, 2019; Vottero, 2017). Harerimana et al. (2022) described digital literacy as encompassing computer literacy with the ability to utilise technologies and information literacy which is linked with the integration of evidence-based practice into clinical care; however, Chauvette et al. (2022) noted that nursing faculty struggled to define digital literacy, as it pertained to nursing informatics, and tended to equate computer skills with informatics competency.

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with the terms *computer literacy* and *digital literacy* often used interchangeably. However, digital literacy is more than the ability to operate a computer or other technologies, it moves beyond to skills, knowledge and understanding that enable "critical, creative, discerning and safe practices when engaging with digital technologies in all areas of life" (Hague & Payton, 2010, p. 3). Therefore, computer literacy is the ability to use computers and computing systems (Shin, Cummings, & Ford, 2018); whereas, digital literacy is the ability to critically identify, select and use digital devices and systems, adapting to new technologies and working in a manner that protects both themselves and others (Australian Curriculum, 2021).

It is significant to note, that whilst the requirements for computer and digital literacy emerged as a consistent theme, selected sources of evidence highlighted poor basic computer skills, poor digital literacy and belief in the *digital native* (as previously discussed), as being significant factors barriers in embedding nursing informatics into undergraduate nursing programs, thereby indicating that assessment and recognition of the importance of computer and digital literacy skills needed to be urgently addressed. The importance of evaluating or assessing computer and digital literacy was identified as a sub-theme and is described below.

#### *5.3.1.2.2 Determining computer and digital literacy*

The selected sources of evidence for the scoping review identified the need to assess the computer and digital literacy of undergraduate nursing students and faculty. Recommendations for assessing these key competencies included the use of recommendations from pre-existing nursing informatics competency frameworks (Egbert et al., 2019; Forman, Armor, & Miller, 2020a; Gonen, Sharon, & Lev-Ari, 2016); nursing informatics assessment tools (Chauvette, Kleib, & Paul, 2022; Forman, Armor, & Miller, 2020a; Honey, Collins, & Britnell, 2021; Repsha et al., 2020), basic computer proficiency assessments (Gambo et al., 2017; Gonen et al., 2016; Kleib & Olson, 2015), student engagement with digital technologies surveys (Lam et al., 2016; Theron, Redmond, & Borycki, 2017) and other assessment tools (Hern et al., 2015; Kleib & Olson, 2015). Assessment of computer and digital literacies were recommended as a baseline, on completion of the education program and one year post-clinical entry (Chauvette, Kleib, & Paul, 2022), as pre-education or baseline surveys (Gambo et al., 2017; Gonen et al., 2016; Hern et al., 2015; Honey, Collins, & Britnell, 2021; Kleib & Olson, 2015; Repsha et al., 2020) and as a process of continual self-reflection and assessment (Brunner et al., 2018; Luo & Kalman, 2018).

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with recommendations to evaluate the computer and digital literacy of students and faculty, as a means of identifying gaps in knowledge and embedding digital literacy through nursing programs (Kleib et al., 2022; Reid, Button, & Brommeyer, 2023; Sipes et al., 2017). However, “there is no coherent and systematic methodology for educating NI to students in nursing and available tools for evaluating competencies in nursing informatics need to be further validated”; as such, there is an urgent need for standardised tools to assess nursing informatics competencies (Lozada-Perezmitre, Ali, & Peltonen, 2022, p. 141). In addition, Brown, Morgan et al. (2020, p. 451) caution that whilst “students have digital literacy in everyday settings…their ability to translate this into practice is limited, restricting their access to and use of digital tools in the workplace”. This highlights the importance of enhancing the digital literacy of undergraduate nursing students, the final sub-theme underpinning *Digital and computer literacy in the student population.*

##### ***5.3.1.2.3 Enhancing computer and digital literacy***

The selected sources of evidence for the scoping review identified the need to enhance the computer and digital literacy of undergraduate nursing students and faculty. The development of basic computer skills, including the ability to perform database searches (Cummings, Borycki, & Madsen, 2015; Vottero, 2017), accessing online courses and resources (Chauvette, Kleib, & Paul, 2022), the ability to perform web searches (Cummings, Borycki, & Madsen, 2015), use of social media (Chauvette, Kleib, & Paul, 2022; Gambo et al., 2017; Hay et al., 2017; Vottero, 2017), use of learning management systems (Chauvette, Kleib, & Paul, 2022; Gonen, Sharon, & Lev-Ari, 2016), accessing YouTube and Edutube videos (Gonen, Sharon, & Lev-Ari, 2016), using Google Drive storage (Gonen, Sharon, & Lev-Ari, 2016), using word processing, spreadsheets and presentation software (Chauvette, Kleib, & Paul, 2022; Foster & Sethares, 2017; Gonen et al., 2016), developing understanding of the concepts and components of information and computer technology, such as hardware, software and electronic networks (O'Connor & LaRue, 2021), and pursuit of basic computer literacy by students prior to commencement of undergraduate studies

(Foster & Sethares, 2017) were identified. The use of an information and communication technologies competency tool, to assess the educational needs of nursing students and faculty, was identified as being a useful means of structuring programs and enhancing computer literacy (Forman, Armor, & Miller, 2020b), with Lam et al (2016, p. 322) noting that "teaching and learning strategies may need to be supplemented, or modified, in order to build students' familiarity and skill level with common technology, before they can be expected to apply ICT knowledge and skills to the professional health workplace".

Digital literacy development recommendations included participation in educational workshops and learning activities (Chauvette, Kleib, & Paul, 2022; Gambo et al., 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Lam et al., 2016; Theron, Borycki, & Redmond, 2017; Theron et al., 2019); development of digital professionalism through class activities (Cummings, Whetton, & Mather, 2017), peer-learning, including linking of educators with leaders in their field (Clever Together, 2015; Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Lam et al., 2016; Theron, Borycki, & Redmond, 2017; Theron, Redmond, & Borycki, 2017; Theron et al., 2019; Vottero, 2017), faculty guidance of students in sourcing credible sources of information (Clever Together, 2015; Mather & Cummings, 2015; Theron, Borycki, & Redmond, 2017) and applying digital technologies to models of care (McGregor et al., 2017). The important link between digital literacy and embedding nursing informatics in undergraduate nursing programs was identified by Harerimana et al. (2022, p. 527) who stated "embedding nursing informatics into the undergraduate nursing curriculum enhances nursing students' digital health literacy, whilst preparing them to use health information systems and technological innovations to support their learning both at university and in the clinical environment".

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with recommendations to develop the computer and digital literacy of undergraduate students identified in a number of studies (Brown, Pope, et al., 2020; Hallam, Thomas, & Beach, 2018), with Brown, Morgan, et al. (2020) noting that basic computer skill proficiency did not necessarily correlate with digital literacy and the transferability of skills to the workplace. Recommendations included embedding the development of digital literacy into education programs (Athreya & Mouza, 2017; Brown, Morgan, et al., 2020; Brown, Pope, et al., 2020), the use of peer-to-peer collaboration (Brown, Morgan, et al., 2020; Jeffrey et al., 2011), modelling of digital literacy behaviours by faculty (Ng, 2012b), the use of digital literacy mentors within the student population (Brown, Morgan, et al., 2020), the development of guidelines and frameworks for embedding digital literacy into education programs (Burton et al., 2015; Hallam, Thomas, & Beach, 2018), the development of core digital literacy competencies for nursing faculty, and the development of digital literacy competencies for entry to practice Registered Nurses (Reid, Button, & Brommeyer, 2023). It is important to note that the links between computer and digital literacy and nursing practice were identified by Staggers et al. (2002, p. 386), more than twenty years ago, with beginning nurses (Level 1) having "fundamental information management and computer technology skills and…(using) existing information systems and available information to manage their practice".

#### *5.3.1.3 Interventions, tools and applications*

The selected sources of evidence for the scoping review identified interventions, tools and applications used to embed nursing informatics into undergraduate nursing programs. Interventions, tools and applications included barcode medication administration (clinical and academic) (Angel, Friedman, & Friedman, 2016; Booth, Sinclair, Brennan, & Strudwick, 2017; Booth, Sinclair, Strudwick, et al., 2017), electronic health records (clinical and academic) (Baxter & Andrew, 2018; Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Choi, Park, & Lee, 2016; Clever Together, 2015; Forman, Armor, & Miller, 2020b; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017; Gonen, Sharon, & Lev-Ari, 2016; Hern et al., 2015; Pobocik, 2015; Raghunathan, McKenna, & Peddle, 2021, 2022; Repsha et al., 2020; Risling, 2017; Sorensen & Campbell, 2016; Theron, Borycki, & Redmond, 2017; Wilbanks, Watts, & Epps, 2018), computer patient order entry (Gonen, Sharon, & Lev-Ari, 2016), and standardised electronic assessment forms (Bonnel, Vogel Smith, & Hober, 2018). Telehealth applications (Hamilton, Iradukunda, & Aselton, 2021; Royal College of Nursing (RCN), 2018), technology-enabled clinical simulation tools (Gambo et al., 2017; Harerimana et al., 2022; Hern et al., 2015), health informatics lectures (Hovenga & Grain, 2016), digital learning platforms (Mather & Cummings, 2015; McGregor et al., 2017; O'Connor et al., 2017), health informatics laboratories (Sapci & Sapci, 2017), and handheld and wearable health technologies, including smart watches and wearable sensors (Clever Together, 2015; O'Connor & Andrews, 2015; Risling, 2017; Royal College of Nursing (RCN), 2018) were also identified.

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with recommendations closely aligned with the digital health applications described in Chapter 2, including electronic health records (Ellis et al., 2020; Jenkins et al., 2018; Mollart et al., 2021), barcode medication administration (Creel, Carruth, & Taylor, 2020; Ledlow et al., 2022), telehealth (Eckhoff, Guido-Sanz, & Anderson, 2022; Rutledge et al., 2021), Smart Mobile Applications (apps) (Callinici, 2017; O'Connor & Andrews, 2018), technology-enabled clinical simulation tools (Padilha et al., 2019; Plotzky et al., 2021) and decision support tools (McDonald, Boulton, & Davis, 2018). Recommendations were made to provide this learning throughout the undergraduate nursing program to ensure education is provided in a "supportive scaffolded educational environment, rather than on clinical placement when nursing staff have limited time to provide teaching and students feel they are a burden" (Mollart et al., 2021, p. 49).

#### *5.3.1.4 Faculty development in nursing informatics*

The selected sources of evidence for the scoping review identified faculty development related to nursing informatics. Recommendations for faculty development included seminars and workshops (Baxter & Andrew, 2018; Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Forman, Armor, & Miller, 2020b; Forman, Flores, & Miller, 2020; Gambo et al., 2017; Gonen, Sharon, & Lev-Ari, 2016; Hern et al., 2015; O'Connor & LaRue, 2021; Wilbanks, Watts, & Epps, 2018), faculty engagement in the development or selection of academic electronic health records and liaising with vendors (Baxter & Andrew, 2018; Booth, Sinclair, Brennan, & Strudwick, 2017; Booth, Sinclair, Strudwick, et al., 2017), emphasis on super-users, described as early adopters of technology, to support faculty engagement (Baxter & Andrew, 2018), peer-to-peer networks and mentorship (Cummings, Borycki, & Madsen, 2015; Gambo et al., 2017; Honey, Collins, & Britnell, 2021), partnerships with clinical facilities (Burke & Ellis, 2016; Clever Together, 2015; Honey, Collins, & Britnell, 2021), access to and development of educational resources (Burke & Ellis, 2016; Chauvette, Kleib, & Paul, 2022; Forman, Armor, & Miller, 2020b; Honey, Collins, & Britnell, 2021; Theron, Borycki, & Redmond, 2017; Theron, Redmond, & Borycki, 2017) and collaboration between universities, other interdisciplinary disciplines and other organisations (Clever Together, 2015; Cummings, Whetton, & Mather, 2017; Hern et al., 2015; O'Connor & LaRue, 2021). Recommendations for faculty self-assessment of nursing informatics competency was also recommended, so that continual professional development can address gaps in knowledge and capacity (Chauvette, Kleib, & Paul, 2022; Gambo et al., 2017), with recommendations for entry level competency standards for faculty (Cummings, Borycki, & Madsen, 2015; Forman, Armor, & Miller, 2020b; O'Connor & LaRue, 2021) and international guidelines and competencies for Nurse Informatics education (Peltonen, Pruinelli, et al., 2019). Importantly, despite the changing teaching environment due to digital technologies, Bonnel et al. (2018, p. 195) reminded faculty that "although the tools we use will change, broad teaching learning principles assist students in gaining comfort with basic concepts and changing technologies".

These findings are reflected in literature, outside of the inclusion criteria of the scoping review, with recognition, that "although highly competent in their own subject areas", many nurse educators "lack the knowledge and skills to include informatics within their curriculum sessions" (Procter, 2021, p. 166). To support faculty in delivering nursing informatics education, there have been recommendations for continuing professional development for faculty (Belchez, 2019; Bove & Sauer, 2023; Kinnunen et al., 2017), promotion of super-users or informatics champions to support faculty engagement (Bove, 2020; Larson, 2017; Nagle, Kleib, & Furlong, 2020), access to a nursing informatics specialist to serve as a resource for faculty (Bove & Sauer, 2023), access to and development of educational resources (Larson, 2017; Nagle, Kleib, & Furlong, 2020; Tischendorf et al., 2024), interprofessional collaboration across universities and clinical settings

(Larson, 2017) and the development of nursing informatics competency standards for faculty or use of existing nursing informatics competencies (Bove, 2020; Kinnunen et al., 2017; Nagle, Kleib, & Furlong, 2020). Underlying these responses to a changing educational environment, is the recognition, of the changing role of educators, with "less emphasis on the notion of the educator as the sage on the stage and more interest in the idea of him/her as the guide on the side" (Devlin & McKay, 2016, p. 101).

#### *5.3.1.5 Competency standards, frameworks and tools*

The selected sources of evidence for the scoping review applied nursing informatics competency standards, frameworks and tools. Nursing competency standards and frameworks applied in the selected studies, included the *American Association of Colleges of Nursing* (AACN) - *The Essentials of Baccalaureate Education for Professional Nursing Practice* (2008) (Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Clancy, 2015; Hern et al., 2015; Kleib & Olson, 2015; Sorensen & Campbell, 2016; Vottero, 2017), the *American Nursing Association (ANA) - Nursing Informatics: Scope and Standards of Practice* (2008) and *Nursing Informatics: Scope and Standards of Practice* (2015) (O'Connor & LaRue, 2021; Oh et al., 2019; Sorensen & Campbell, 2016; Vottero, 2017), the *Canadian Association of Schools of Nursing (CASN)* - *Nursing informatics entry-to-practice competencies for Registered Nurses* (2012b) (Chauvette, Kleib, & Paul, 2022; Cummings, Borycki, & Madsen, 2015; Hovenga & Grain, 2016; O'Connor & LaRue, 2021; Risling, 2017; Theron, Borycki, & Redmond, 2017; Theron, Redmond, & Borycki, 2017; Theron et al., 2019) and the *Canadian Association of Schools of Nursing (CASN)- Nursing informatics teaching toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula (Canadian Association of Schools of Nursing (CASN), 2013)* (Chauvette, Kleib, & Paul, 2022; Cummings, Borycki, & Madsen, 2015; Forman, Armor, & Miller, 2020b; Harerimana et al., 2022; Kleib & Olson, 2015). Other nursing informatics standards and frameworks applied in the selected studies, included the *National League of Nursing (NLN) - Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda* (2008) (Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Chauvette, Kleib, & Paul, 2022; Choi, Park, & Lee, 2016; Gambo et al., 2017; Gonen, Sharon, & Lev-Ari, 2016) and *Quality and Safety Education for Nurses Institute (QSEN Institute) – QSEN Competencies* and *Project Overview* (Quality and Safety Education for Nurses Institute (QSEN Institute), 2016; QSEN, 2022a, 2022b, 2023) (Bonnel, Vogel Smith, & Hober, 2018; Clancy, 2015; Clever Together, 2015; Forman, Armor, & Miller, 2020b; Foster & Sethares, 2017; Gambo et al., 2017; Gonen, Sharon, & Lev-Ari, 2016; Hern et al., 2015; Kleib & Olson, 2015; Luo & Kalman, 2018; Oh et al., 2019; Vottero, 2017).

Health informatics standards and frameworks applied in the selected studies, included American Medical Informatics Association (AMIA) - Board White Paper: definition of biomedical informatics and specification of core competencies for graduate education in the discipline (Kulikowski et al., 2012) (Egbert et al., 2019; Harerimana et al., 2022; Hovenga & Grain, 2016), Canada's Health Informatics Association - Informatics Professional Core Competencies v3.0 (2012) (Egbert et al., 2019), the Global Health Workforce Council - Global academic curricula competencies for health information professionals: draft for public comment (2015) (Egbert et al., 2019; Hovenga & Grain, 2016), the Health Information and Management Systems Society - The electronic health record (n.d.) (Bonnel, Vogel Smith, & Hober, 2018), the Health Information Technologies COMPetencies - Empowering a digitally skilled workforce (2017) (O'Connor et al., 2017) and the International Medical Informatics Association - Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics First Revision (Mantas et al., 2010) (Egbert et al., 2019; Hovenga & Grain, 2016; O'Connor & LaRue, 2021; Sapci & Sapci, 2017). Other health informatics standards and frameworks applied in the selected studies, included the National Institute for Health and Care Excellence (NICE) - Evidence standards framework for digital health technologies (2019) (Topol, 2019), the Institute of Medicine (IOM) - Core Competencies (Greiner & Knebel, 2003) (Foster & Sethares, 2017), the Technology Informatics Guiding Education Reform (TIGER) - The TIGER initiative: Evidence and informatics transforming nursing: 3-Year action steps toward a 10-year vision (2007), The TIGER initiative: Collaborating to integrate evidence and informatics into nursing practice and education: An executive summary (2008), TIGER Informatics Competencies Collaborative final report (2009), Informatics Competencies for Every Practicing Nurse: Recommendations from the TIGER Collaborative (2010), Technology Informatics Guiding Education Reform (TIGER) Initiative (2024) and An International Recommendation Framework of Core Competencies in Health Informatics for Nurses (Hübner et al., 2018) (Bonnel, Vogel Smith, & Hober, 2018; Choi, Park, & Lee, 2016; Clancy, 2015; Egbert et al., 2019; Forman, Armor, & Miller, 2020b; Foster & Sethares, 2017; Gonen, Sharon, & Lev-Ari, 2016; Harerimana et al., 2022; Hern et al., 2015; Hovenga & Grain, 2016; Kleib & Olson, 2015; O'Connor et al., 2017; O'Connor & LaRue, 2021; Risling, 2017; Sapci & Sapci, 2017; Vottero, 2017) and United Kingdom Council for Health Informatics Professionals (UKCHIP) - The UKCHIP Code of Conduct (2017) (O'Connor & LaRue, 2021). Other standards and frameworks, including nursing or health informatics elements applied in the selected studies, included the International Nursing Association for Clinical Simulation and Learning (INACSL) - Standards of Best Practice: Simulation (2016) (Gambo et al., 2017), and the Nursing and Midwifery Council (NMC) - Standards for nurses (2018) (Topol, 2019).

Australian nursing and health informatics standards and frameworks applied in the selected studies, included the *Australian Health Informatics Education Council - Health Informatics Scope, Careers and Competencies Version 1.9* (2011) (Egbert et al., 2019), the *Australian Nursing and Midwifery Accreditation Council* (formerly Australian Nursing and Midwifery Council) - *Australian* *nursing and midwifery competency standards for nurses and midwives* (2006) and *Registered Nurse Accreditation Standards (2012)* (Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Mather & Cummings, 2015; Mather, Cummings, & Nichols, 2016), the *Australian Nursing and Midwifery Federation - Nursing informatics standards for nurses and midwives* (2015) (Harerimana et al., 2022; O'Connor & LaRue, 2021) and the *Nursing and Midwifery Board of Australia and Southern Cross University - 2nd Draft revised Registered nurse standards for practice* (2015) (Mather & Cummings, 2016).

Whilst these standards and frameworks informed the studies and integration of nursing informatics into undergraduate nursing programs, other nursing informatics competency assessment tools were also applied or recommended in the selected studies, including the *Canadian Nurse Informatics Competency Assessment Scale (C-NICAS)* (Kleib & Nagle, 2018a) which was identified in one of the selected studies (Chauvette, Kleib, & Paul, 2022), TIGER-based *Assessment of Nursing Informatics Competencies tool (TANIC)* (Hill et al., 2014; Hunter et al., 2015) which was identified in one of the selected studies (Forman, Armor, & Miller, 2020b), the Self-Assessment of Nursing Informatics Competencies Scale (SANIC) (Staggers, Gassert, & Curran, 2001) which was identified in two of the selected studies (Forman, Armor, & Miller, 2020b; Repsha et al., 2020) and the *Canadian Association of Schools of Nursing (CASN) Nursing Informatics Teaching Toolkit: Supporting the integration of the CASN Nursing Informatics Competencies into nursing curricula* (2013) which was applied in one of the selected studies (Forman, Armor, & Miller, 2020b).

## 5.4 Questions for Delphi study – Phase 2

As identified in Chapter 4, the scoping review protocol identified the purpose of the scoping review "as the basis for a Delphi study, in which nursing informatics and its integration into undergraduate nursing curricula will be explored and described in collaboration with domain experts" (Reid, Button, et al., 2022, p. 1). Emerging from the frequency count findings and qualitative content analysis, were the five key themes of *1) Barriers to Nursing Informatics education, 2) Digital and computer literacy in the student cohort, 3) Interventions, tools and applications, 4) Faculty development in Nursing Informatics,* and *5) Competency standards, frameworks and tools.* The sub-themes for Barriers to nursing informatics were - *Understanding of nursing informatics, Infrastructure and resources, Student access to digital technologies, Belief in the digital native, Evolving nature of nursing informatics, Faculty responses to nursing informatics*, and *Nursing informatics competencies and resources. The sub-themes for Computer and digital literacy in the student cohort were Computer and digital literacy in the student cohort, Determining computer and digital literacy,* and *Enhancing computer and digital literacy.* These themes and sub-themes informed the development of the questions for the Delphi Study and are described and justified below.

### 5.4.1 Questions related to barriers to nursing informatics education

Barriers to nursing informatics education in undergraduate nursing programs emerged as a theme from content analysis of the selected sources of evidence and this theme was underpinned by seven sub-themes.

#### *5.4.1.1 Questions related to understanding of nursing informatics*

As identified in the scoping review, a lack of understanding of nursing and health informatics, limited understanding of the role of nursing informatics in patient care outcomes, limited understanding of nursing informatics applications and a lack of consistent taxonomy and language related to nursing informatics were consistently identified as barriers to the effective integration of nursing informatics into undergraduate nursing programs. The following two questions were developed:

- In your own words, how would you define Nursing Informatics?
- How is Nursing informatics relevant to nursing?

#### *5.4.1.2 Question related to infrastructure and resources*

Findings from the scoping review identified limited infrastructure and resources, resulting in computer crashes, power outages, and hardware and software not working, a lack of technical support and poor infrastructure, poor internet connectivity and the development, cost and maintenance of hardware and software, as significant barriers to the effective integration of nursing informatics into undergraduate nursing programs and associated clinical practice. The following question was developed:

- What infrastructure and resource barriers have you encountered in the use of Nursing Informatics in undergraduate nursing education?

#### *5.4.1.3 Question related to student access to digital technologies*

The scoping review findings identified a lack of student access to digital technologies and associated resources, both in the university setting and on clinical placement, as barriers to the effective integration of nursing informatics into undergraduate nursing programs. This lack of access was associated with a lack of access to devices and associated software, university and clinical setting policies on student use of mobile devices, clinical setting policies regarding student use of digital technologies and concerns regarding the legal and ethical implications of undergraduate nursing students accessing patient information. The following question was developed:

- What barriers have you encountered in students accessing digital technologies, both in the university and clinical placement settings?

#### *5.4.1.4 Questions related to belief in the digital native*

The selected sources of evidence for the scoping review identified belief in the concept of the *digital native* as being a barrier to nursing informatics education in undergraduate nursing programs and resulted in a lack of proficiency in using digital health technologies, poor information seeking, retrieval, and analysis skills, and limited information literacy and understanding of higher level informatics principles. The following questions were developed:

- In your own words, what is your understanding of the term Digital Native?

- How does the concept of the Digital Native inform nursing education?

#### *5.4.1.5 Questions related to the evolving nature of nursing informatics*

As identified in the scoping review, the rapid introduction of new digital healthcare technologies was an obstacle in embedding these technologies into nursing education. This issue was further complicated by faculty not always understanding definitions of these key concepts or how to apply them to the curriculum. The following questions were developed:

- In your workplace, do you have access to new digital healthcare technologies?

- Are you confident in the use of these technologies?

#### *5.4.1.6 Questions related to faculty responses to nursing informatics*

Findings from the scoping review identified faculty resistance and technological stress as significant barriers to nursing informatics education in undergraduate nursing programs and were associated with changes to traditional modes and methods of teaching, a lack of understanding of digital technologies and Informatics, a lack of acceptance of nursing informatics and a lack of digital competence. The issues of faculty resistance and technological stress were linked with a lack of best practice guidelines for undergraduate nursing informatics and limited faculty educational opportunities. The following questions were developed:

- How has your role changed as a result of digital healthcare technologies and Nursing Informatics?

- Do you have any concerns regarding your own digital literacy?

#### *5.4.1.7 Questions related to competencies and resources*

The scoping review findings identified a lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies as being a barrier to nursing informatics education in undergraduate nursing programs. A lack of contemporary informatics competencies, tailored for purpose, was identified as a barrier to learning, with digital competencies identified as enabling safe, effective and efficient healthcare within the digital healthcare environment. Limited recommendations, guidelines and evidence-based educational strategies for the integration of Informatics content into undergraduate programs were also highlighted. The following questions were developed:

- Do you use Nursing Informatics competency standards in your role? Please list them.
- What best practice guidelines or evidence-based strategies inform your practice regarding the use of Nursing Informatics?

### 5.4.2 Questions related to digital and computer literacy in the student cohort

Digital and computer literacy in the undergraduate nursing population emerged as a theme from content analysis of the selected sources of evidence and this theme was underpinned by three sub-themes.

#### *5.4.2.1 Questions related to computer and digital literacy*

The selected sources of evidence for the scoping review identified a need for digital literacy, for both students and faculty, which encompasses computer literacy, with the ability to utilise technologies, and information literacy, which is linked with the integration of evidence-based practice into clinical care. However, there has been a tendency for faculty to equate computer skills with Informatics competency. The following questions were developed:

- In your own words, how would you define computer literacy?
- In your own words, how would you define digital literacy?
- Is there a difference between computer literacy and digital literacy?

#### *5.4.2.2 Questions related to determining computer and digital literacy*

As identified in the scoping review, there is a need to both assess and enhance the computer and digital literacy of undergraduate nursing students and faculty. Recommendations for assessing these key competencies included the use of recommendations from pre-existing nursing informatics competency frameworks, nursing informatics assessment tools, basic computer proficiency assessments, student engagement with digital technologies surveys and other assessment tools. Assessment of computer and digital literacies were recommended as a baseline, on completion of the education program and one-year post-clinical entry, as pre-education or baseline surveys, and as a process of continual self-reflection and assessment. The following questions were developed:

- Have you assessed your own computer and digital literacy? If so, what tools have you used?

- In your opinion, should undergraduate nursing students have their computer and digital literacy assessed? If so, when? How frequently? How could the results be used across the program of education?

#### *5.4.2.3 Questions related to enhancing computer and digital literacy*

Findings from the scoping review identified the need for nursing students and faculty to possess basic computer skills. Skills including the ability to perform database searches, access online courses and resources, perform web searches, use social media, use learning management systems, access YouTube and Edutube videos, use Google Drive storage, use word processing, spreadsheets and presentation software and understand the concepts and components of information and computer technology, such as hardware, software and electronic networks, should be developed prior to commencement of undergraduate studies. In addition, the use of an information and communication technologies competency tool, to assess the educational needs of nursing students and faculty, was recommended. The following questions were developed:

- Do you feel confident in your computer and digital literacy?

- How might these competencies be strengthened, for both faculty and undergraduate nursing students?

### 5.4.3 Questions related to interventions, tools and applications

The scoping review findings identified nursing informatics interventions, tools and applications used in undergraduate nursing education, including barcode medication administration, electronic health records, computer patient records, standardised electronic assessment forms, telehealth applications and technology-enabled clinical simulation tools. Health informatics lectures, digital learning platforms, health informatics laboratories, and handheld and wearable health technologies were also identified. The following questions were developed:

- What digital healthcare technologies have you used in undergraduate nursing education?

- What additional tools do you believe would enhance undergraduate nursing education?

### 5.4.4 Questions related to faculty development in nursing informatics

The selected sources of evidence for the scoping review identified recommendations for faculty development, relating to nursing informatics, including seminars and workshops, faculty engagement in the development or selection of academic electronic health records and liaising with vendors, emphasis on super-users, described as early adopters of technology, to support faculty engagement, peer-to-peer networks and mentorship partnerships with clinical facilities, access to and development of educational resources and collaboration between universities, other interdisciplinary disciplines and other organisations. In addition, faculty self-assessment of nursing informatics competency was also recommended, so that continual professional development can address gaps in knowledge and capacity. The following questions were developed:

- Have you undertaken professional development relating to Nursing Informatics? If so, please describe the nature of this education.

- What professional development would enhance your understanding of Nursing Informatics?

### 5.4.5 Questions related to competency standards, frameworks and tools

As identified in the scoping review, a wide range of nursing informatics competency standards, frameworks and tools were identified, including those published by the Technology Informatics Guiding Education Reform (TIGER) Initiative, Quality and Safety Education for Nurses Institute (QSEN Institute), American Association of Colleges of Nursing (AACN), American Nursing Association (ANA), Canadian Association of Schools of Nursing (CASN), Australian Nursing and Midwifery Accreditation Council (ANMAC), Australian Nursing and Midwifery Federation (ANMF) and the Nursing and Midwifery Board of Australia and Southern Cross University. Health informatics standards and frameworks were also identified, including those published by the American Medical Informatics Association (AMIA), Canada's Health Informatics Association, the International Medical Informatics Association (IMIA) and National Institute for Health and Care Excellence (NICE). The following questions were developed:

- What Nursing Informatics competency standards, frameworks or assessments inform your practice?

- Of what value would Nursing Informatics competency standards, frameworks or assessments have in the program of nursing education you are involved with currently?

## 5.5 Conclusion

The sources of evidence selected in the scoping review were analysed using frequency counts and qualitative content analysis. These findings summarised the study settings, aims and purposes of the studies, study designs, sampling procedures, data collection and analysis, theories, models and frameworks applied in the sources of evidence, nursing informatics competency standards/ frameworks, pre-education competency assessment, competency assessment tools, basic computer literacy, interventions, barriers and benefits of nursing informatics in undergraduate education, tools and applications and faculty development. Key information relevant to the scoping review questions explored the themes of barriers to nursing informatic education, computer and digital literacy in the student cohort, interventions, tools and applications, faculty development in nursing informatics, and competency standards, frameworks and tools; these themes were discussed and explored in conjunction with contemporary literature. Following development of the questions emerging from the scoping review, the Delphi study was commenced. The Delphi technique, for the purpose of this study, was used to generate and establish consensus and to inform recommendations to integrate nursing informatics into undergraduate nursing curricula. “Consensus building is one of the primary roles of the Delphi technique in modern day healthcare research” (Chalmers & Armour, 2019, p. 718). The discussion of the Delphi technique method is detailed in *Chapter 6: Research Methods – Phase 2 – Delphi Study***.**

# Chapter 6 Research Methods - Phase 2 – Delphi Study

## 6.1 Introduction

A Delphi study was conducted to explore and describe nursing informatics in collaboration with domain experts, using *Conducting and REporting DElphi Studies (CREDES)* as first described by Jünger et al. (2017). Additional sources of evidence were used to further inform the Delphi study method, including *The Delphi Method for Graduate Research* (Skulmoski, Hartman, & Krahn, 2007), *Enhancing rigour in the Delphi technique research* (Hasson & Keeney, 2011), *The Delphi technique in nursing and health research* (Keeney, Hasson, & McKenna, 2011), *The Delphi technique in doctoral research: Considerations and rationale* (Davidson, 2013), *The Delphi Technique* (Chalmers & Armour, 2019), *Delphi Technique in Health Sciences: A Map* (Niederberger & Spranger, 2020), *Reporting guidelines for Delphi techniques in health sciences: A methodological review* (Spranger et al., 2022) and *'More of an art than a science'? The development, design and mechanics of the Delphi Technique* (Drumm, Bradley, & Moriarty, 2022). As identified by Jünger et al. (2017, p. 684), "since credibility of the resulting recommendations depends on the rigorous use of the Delphi technique, there is a need for consistency and quality both in the conduct and reporting of studies. This chapter provides a transparent and explicit discussion of the Delphi study data collection and data analysis procedures, with the results from the study described in detail in *Chapter 7: Phase 2 - Delphi study findings.*

## 6.2 Development of a Delphi study protocol

The development of an *a priori* protocol is recommended to inform the Delphi study (Chalmers & Armour, 2019) and "lay the foundation for unambiguous reporting on the methodological features of a particular Delphi study, including possible modifications" (Jünger et al., 2017, p. 703). As previously stated, the CREDES Guideline (Jünger et al., 2017) has sixteen recommendations for critical appraisal of the methodology and standards for transparent reporting of Delphi studies. These recommendations also provided a means of establishing an *a priori* protocol for the study (refer to *Appendix B2*).

## 6.3 Reporting guidelines

As described in *Chapter 3: Study Methodology*, a criticism of the Delphi technique has been the limited methodological guidance, which has been further exacerbated by a lack of reporting guidelines. Reporting guidelines are developed to explicitly detail the requirements of a methodology, thereby enhancing the methodological rigor and the trustworthiness of research findings (Kim, 2023). *Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: recommendations based on a methodological systematic review* has been published on the Equator Network (2022). The Equator Network (n.d.) “is an international initiative that seeks to improve the reliability and value of published health research literature by promoting transparent and accurate reporting and wider use of robust reporting guidelines”. *Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: recommendations based on a methodological systematic review* (Jünger et al., 2017) was developed in response to the lack of clear recommendations and a reporting standard for Delphi studies when applied to best practice guidelines in palliative care. Since its publication, the CREDES guideline, has been applied to other Delphi studies, outside of the palliative care discipline, including emergency management responses (Nutbeam et al., 2022), health literacy assessment (Chen et al., 2023), dementia care best practice (Gibson et al., 2023), child abuse and neglect measurement (Haworth, Montgomery, & Schaub, 2023), dignity in care questionnaire development (Heuzenroeder et al., 2022) and high-level endurance factors (Konopka et al., 2022). Other studies using the guideline have focused on curriculum development (Rajhans et al., 2020), nursing protocols (Rasmussen et al., 2023), undergraduate nursing evaluations (Dai et al., 2019), post-graduate nursing competency assessment (Xu, Dong, et al., 2022) and health informatics (Denecke et al., 2023).

### 6.3.1 Reporting guidelines and methodological rigour

The CREDES guideline has sixteen recommendations “concerning the rationale for the choice of the Delphi technique, its conduct and the reporting of Delphi studies” (Jünger et al., 2017, p. 701). The process of transparency allows the reader to understand the methodological decisions, the steps undertaken, the process of consensus building and the results and findings of the study (Jünger et al., 2017). The CREDES Guideline aligns with Hasson and Keeney’s (2011) call to strengthen the methodological rigour of Delphi studies. Hasson and Keeney (2011), in *Enhancing rigour in the Delphi technique research*, addressed trustworthiness and the Delphi technique, noting Lincoln and Guba’s (1985) parallel methodological criteria to establish trustworthiness - credibility, dependability, confirmability and transferability.

*Credibility* refers to the confidence in the findings and can be strengthened through prolonged engagements, persistent observation, triangulation, referential adequacy, peer debriefing and negative case analysis (Lincoln & Guba, 1985, 2016). Credibility of Delphi findings “refers to the extent to which they match the realities of the participants” (Engels & Powell Kennedy, 2007, p. 435) and can be established through ongoing iteration and feedback to the selected experts (Hasson & Keeney, 2011).

*Dependability* refers to the consistency and replicability of findings and can be strengthened through an audit which reviews the method of inquiry, data, findings, interpretations, and recommendations (Lincoln & Guba, 1985, 2016). The dependability of a Delphi study “refers to the degree to which data can be believed" (Cornick, 2006, p. 64) and can be enhanced through the use of a wide range of participants recognised as experts in their field (Hasson & Keeney, 2011).

*Confirmability* refers to how the findings and interpretations demonstrate the responses of the respondents and not the potential biases of the researcher and can be strengthened through an audit trail, triangulation and reflexive journalling by the researcher (Lincoln & Guba, 1985, 2016). The confirmability of a Delphi study can be established through a transparent and detailed description of the data collection and analysis processes (Hasson & Keeney, 2011).

*Transferability* refers to the ability to transfer findings to other contexts, can only be determined by the potential user and can be strengthened by thick descriptions of the context, the participants, the context of the study and the methods used (Lincoln & Guba, 1985, 2016). The transferability of a Delphi study can be enhanced through verifying the applicability of the findings (Hasson & Keeney, 2011).

## 6.4 Application of reporting guidelines to the study

The CREDES Guideline was selected to inform the reporting of the study, with the understanding that "guidelines and checklists significantly enhance the quality, transparency and consistency of manuscripts" (McEvoy, Tume, & Trapani, 2022, p. 291) and that guidelines provide a structured means.

### 6.4.1 Rationale for the choice of the Delphi technique

The rationale for the choice of the Delphi technique includes justification of the choice of the Delphi technique and recognition of the tacit knowledge and value of expert judgment (Jünger et al., 2017).

#### *6.4.1.1 Justification*

Jünger et al. (2017) stated the decision to implement the Delphi technique needs to be well justified. The Delphi technique is a flexible approach to gathering the collective insights of experts on a specific topic of interest (Barrett & Heale, 2020; Beiderbeck et al., 2021; Chalmers & Armour, 2019; Keeney, Hasson, & McKenna, 2011), particularly where limited information is available (Rasmussen et al., 2023). As noted, in *Chapter 3: Study methodology*, the Delphi technique is a consensus development method; consensus development methods combine existing evidence with expert opinion to explore a phenomenon of interest (Arakawa & Bader, 2022). The Delphi technique overcomes the limitations of other consensus development methods, including lower rates of consensus, time limits and expense (Arakawa & Bader, 2022; Keeney, Hasson, & McKenna, 2011). In the study, expert opinion was sought by using the Delphi Technique, regarding the embedding of NI into undergraduate nursing curricula. This phase of the study will be strengthened through the merging of the two sets of data, resulting in a third set of data, from which the findings will be drawn (refer to *6.11 Triangulation* for discussion, including critiques, of the concept of triangulation).

### 6.4.2 Planning and design

In providing recommendations for the sound and rigorous conduct of Delphi studies, Jünger et al. (2017, p. 701) noted the potential for the Delphi technique to be flexible and "create an environment that will allow experts to arrive at justifiable, valid and credible solutions based on the best available evidence and their experiential expertise." This potential is underpinned by the requirement to justify the method of the study (due to its flexible nature) and to establish a clear definition of consensus (Jünger et al., 2017).

#### *6.4.2.1 Planning and process*

Due to the flexible nature of the Delphi technique, Jünger et al. (2017) stated that all modifications to the technique must be clearly described and justified. Keeney et al. (2011), in *The Delphi Technique in Nursing and Health Research*, described a number of Delphi methods, including Classical Delphi, Modified Delphi, Decision Delphi, e-Delphi and Argument Delphi and noted a lack of formal, universal guidelines. Häder (2014, as cited in Niederberger & Spranger, 2020) described four types of Delphi – aggregation of ideas, most precise prediction of an uncertain issue, collecting expert opinions on a diffuse issue and consensus. Niederberger & Spranger (2020, p. 3), noted in *Delphi Technique in Health Sciences: A Map*, that "development of new variants has also been accompanied by epistemological and methodological changes to the traditional understanding of the Delphi method", but that authors often failed to make these changes explicit in reporting. In this study, the Classical Delphi technique was applied, as described by Skulmoski et al. (2007), in *The Delphi Method for Graduate Research*, and was characterised by anonymity of the participants, iteration, controlled feedback and statistical aggregation of the group response; this method adheres to the original Delphi as described by Rowe and Wright (1999).

#### *6.4.2.2 Definition of consensus*

The definition of consensus should be an *a priori* criterion, unless this impedes the exploratory nature of the study (Jünger et al., 2017). "Consensus can mean a group opinion, solidarity towards a sentiment, or sometimes absolute alignment of the opinion of experts" (Nasa, Jain, & Juneja, 2021, p. 120), but caution must be taken when establishing consensus to ensure it is authentic, realistic and clearly defined (Barrett & Heale, 2020; Donohoe, Stellefson, & Tennant, 2012; Drumm, Bradley, & Moriarty, 2022; Fink-Hafner et al., 2019; Hasson & Keeney, 2011; Humphrey-Murto & de Wit, 2019; Niederberger & Spranger, 2020). Keeney et al. (2011), in *The Delphi Technique in Nursing and Health Research*, noted that the issue of consensus in Delphi studies continues to be debated and definitions of consensus are often stated post hoc or omitted entirely.

The most common approach to defining consensus is through statistical analyses, with consensus typically based on the percentage of agreement (Barrios et al., 2021; Holey et al., 2007; Jünger et al., 2017; Keeney, Hasson, & McKenna, 2011). Keeney et al. (2006, p. 211), in *Consulting the oracle: Ten lessons from using the Delphi technique in nursing research*, noted that there were no recognised recommendations for the level of consensus, warning that “the extent to which participants agree with each other (consensus) does not mean that the ‘correct’ answer has been found”, but suggested a 75% consensus would be the minimal requirement. Cited recommendations for a percentage of consensus threshold have included 70% (Hsu & Sandford, 2007a), 75% (Barrios et al., 2021; Chan, 2022), 51-80% (Hasson, Keeney, & McKenna, 2000) and 51-100% (Chalmers & Armour, 2019). Other authors have recommended focussing on the “stability of group response over successive rounds” (Hasson, Keeney, & McKenna, 2000; Hsu & Sandford, 2007a; Nasa, Jain, & Juneja, 2021), with Barrios et al. (2021, p. 2) noting that “the consistency of experts’ responses between successive rounds of a Delphi study, has been considered a necessary criterion in order to assess consensus”. In this study, the threshold for consensus was 75% agreement, in recognition of the recommendations from Barrios et al. (2021), in *Consensus in the delphi (sic) method: What makes a decision change?,* who noted:

> Our data indicate that group agreement of 75% acts as a threshold, since the pattern of responses observed differs on either side of this level of consensus. More specifically, consensus among participants increases when feedback indicates group agreement of at least 75% and decreases when it is less than 75%. (p. 5)

Jünger et al. (2017, p. 701), in recognition that consensus may not be reached, recommended a “clear and transparent guide for action on (a) how to proceed with certain items or topics in the next survey round, (b) the required threshold to terminate the Delphi process and (c) procedures to be followed when consensus is (not) reached after one or more iterations”. In this study, consensus was facilitated by the researcher through the iterations of questionnaires to achieve a convergence of opinion, with the understanding that consensus does not imply that a solution or correct answer has been found, but rather that agreement has been reached by the experts (Keeney, Hasson, & McKenna, 2011). In addressing the recommendations by Jünger et al. (2017), for an *a priori* criterion for consensus, the procedure for *how to proceed with certain items or topics in the next survey round*, was to refine these items or topics for inclusion in the next round, *the required threshold to terminate the Delphi process* was through establishing the stability of the groups response and agreement (as described above), and *the procedures to be followed when consensus is (not) reached after one or more iterations* was to delete or modify these survey items.

### 6.4.3 Study conduct

Study conduct has four key recommendations – informational input, prevention of bias, interpretation and processing of results, and external validation, which describe and justify the details in the study design (Jünger et al., 2017).

#### *6.4.3.1 Informational input*

Jünger et al. (2017) recommended that all material provided to the expert panel should be reviewed and piloted to avoid the risk of bias. Whilst authors have emphasised the importance of justifying the validity and reliability of the Delphi approach used (Beiderbeck et al., 2021), the majority of studies neglect to provide any clear information regarding the validity and reliability of Delphi surveys or piloting of the survey instrument (Jünger et al., 2017). Jünger et al. (2017, p. 700) noted that the lack of explicit statements regarding piloting of the survey instruments "makes the studies vulnerable to bias and arbitrariness during data collection, analysis and interpretation of findings. Furthermore, it renders the Delphi technique susceptible to criticism as an undependable research method". Jünger et al. (2017) recommended piloting the survey instrument to determine the potential effect on the experts' judgments and responses, with a representative sample selected to participate in the pilot testing based on the same inclusion criteria (Doody & Doody, 2015; Malmqvist et al., 2019; Thabane et al., 2010) . The questionnaire, used in Round One of this study, was developed using the findings from the scoping review and a meeting was held between the researcher and the PhD supervisors to evaluate and edit the questionnaire prior to two rounds of face, content and construct validity testing by a group of 11 people, representative of the expert panel, but not associated with this study.

#### *6.4.3.2 Prevention of bias*

Measures must be taken to prevent researchers influencing the responses from the experts, either deliberately or inadvertently (Jünger et al., 2017). Prevention of bias, as defined by Jünger et al. (2017), includes the balanced composition of the research group, the use of an independent researcher to coordinate the consensus strategy (if conflicts of interest are identified within the research team), ensuring critical reflection of the outcomes by the team, and a final draft of the outcomes, being reviewed by an external expert, prior to dissemination. Hasson and Keeney (2011), also noted in *Enhancing rigour in the Delphi technique research*, the potential for personal bias due to phrasing of questions and situational bias due to data collection over differing time periods.

It is acknowledged that the anonymity of group members in a Delphi study, removes inherent biases, such as group conformity and peer pressures (Chalmers & Armour, 2019; Fink-Hafner et al., 2019; Nasa, Jain, & Juneja, 2021); however, Keeney, Hasson and McKenna (2011) asserted that complete anonymity is not guaranteed, due to the researcher knowing the group members and the likelihood that the group members know each other, particularly in a specific phenomenon of interest. Therefore, the authors use the term *quasi-anonymity*, to acknowledge that the group members may know each other, but their opinions and judgements remain anonymous. The use of anonymity eliminates subject bias, due to the group's members being able to express their opinions without the psychological pressures associated with face-to-face meetings (Keeney, Hasson, & McKenna, 2011).

The issue of anonymity and other inherent biases need to be addressed to strengthen the dependability and confirmability of the study findings. To address these issues, in this study, the composition of the pilot and Delphi study expert groups were explicitly described and justified, consensus was clearly defined, critical reflections were undertaken by the researcher, and an audit trail, triangulation and reflexive journalling, as recommended by Lincoln & Guba (1985, 2016), were performed. The quasi-anonymity of the experts, in the Delphi study and the pilot testing of the initial questionnaire, was maintained through assigning a code number to each group member, with the code key only accessible to the researcher and the PhD supervisors (refer to *6.5 Ethics approval for Delphi study*).

#### *6.4.3.3 Interpretation and processing of results*

In addressing the interpretation and processing of results, Jünger et al. (2017, pp. 702-703) advised that "Consensus does not necessarily imply the 'correct' answer or judgement" and "the value of stable disagreement must not be underestimated since it provides informative insights and highlights differences in perspectives regarding complex issues.". Therefore, it is important to avoid the manipulation of consensus and to recognise that consensus may not be achieved on all items being addressed (Niederberger & Köberich, 2021). The lack of *a priori* criterion for establishing consensus and the interpretation and processing of results was identified by Humphrey-Murto & de Wit, (2019) as a significant concern in Delphi studies. In response to criticisms regarding the lack of transparency and lack of methodological rigor in Delphi studies, the requirement for an *a priori* protocol has been emphasised (Barrios et al., 2021; Beiderbeck et al., 2021; Jünger et al., 2017; Nasa, Jain, & Juneja, 2021; Spranger et al., 2022). For this study, an *a priori* protocol was developed, including the definition of consensus and procedures for responding to a lack of consensus, with acknowledgement of the value of disagreement (refer to *Appendix B2*).

#### *6.4.3.4 External validation*

Jünger et al. (2017) recommended the use of an external authority to validate the findings of the Delphi study prior to dissemination and publication and to limit researcher bias. In this study, the Delphi expert group was considered to be the experts in the phenomenon of interest; as described by Emerson (2021, p. 472), whilst the researcher determines the nature of *the expert*, "as long as the researcher is transparent about the inclusion criteria, readers are able to consider whether they agree with the experts". Therefore, the findings of the Delphi rounds were disseminated to the PhD supervisors and the Delphi experts to identify any concerns or discrepancies prior to publication. To address any conflicts or disagreements arising from this process, the *a priori* protocol stipulated that a meeting be held between the researcher and the supervisors to discuss any issues identified in the findings, followed by returning the rewritten findings to the Delphi experts for further review (refer to *Appendix B2*). Whilst not strictly adhering to the definition of external validation as described by Jünger et al. (2017), the process of returning findings to the Delphi experts enhanced the trustworthiness of the findings.

### 6.4.4 Reporting

Reporting is the last section of the CREDES Guideline and includes eight guidelines. Jünger et al. (2017, p. 703) state that "All methodological decisions throughout the Delphi process should be reported transparently to allow readers to understand the steps taken, the evolvement of consensus building and to judge the results obtained". This transparency meets the requirements for methodological criteria to establish trustworthiness as described by Lincoln & Guba (1985, 2016).

#### *6.4.4.1 Purpose and rationale*

The purpose of the Delphi study must be clearly stated to justify the appropriateness of the method (Jünger et al., 2017). *6.4.1.1 Justification* describes the purpose and rationale of the study and the appropriateness of using the Delphi technique.

#### *6.4.4.2 6.4.4.2 Expert panel*

The criteria for the selection of experts, recruitment, expertise and response rates should be reported (Jünger et al., 2017). The Delphi technique seeks to collect information from *experts* who have the required knowledge and experience on the phenomenon of interest (Avella, 2016; Chalmers & Armour, 2019; Khodyakov et al., 2023; Nasa, Jain, & Juneja, 2021), with Avella (2016, p. 307), in Delphi Panels: Research Design, Procedures, Advantages, and Challenges, stating that, in general "participant invitation criteria should include those measurable characteristics that each participant group would acknowledge as those defining expertise, while still attempting to recruit a broad range of individual perspectives within those criteria". Chalmers and Armour (2019, p. 721), recommended that using benchmarks, such as qualifications or years of experience, does not necessarily "translate to knowledge in the area"; instead, they advise selecting individuals with a commitment to learning in that area, with Khodyakov et al. (2023, p. 15), in *RAND Methodological Guidance for Conducting and Critically Appraising Delphi Panels*, noting that "depending on the panel topic and goals, expertise may be defined broadly to include lived experience". The authors also emphasised the importance of the composition of the panel reflecting the purpose of the specific Delphi study. The inclusion criteria for this study are described below.

For this study, all participants were required to be Registered Nurses; with the rationale for this inclusion criteria, being the need for nurses' voices to be heard about matters of importance for nursing (Hare & Whitehouse, 2022; Hendricks & Cope, 2016; Lieschke et al., 2022; Rocel & Williams, 2024). As defined by the Nursing and Midwifery Board of Australia (2016a, p. 6), a "Registered nurse is a person who has completed the prescribed education preparation, demonstrates competence to practise and is registered under the Health Practitioner Regulation National Law as a registered nurse in Australia." Similar definitions exist globally, with a Registered Nurse defined in the United States of America as "an individual who has graduated from a state-approved school of nursing, passed the NCLEX-RN Examination and is licensed by a state board of nursing to provide patient care" (National Council of State Boards of Nursing (NCSBN), 2024); Canada defining a Registered Nurse as typically completing a four year post-secondary university nursing program, with "no national registration/licensure process for nurses in Canada"…and "each province has its own regulatory body and assessment process' (National Nursing Assessment Service (NNAS), 2024); and New Zealand defining a Registered Nurse as completing "a three-year Bachelor of Nursing degree (level 7 on the New Zealand Qualifications Authority Framework) or a two-year graduate entry master's degree (level 8 on the New Zealand Qualifications Framework)" (Te Kaunihera Tapuhi o Aotearoa - Nursing Council of New Zealand, n.d.).

The selection of experts included nurse informaticians, experts in nursing informatics and nurse educators, as these populations were all deemed to be experts in either education, nursing informatics or both. These experts were selected using the following definitions:

*Nursing informatician* – The terms *nursing informaticians* and *nursing informaticists* are used interchangeably in the literature and are defined as "healthcare information systems developers and implementors who use project and change management expertise and optimize electronic medical health records, quality initiatives and reporting" (HIMSS, 2023, p. 4).

*Expert in nursing informatics* – Using the definition of expert, as defined by Benner (1982), in *From Novice to Expert*, an expert is defined as an individual who intuitively uses their experience to respond to a given situation. Therefore, an *expert in nursing informatics* is defined as an individual who intuitively applies nursing informatics within their everyday practice (Kaminski, 2010).

Nurse educators – A *nurse educator* "is defined as a registered nurse who assesses, plans, implements and evaluates nursing education and professional development programs" within academic and clinical settings (Sayers, DiGiacomo, & Davidson, 2011, p. 45).

*6.8.2 Delphi study participants* describes the sampling procedure for the Delphi study and adheres to Lincoln & Guba's (1985, 2016) recommendations for thick descriptions of methods to enhance the trustworthiness of the findings.

#### *6.4.4.3 Description of methods*

The description of the methods used in the Delphi study need to be clear and comprehensible; identifying the synthesis of the topic information, piloting of material, the number of survey rounds, data analysis methods, processing and of experts' responses to inform subsequent rounds and methodological decisions by the research team throughout the study (Jünger et al., 2017).

#### *6.4.4.4 Procedure*

A flow chart detailing the stages of the Delphi study is required to illustrate the Delphi procedure (Jünger et al., 2017). Similar to the PRISMA flow diagram developed for the scoping review in this study, a flow chat was developed to illustrate the Delphi procedure. This formed part of the audit trail, as recommended by Lincoln & Guba (1985, 2016) and strengthened the dependability of the findings (refer to *Figure 6.1 - Delphi Study Flow Chart*).

#### *6.4.4.5 Definition and attainment of consensus*

The definition and attainment of consensus needs to be clearly and comprehensively described, including the strategies for responding to non-consensus (Jünger et al., 2017). *6.4.2.2 Definition of consensus* defines consensus for the purpose of this study to enhance the credibility and confirmability of the findings. The attainment of consensus, including responses to non-consensus are described in *Chapter 7: Phase 2 – Delphi study findings.*

#### *6.4.4.6 Results*

Jünger et al. (2017) recommend that the results from each round be separately described to enhance the transparency of the findings, including the average group response, changes between rounds, as well as any modifications to the data collection instrument. Barrett & Heale (2020), in *What are Delphi studies?*, highlights the importance of providing Delphi participants with the results from each round, and this data is described in *Chapter 7: Phase 2 - Delphi study findings*.

#### *6.4.4.7 Discussion of limitations*

As previously identified, all methodological decisions must be clearly described to allow readers to understand the methods, consensus building and results of the study. Included in this open disclosure must be clear statements about the limitations of the study impacting on the findings of the study (Jünger et al., 2017). Limitations of the Delphi technique can include the lack of standard guidelines for the method, sample size, the use of experts, non-responders and identifying when questioning should end (Chalmers & Armour, 2019). These identified limitations have been addressed through the use of the CREDES Guideline (Jünger et al., 2017) which addresses methodological rigour, sample size, experts, non-response and the *a priori* definition of consensus. Discussion of the limitations of this study are described in *Chapter 8: Integration of findings.*

#### *6.4.4.8 Adequacy of conclusion*

The adequacy of the study conclusions should reflect the results of the Delphi study (Jünger et al., 2017). Chalmers and Armour (2019) caution that the conclusions presented in Delphi studies may be undermined by a lack of methodological rigour and clarity and recommend the use of the CREDES Guideline to address these issues. In adherence with the recommendations, the CREDES Guideline was used to inform the development of this study, and the findings were clearly described (refer to *Chapter 7: Phase 2 – Delphi study findings*).

#### *6.4.4.9 Publication and dissemination*

Publication and dissemination of the findings, conclusion and recommendations of the Delphi study should be clearly stated (Jünger et al., 2017). This process is enhanced by transparent reporting of the study, adherence to methodological rigour strategies (Jünger et al., 2017) and the disclosure of underlying epistemological principles (Spranger et al., 2022). As described in *6.4.3.4 External validation*, the findings of the Delphi rounds were disseminated to the PhD supervisors, the Delphi experts and experts external from this study to strengthen external validity; in addition, prior to submission of the PhD thesis and publication of journal articles, the findings, conclusion and recommendations of this study were also externally validated using the same procedure. Dissemination of the findings of the Delphi phase of this study were through the submission of the PhD thesis and the subsequent publication of the results in high-ranking international nursing education and health informatics journals.

## 6.5 Ethics approval for Delphi study

In accordance with the requirements of the *Human Research Ethics Committee (HREC)* at Flinders University (2023), ethics approval was sought prior to commencing this study. In adherence with the *National Statement on Ethical Conduct in Human Research 2023* (National Health and Medical Research Council (NHMRC), 2023) consideration was given to participant consent, identifying and managing risks, safeguarding of personal information which included storage and disposal of participant data, and the potential benefits of the proposed research (Refer to *Appendix B3: HREC Ethics Approval Email*). The strategies for addressing these aspects of this study will now be outlined.

### 6.5.1 Participant consent

Informed and valid consent was obtained from all participants recruited for the pilot testing and Delphi studies. A participant was considered to have given valid consent if the elements of consent were met; these elements are competence to understand, voluntariness, disclosure of material information, and understanding of the planned research and authorisation (Beauchamp & Childress, 2019). To meet these elements, participants voluntarily participated without any inducements. Pilot test participants were contacted via email recruitment (refer to *Appendix B4*) and Delphi study participants were recruited (refer to *Appendix C1*) through the use of email, social media and contact with the ACN (Australian College of Nursing), AIDH (Australasian Institute of Digital Health, ANMAC (Australian Nursing and Midwifery Accreditation Council, ANTS (Australian Nurse Teachers' Society), IMIA (International Medical Informatics Association), IMIA – SIG SEP (International Medical Informatics Association – Special Interest Group – Students and Emerging Professionals) and Jenny Hurley (Chief Nursing and Midwifery Officer – SA Health). Potential participants were provided with either the *Participant information and consent form – Pilot test* (refer to *Appendix B5*) or the *Participant information and consent form – Delphi study* (refer to *Appendix C2*); these documents included the right to refuse to participate or withdraw from this study at any time. Participants were provided with the contact details of the researcher to address any questions or concerns. Participants were then asked to return the signed Participant and information consent forms via email to the researcher; these documents have been securely stored.

### 6.5.2 Identifying and managing risks

The principles of nonmaleficence and beneficence underpin ethical research and require that one should not inflict harm and should prevent harm (Beauchamp & Childress, 2019). The identification and management of risks adheres to these tenets by seeking to establish potential risks prior to the research study. For the purpose of research, risk can be defined as the potential for harm, discomfort or distress (NHMRC, 2023). These harms may include physical harms, psychological harms, social harms, economic harms, legal harms and devaluation of personal worth. Discomfort and inconvenience are viewed as being less serious potential risks of research. To manage these risks, researchers are required to include adequate mechanisms to address any harms that may occur and a process of monitoring throughout the research process.

This study was deemed to be one of low risk, that is "research in which the only foreseeable risk is no greater than discomfort" (NHMRC, 2023, p. 13). The principal potential risk was of anxiety induced by the research process. The management strategy for this risk was to ensure that all participants were provided with informed and valid consent procedures, were advised of their ability to withdraw from this study at any time, were provided with the contact details for the researcher, and were provided with the Flinders University's Research Ethics and Compliance Office team contact phone number and email address. In this study, no risks emerged, with the study process and potential for emerging risks monitored by the researcher and PhD supervisors.

### 6.5.3 Safeguarding personal information

Safeguarding personal information and identifying and managing risk was a means of preventing (or at least mitigating) harm in this study. In accordance with the requirements of the Human Research Ethics Committee (HREC) at Flinders University, raw data was only accessed by researchers on this project and data storage was in adherence with the Flinders University (2023c) *Research Data Management Procedures,* which requires that "all research data must be stored using an approved Flinders University data storage solution for digital data"*.* As outlined in *Data storage – Find the recommended storage option for your Data* (Flinders University, 2021), considerations were required regarding the nature of the data collected, where the data needed to be stored, how the data would be shared and accessed, how long the data should be accessible and how long the data should be kept. In accordance with the Flinders University *Records Management Policy* (2023b) and *Information classifications: Knowing what your data is and who can see it* (2020), the data collected in the pilot testing and Delphi study met the *Restricted* classification, meaning that it should only be accessible by limited internal people within the University (the researcher and the PhD supervisors). A *Research Data Management Plan (DMP)* (Flinders University, 2024a), which documented how data would be collected and managed was developed and an *R Drive* was accessed for data storage (Flinders University, 2023a). All participants were assigned codes to adhere to anonymity requirements and the list of codes was stored separately from the research data and only accessible to the researcher. Data was only accessed by the researcher and the PhD supervisors and as per the Participant information and consent forms, data will be stored for 10 years following the completion of this study and then destroyed. (Please note – Data management plan available on request).

### 6.5.4 Potential benefits for participants

Underpinning the development of this research study was the recognition of the ethical principle of beneficence; that is the promotion of good and the prevention of harm. The promotion of good required that participants in this study received a benefit from participation. The major benefit of participation in this study was anticipated to be the opportunity for participants to voice their experiences and beliefs about nursing informatics, including recommendations for further integration of nursing informatics into undergraduate nursing programs. No financial inducements were offered. Participants will also have access to this study findings that will continue to inform their expertise in nursing informatics.

## 6.6 Flow chart development

To provide an audit trail and strengthen the dependability of this study findings, a flow chart was developed. The use of a flow chart or diagram, was recommended by Jünger et al. (2017, p. 702), with requirements for the chart "to illustrate the stages of the Delphi process, including a preparatory phase, the actual ‘Delphi rounds’, interim steps of data processing and analysis, and concluding steps”. In the study by Jünger et al. (2017), six studies were noted to include a flow chart and several of these studies (Bradford et al., 2014; Jünger et al., 2012; Strupp et al., 2014) were used to inform the development of a flow chart of the Delphi phase of this study.

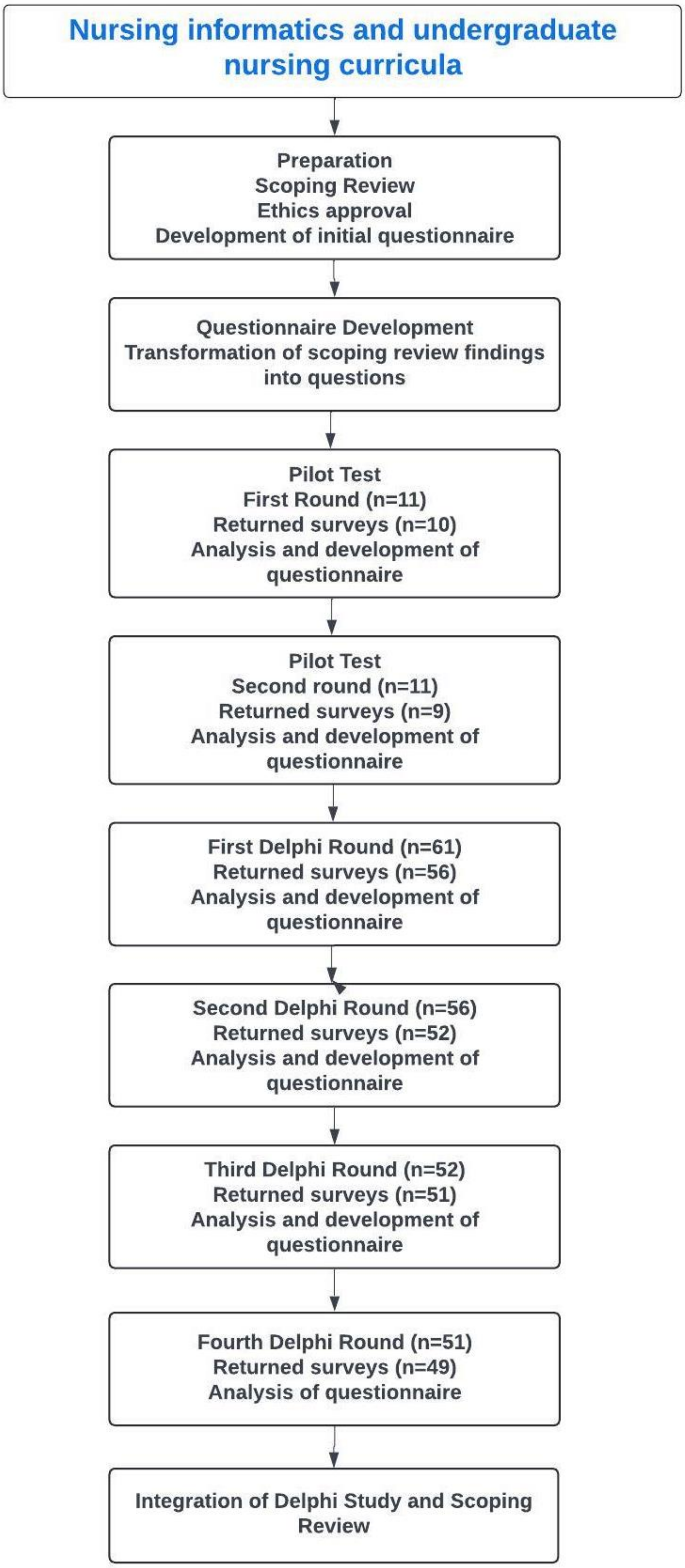



**Figure 6.1 Delphi Study Flow Chart**

## 6.7 Questionnaire development

Questionnaires are one of the most widely used data collection methods in research (Da Cunha de Sá-Caputo et al., 2020; Tsang, Royse, & Terkawi, 2017; Vakili & Jahangiri, 2018); however, they require systematic development to limit measurements errors, including: developing and testing a questionnaire: research background, questionnaire conceptualisation, format and data analysis, and establishing validity and reliability (Bolarinwa, 2015; Da Cunha de Sá-Caputo et al., 2020; Kimberlin & Winterstein, 2008). Dalkey and Helmer (1963, p. 458), in the seminal publication *An Experimental Application of the DELPHI Method to the Use of Experts*, reporting on the first use of the Delphi technique, defined the technique as seeking to obtain “the most reliable consensus of opinion of a group of experts” through the use of “a series of intensive questionnaires interspersed with controlled opinion feedback”. Iterative rounds of questionnaires are used to solicit information from experts, and whilst the original study conducted by Dalkey and Helmer (1963) used five questionnaires, three rounds are most commonly used (Chalmers & Armour, 2019; Niederberger & Spranger, 2020; Spranger et al., 2022).

One of the criticisms of questionnaires, used in the Delphi technique, has been the lack of detail which has limited considerations of methodological quality (Drumm, Bradley, & Moriarty, 2022; Niederberger & Spranger, 2020). Radhakrishna (2007), in *Tips for Developing and Testing Questionnaires/Instruments*, addressed key steps in the development of a questionnaire. These steps included a thorough understanding of the *background* to the proposed research, established by the purpose, aims and objectives, *questionnaire conceptualisation* which transforms the literature or theoretical content into statements or questions, format and data analysis which focuses on further development of the questions, questionnaire layout and proposed data analysis, *establishing validity* through validity measures depending on the objectives of the research and *establishing reliability* through pilot testing and the use of reliability types depending on the nature of the data (Radhakrishna, 2007). Pilot testing of questionnaires, in Delphi studies, were identified in the literature (Bhuasiri et al., 2012; Bichel-Findlay et al., 2023; Chianchana, 2021; Haworth, Montgomery, & Schaub, 2023; Heuzenroeder et al., 2022; Jacob, Duffield, & Jacob, 2017; Konopka et al., 2022; Massaroli et al., 2017; Nutbeam et al., 2022; Staykova, 2012; Strupp et al., 2014; Varndell, Fry, & Elliott, 2021); however, the methodological descriptions were often limited, as noted by Clibbens, Walters and Baird (2012, p. 37), in *Delphi research: issues raised by a pilot study*, “Delphi researchers should publish greater detail about their approach to pilot studies”. The pilot testing procedure is described below.

### 6.7.1 Pilot testing of questionnaire

The terms, *pilot testing*, *pre-testing* and *trial run* are used in the literature interchangeably and sometimes are defined differently (Bowden et al., 2002; Novakowski & Wellar, 2008; van Teijlingen

& Hundley, 2002); however, for the purpose of this study, *pilot testing* was defined as using a draft Delphi questionnaire tested on a small representative panel (Keeney, Hasson, & McKenna, 2011; Novakowski & Wellar, 2008). Pilot testing of a survey instrument is recommended to avoid inherent researcher bias (Davidson, 2013), to enhance the validity and reliability of the study findings (Jünger et al., 2017; Keeney, Hasson, & McKenna, 2011; von der Gracht, 2012), to determine the feasibility of data collection procedures (Brooks, Reed, & Savage, 2016; Morin, 2023; Spurlock, 2018; Teresi et al., 2022), and is a valuable step that can eliminate poorly worded questions and eliminate errors prior to dissemination to the Delphi panel (Clibbens, Walters, & Baird, 2012; Jillson, 2002; Varndell, Fry, & Elliott, 2021). In addition, pilot testing provides the researcher with valuable insights into the research skills they need to develop, prior to the implementation of the main study (Doody & Doody, 2015; In, 2017) and is "especially important for inexperienced researchers who may be overly ambitious regarding the scope of their research or underestimate the time it will take a Delphi research participant to fully respond to the Delphi survey" (Skulmoski, Hartman, & Krahn, 2007, p. 4). van Teijlingen and Hundley (2002) acknowledged that a pilot study cannot guarantee success; however, it strengthened the likelihood of a successful main study, with Clibbens, Walters and Baird (2012, p. 39) noting that "pilot studies could offer a means to ensure greater rigour, particularly in light of criticisms about the design of first-round questions". Addressing the limited discussions of pilot testing of Delphi questionnaires, Varndell, Fry and Elliott (2021) identified the importance of pilot testing of questionnaires to enhance comprehension and limit potential issues which may impact data integrity, Malmqvist et al. (2019, p. 1), in *Conducting the Pilot Study: A Neglected Part of the Research Process? Methodological Findings Supporting the Importance of Piloting in Qualitative Research Studies*, stated that "while methodological texts recommend the use of pilot studies in qualitative research, there is a lack of reported research focusing on how to conduct such pilot studies".

In this study, the *First Round Questionnaire* was developed from the findings of the scoping review (refer to *Chapter 5: Phase 1 – Scoping review findings*). The questions were revised, in consultation with the PhD supervisors, to reflect Davidson's (2013, p. 56) advice "to be careful not to slant or bias this initial questionnaire in order to direct the outcome desired by the researcher inadvertently". Following the initial questionnaire development, pilot testing of the instrument was required. As described in *6.4.3.1 Informational input*, a lack of explicit statements regarding pilot testing of survey instruments makes studies vulnerable to criticisms regarding validity and reliability (Jünger et al., 2017).

The aims of the pilot testing, recruitment of the pilot testing participants, the rounds of questionnaires and the validity and reliability of the questionnaire are described below.

#### *6.7.1.1 Aim of the pilot testing*

The aims of a pilot study include reducing researcher bias in the survey instrument, enhancing the validity and reliability of the main study findings, and evaluating the feasibility of the data collection procedure. Lancaster, Dodd and Williamson (2004, p. 307), in *Design and analysis of pilot studies: recommendations for good practice*, state that "giving a clear list of aims and objectives within a formal framework will encourage methodological rigour"; this approach also reduces the likelihood of issues with data collection in the main study (Brooks, Reed, & Savage, 2016; Doody & Doody, 2015; Keeney, Hasson, & McKenna, 2011).

The aim of pilot testing the survey instrument was to strengthen the methodological rigour of the questionnaire. More specifically, the objectives of piloting the Delphi questions were, to ensure that:

- The participants understood all questions in the questionnaire and interpreted questions in the same way;
- The participants understood the instructions for the questionnaire, including returning of completed questionnaires;
- The participants were motivated to complete the questionnaire;
- Gaps in data collection were identified, including the collection of data not relevant to this study; and
- That any issues with the questions and suggested changes to the questionnaire were identified, considered and implemented (where appropriate).

#### *6.7.1.2 Pilot test participants*

In addressing the sample size recommended for pilot testing, Clibbens, Walters and Baird (2012) noted that most studies did not stipulate the sample size used for pilot testing. A review of Delphi studies, which identified the use of pilot testing, did not state the number of participants (Bichel-Findlay et al., 2023; Nutbeam et al., 2022; Varndell, Fry, & Elliott, 2021), were to still to be implemented (Heuzenroeder et al., 2022; Jacob, Duffield, & Jacob, 2017) or indicated the use of three participants (Massaroli et al., 2017), five participants (Konopka et al., 2022; Massaroli et al., 2017; Staykova, 2012), six participants (Bhuasiri et al., 2012; Haworth, Montgomery, & Schaub, 2023; Strupp et al., 2014), ten participants (Sim et al., 2018) and twenty participants (Chianchana, 2021). For the purpose of this study, the aim was to recruit a sample of ten participants for pilot testing the questionnaire.

Convenience and purposive sampling were used to sample nurse educators (n=26) for pilot testing of the questionnaire. Convenience sampling means the participants are selected due to their easy accessibility to the researcher (Bhardwaj, 2019; Onwuegbuzie & Collins, 2017; Whitehead & Whitehead, 2016), and the sampling procedure selected nurse educators working at the same University as the researcher. Purposive sampling involves the recruitment of participants who meet pre-determined criteria (Bhardwaj, 2019; Onwuegbuzie & Collins, 2017; Whitehead & Whitehead, 2016). And the sampling procedure selected participants who were nurse educators, ensuring that the sample adhered to the requirements for the pilot testing sample to have the same inclusion/ exclusion criteria as the main study (Thabane et al., 2010).

#### *6.7.1.3 Recruitment of pilot test participants*

The recruitment of pilot test participants commenced in January 2024, using a proforma approved by the Human Research Ethics Committee (HREC project number 2156) (refer to *Appendix B4*). Potential participants (n=12), who responded to the recruitment email, were then provided with the *Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study. Pilot Test of a Delphi questionnaire (HREC project number 2156) Participant information and consent form* (refer to *Appendix B5*) and requested to return the signed document, prior to progressing to the initial stage of the pilot testing procedure***.***

#### *6.7.1.4 First round of pilot testing*

Following the return of the participant information and consent forms, participants (n=11) were sent the first round of the questionnaire for pilot testing (refer to *Appendix B6*) in February 2024. The questionnaire was developed using the findings from the scoping review and participants were asked to respond to the questions, identify any issues with the questions and suggest changes to the questionnaire. The answers and feedback from each (returned) questionnaire (n=10) were input into a summary document (please note – the summary document is available on request). In adherence with the aims of the pilot study, the questionnaires were evaluated to determine if the participants understood all questions and interpreted questions in the same way; the participants understood the instructions for the questionnaire, including returning of completed questionnaires; and the participants were motivated to complete the questionnaire. Collection of data not relevant to this study and omission of key data were identified and questions were modified to more effectively obtain the required data. Suggested changes to the questionnaire were then identified, considered and implemented (where appropriate). These changes were then reflected in the second round of the questionnaire, which was developed by the researcher with feedback from the PhD supervisors.

#### *6.7.1.5 Second round of pilot testing*

Following the development of the second questionnaire (refer to *Appendix B7*), the questionnaire was emailed to the participants (n=11). The returned questionnaires (n=9) were evaluated to determine if the participants understood all questions and interpreted questions in the same way; the participants understood the instructions for the questionnaire, including returning of completed questionnaires; and the participants were motivated to complete the questionnaire. Suggested changes to the questionnaire were then identified, considered and implemented (where appropriate) and these changes were then reflected in the first round of the Delphi study (refer to *Appendix C3*), which was developed by the researcher with feedback from the PhD supervisors.

### 6.7.2 Methodological rigour of the questionnaire

The aim of a research questionnaire is to obtain valid and reliable information; therefore, establishing the validity and reliability of the instrument is an essential requirement in the research process (Bolarinwa, 2015; Da Cunha de Sá-Caputo et al., 2020; Kimberlin & Winterstein, 2008; Mohamad et al., 2015; Taherdoost, 2016; Vakili & Jahangiri, 2018). Methodological rigour "refers to a researcher's responsibility to ensure that procedures have been adhered to and confounding factors eliminated [where possible] to produce dependable results" (Hasson & Keeney, 2011, p. 1695); in addressing the methodological rigour of questionnaire development, validity and reliability are typically addressed.

#### *6.7.2.1 Debate regarding validity and reliability in mixed-methods research*

There has been some debate regarding the use of validity and reliability in mixed-methods research, with validity, reliability and generalisability aligned with quantitative research and trustworthiness and transferability with qualitative research (Carcary, 2009; Farrelly, 2013; Noble & Smith, 2015; Onwuegbuzie & Johnson, 2006; Onwuegbuzie & Leech, 2007). As noted by Carcary (2009, p. 11), in *The Research Audit Trial – Enhancing Trustworthiness in Qualitative Inquiry*, "the issues of validity, reliability and generalisability, used in evaluating positivist studies, are regarded of relatively little significance by many qualitative researchers for judging the merits of their interpretive investigations". Onwuegbuzie and Johnson (2006) argued that *validity* in mixed-methods research, should be replaced with *legitimation*, with nine types of legitimation described (Cohen, Manion, & Morrison, 2018; Krawczyk et al., 2019). Harrison, Reilly and Creswell (2020) noted that the requirements for methodological rigor from both the quantitative and qualitative paradigms should be employed in mixed-methods research (where applicable), but also recommended that an overarching assessment of the methodological rigor of the mixed-methods study should be evident. The development of a specific framework or reporting guidelines to evaluate the overall methodological rigor of mixed-methods research remains a subject for discussion (Fàbregues et al., 2021; Guetterman, Molina-Azorin, & Fàbregues, 2022; Harrison, Reilly, & Creswell, 2020), with Fàbregues et al. (2021, p. 2847), in *Addressing quality in mixed methods research: a review and recommendations for a future agenda*, stating that “mixed methods research has a number of unique features with respect to monomethod research and, as such, should be appraised according to its own set of quality criteria”.

#### 6.7.2.2 Validity of the questionnaire

*Validity* is defined as the extent to which an instrument measures what it intends to measure (Bolarinwa, 2015; Cohen, Manion, & Morrison, 2018; Hasson & Keeney, 2011; Kimberlin & Winterstein, 2008; Mohamad et al., 2015; Singh, 2017; Taherdoost, 2016). Validity is broadly categorised as internal validity and external validity (Bolarinwa, 2015). *Internal validity* refers to the extent to which the results represent the truth are not due to methodological errors (Bolarinwa, 2015; Cohen, Manion, & Morrison, 2018; Patino & Ferreira, 2018; Singh, 2017); whereas, *external validity* refers to the generalisability (or transferability) of results to applicable populations represented by the sample group (Bolarinwa, 2015; Cohen, Manion, & Morrison, 2018; Patino & Ferreira, 2018; Singh, 2017). Validity is typically measured using face validity, content validity, construct validity, criterion validity and concurrent validity (Singh, 2017), and one of the aims of pilot testing, in this study, was to evaluate the face validity, content validity, and construct validity of the questionnaire.

*Face validity* refers to the whether the questionnaire appears to measure what it intends to measure (Singh, 2017; Taherdoost, 2016). Face validity can be strengthened by determining whether the questionnaire is clear, unambiguous and relevant (Taherdoost, 2016).This criteria was established by checking the participants’ responses to the questions and whether these responses indicated a lack of understanding or clarity. The relevance of responses was also checked, to ensure that responses provided data which was relevant to this study.

*Content validity* refers to whether the questionnaire will actually measure what it intends to measure (Singh, 2017; Taherdoost, 2016). Content validity can be strengthened through exhaustive literature reviews to determine relevant constructs and review by experts in the field (Taherdoost, 2016). This criterion was met by the extensive scoping review prior to the Delphi study to determine key constructs relating to nursing informatics and undergraduate nursing education. Evaluation of the responses in the pilot testing sought to determine if the identified constructs lacked clarity or were unknown.

*Construct validity* refers to whether the questionnaire adequately measures the required concepts/ constructs (Singh, 2017; Taherdoost, 2016). Construct validity can be strengthened through convergent validity and discriminant validity, with convergent validity measuring whether similar constructs score similarly and discriminant validity measuring whether unrelated constructs have minimal or limited correlation (Taherdoost, 2016). Factor analysis can be conducted to determine both convergent and discriminant validity (Taherdoost, 2016). *Construct validity* was evaluated to determine whether the questionnaire adequately measured the required concepts/ constructs and by comparing the responses, from both rounds of pilot testing, to ascertain if similar responses were provided across both questionnaires.

#### *6.7.2.3 Reliability of the questionnaire*

*Reliability* is defined as the consistency of the measurement over time and is measured by equivalence, replicability/ stability and homogeneity/ internal consistency (Bolarinwa, 2015; Cohen, Manion, & Morrison, 2018; Heale & Twycross, 2015; Kimberlin & Winterstein, 2008; Mohamad et al., 2015; Singh, 2017; Taherdoost, 2016; Zohrabi, 2013); in other words, “when the instrument is administered repeatedly at different times, and it should remain consistent” (Mohamad et al., 2015, p. 165), thereby meeting the requirement for consistency and replicability (Da Cunha de Sá-Caputo et al., 2020; Taherdoost, 2016; Vakili & Jahangiri, 2018). Three types of reliability are commonly identified in the literature: alternate-form reliability (or equivalence), internal consistency reliability (or homogeneity) and test-retest reliability (or stability) (Bolarinwa, 2015; Cohen, Manion, & Morrison, 2018; Heale & Twycross, 2015; Kimberlin & Winterstein, 2008; Nha, 2021), with some authors referring to internal and external reliability (Zohrabi, 2013). *Alternate-form reliability* refers to the use of a differently worded questionnaire that measures the same constructs, with equivalence indicated through the degree of correlation; however, this form of reliability test is rarely used (Bolarinwa, 2015). *Internal consistency reliability* refers to the extent to which the same constructs are being measured in the questionnaire and is commonly measured using split-half reliability and coefficient alpha index (Bolarinwa, 2015). *Test-retest reliability* is the most common test of reliability in questionnaires (Bolarinwa, 2015), and requires that the same instrument be readministered to the same population under the same conditions, with stability indicated if the same responses are received following repeated testing (Bolarinwa, 2015; DeVon et al., 2007; Pallant, 2016; Polit, 2014; Schnall, Wolkin, & Nakata, 2018).

Berchtold (2016) noted that test–retest is routinely evaluated in the development of survey tools; however, that reported research has interpreted two very different versions of test-retest, that is *reliability* and *agreement*. The author differentiated between the two concepts, stating that “agreement is the capacity of a test or any other measurement tool applied twice on the same respondents under the same conditions to provide strictly identical results”; whereas reliability “is the capacity of a test to replicate the same ordering between respondents when measured twice” (Berchtold, 2016, p. 1), with de Vet et al. (2006) noting that an umbrella term for the inclusion of both reliability and agreement was *reproducibility*. Hasson and Keeney (2011, p. 1699) observed that a number of Delphi studies had applied measures to evaluate the stability of responses from participants over time, but these methods lacked strict adherence to statistical test-retest procedures, suggesting that this procedure would be more appropriately termed “a snapshot of expert opinion” at a moment in time.

As with the discussion regarding the use of specific taxonomies aligned with qualitative, quantitative or mixed-methods paradigms, there is debate regarding whether reliability is a relevant concept for qualitative research (Bengtsson, 2016; Carcary, 2009, 2020; Noble & Smith, 2015). Noble and Smith (2015), in *Issues of validity and reliability in qualitative research*, noted that statistical methods used to establish validity and reliability in quantitative studies, were not applicable in qualitative research and instead the trustworthiness of the method, including consistency and confirmability should be evaluated. The reconceptualisation of reliability, from a qualitative perspective, focuses on the transparency of the research methods and can be enhanced through the use of an audit trail (Carcary, 2009, 2020). Carcary (2020), in *The Research Audit Trail: Methodological Guidance for Application in Practice*, developed a *research audit checklist*, including research problem identification, literature, review, research framework definition, sample selection, evidence collection, evidence management and analysis, and artefact development. The recommendations also identified the need to establish an *intellectual audit trail* which focused on clarification of philosophical stance, consideration of alternatives for evidence collection and data analysis and evidence interpretation (Carcary, 2020). This method aligns with Lincoln and Guba’s (1985) parallel methodological criteria to establish trustworthiness.

As discussed in *3.7 Addressing the challenges in using Mixed Methods*, mixed-methods requires understanding of both quantitative and qualitative approaches (Creswell, 2015; Creswell & Creswell, 2018; Creswell & Plano Clark, 2018), including addressing the rigor of the research, which includes reliability, validity, bias control, generalisability, credibility, trustworthiness, and transferability (Creswell & Plano Clark, 2018). In this study, the *First Round Questionnaire* used a qualitative approach, that is a series of open-ended questions (Braun et al., 2021; Ponto, 2015), and was pilot tested, in adherence with the recommendations from Jünger et al. (2017) (refer to *6.4.3.1 Informational input*). Discussions of the trustworthiness, including credibility, dependability, confirmability and transferability, are described in *6.2 Development of a Delphi study protocol.* The explicit and transparent description of the development and testing of the questionnaire and the use of the CREDES guideline provided an audit trail, thereby enhancing the reliability or trustworthiness of the survey instrument.

## 6.8 Delphi study

Following pilot testing of the Delphi questionnaire and in adherence with the reporting guidelines (refer to *6.3 Reporting guidelines*) and *a priori* protocol (refer to *Appendix B2*), the Delphi study commenced in March 2024.

### 6.8.1 Aim of the Delphi study

This Delphi study aimed to explore and describe nursing informatics in collaboration with domain experts, with a focus on undergraduate curricula development and competency in nursing informatics. The overall study (scoping review and Delphi study) aimed to address whether a distinct body of knowledge on nursing informatics could be further developed to be used to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula. Justification of the decision to use the Delphi technique, as a method to achieve the research aim, was described in *6.4.1 Rationale for the choice of the Delphi technique.*

### 6.8.2 Delphi study participants

The criteria for the selection of experts should be reported (Jünger et al., 2017). Sample size is dependent on the purpose of the study, the type of Delphi Design and the time frame available for data collection; however, there has been limited agreement on the required size for an expert panel (Keeney, Hasson, & McKenna, 2001). Keeney, Hasson and McKenna (2001) noted that there are a wide range of opinions regarding an adequate sample size for a Delphi study, with most recommendations supporting the use of heterogenous samples to support a broad range of expert opinions (Avella, 2016; Beiderbeck et al., 2021). Chalmers and Armour (2019, p. 730), in *The Delphi Technique*, stated that "there are no guidelines for selecting the number of expert panel members with the Delphi technique", but that decisions regarding sample size were premised on the aims of this study and the understanding, that whilst a homogenous expert panel may arrive at consensus quickly, there are limitations on the generalisability of findings and that conversely, while a heterogenous expert panel may take longer to arrive at a consensus, the results are generalisable to a broader population. Whilst linked to increased generalisability of the study findings, a heterogenous sample which is too large, can result in low response rates and an increased time commitment from researchers and participants (Hsu & Sandford, 2007a). Keeney, Hasson and McKenna (2011), in *The Delphi Technique in Nursing and Health Research*, asked the question – *What size does the sample have to be?* - and concluded that if a sample is homogenous, then a smaller sample size of 10-15 participants may be sufficient, but provided no specific recommendations for heterogenous samples. The lack of specific recommendations for sample sizes was also identified by Nasa, Jain and Juneja (2021), who noted that sample sizes can range from 10 to 1000, but the use of triple-digit sample sizes are unusual due to the logistics of data management and managing the rounds of the Delphi study.

For this study, the selection of experts included nurse informaticians, experts in nursing informatics and nurse educators, as these populations were all deemed to be experts in either education, nursing informatics or both. It is important to note, that all participants were required to be Registered Nurses. The sample sizes of nurse informaticians and experts in nursing informatics (n=20) and nurse educators (n=20) were sought with the understanding that attrition throughout this study may result in a smaller population overall.

### 6.8.3 Recruitment of Delphi study participants

Recruitment of participants for the Delphi study included the use of email, social media and contact with the ACN (Australian College of Nursing), AIDH (Australasian Institute of Digital Health, ANMAC (Australian Nursing and Midwifery Accreditation Council, ANTS (Australian Nurse Teachers' Society), IMIA (International Medical Informatics Association), IMIA – SIG SEP (International Medical Informatics Association – Special Interest Group – Students and Emerging Professionals) and Jenny Hurley (Chief Nursing and Midwifery Officer – SA Health). Recruitment of participants used a proforma approved by the Human Research Ethics Committee (HREC project number 2156) (refer to *Appendix C1*) and this was disseminated via email, on social media and to professional bodies. Potential participants who responded to the recruitment information, were then provided with the *Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study. Delphi Study (HREC project number 2156) Participant information and consent form* (refer to *Appendix C2*) and requested to return the signed document, prior to progressing to the initial stage of the Delphi study.

## 6.9 Data collection

The Delphi technique typically uses iterative rounds of questionnaires to obtain information from experts regarding the phenomenon of interest (Hasson & Keeney, 2011; Keeney, Hasson, & McKenna, 2011; Niederberger & Spranger, 2020; Spranger et al., 2022). Approaches to data collection in Delphi studies will now be described.

### 6.9.1 First round questionnaires

Typically, the first round questionnaire, in a Delphi study, has a series of open-ended and broad questions relating to the phenomenon of interest and designed to elicit responses from the expert panel (Chalmers & Armour, 2019; Keeney, Hasson, & McKenna, 2011; Skulmoski, Hartman, & Krahn, 2007), with Davidson (2013, p. 56), in *The Delphi technique in doctoral research: Considerations and rationale*, noting that the "initial open-ended questionnaire is critical as it serves as the foundation for everything that follows" and that researchers must avoid bias or attempts to affect the outcomes. However, pre-existing information may be used to design consensus statements in the first questionnaire to reduce disparity of responses and limit participant fatigue (Chalmers & Armour, 2019; Drumm, Bradley, & Moriarty, 2022; Niederberger & Spranger, 2020).

### 6.9.2 Second round questionnaire

Following analysis of the responses to the first questionnaire in the Delphi study, subsequent structured questionnaires are developed based on these results, incorporating feedback to inform questions and provide specific comments to participants (Keeney, Hasson, & McKenna, 2011; Skulmoski, Hartman, & Krahn, 2007). Chalmers and Armour (2019) note that there are very few guidelines for how to develop structured questionnaires but recommend that the researcher should identify themes from the round one responses and consolidate the use of terminology.

### 6.9.3 Subsequent rounds of questionnaires

Following the first two rounds of the Delphi technique, critical issues/ elements are determined and explored in a more in-depth manner with participants either coming to consensus or justifying disparity of responses (Chalmers & Armour, 2019; Davidson, 2013). Delphi questionnaires often use Likert scales to measure the opinions of the participants (Barrios et al., 2021; Drumm, Bradley, & Moriarty, 2022). “A Likert scale is a psychometric scale commonly used in all types of questionnaires and is the most widely used scale in survey research in all disciplines” (Keeney, Hasson, & McKenna, 2011, p. 77). Likert and Likert-type scales will now be discussed.

### 6.9.4 Likert and Likert-type scales in Delphi studies

In 1932, Rensis Likert (1932), in *A Technique for the Measurement of Attitudes*, published a scale for the measurement of attitudes which became known as the *Likert scale*. Likert (1974) identified criteria aligned with the Likert scale, including that statements were to be expressions of desired behaviour (not of fact), that the language used should be simple and easy to understand, that the scale have the modal response in the middle of all possible responses, that statements should be worded and positioned to reduce stereotyped responses, and that only a single attitudinal variable be included in each statement. There is also differentiation between the types of Likert scales. A Likert scale uses a number of Likert-type statements which combine to measure a distinct phenomenon as a whole; whereas, Likert-type questions consist of a number of items which are measured individually but use a Likert response format (Batterton & Hale, 2017; Joshi et al., 2015; Tanujaya, Prahmana, & Mumu, 2023).

The original Likert scale used a five-point scale, with “the ONE end assigned to one extreme of the attitude continuum and the FIVE to the other” and with “the three assigned to the undecided position (Likert, 1932, p. 46). Since this time, a broad range of Likert scales have been developed using two to twelve-point scales (Taherdoost, 2019). Five point-scales have been reported to be the most commonly used scale (Tanujaya, Prahmana, & Mumu, 2023), and are easier to complete, reduce participant frustration and increase the participant response rate (Babakus & Mangold, 1992; Bouranta, Chitiris, & Paravantis, 2009; Sachdev & Verma, 2004); with Aybek and Toraman

(2022), in an empirical study of the optimum number of response categories for the Likert type of scales, stating:

> Using a 5-point response option provides advantages over using a 3-point response category, but does not pose a major disadvantage compared to a 7-point response category. Therefore, researchers are recommended to use a 5-point response category, also considering the ease of responding. (p.544)

Delphi studies, employing the use of Likert scales or Likert-type questions, have included nursing care recommendations (Rasmussen et al., 2023), curriculum reviews (Rajhans et al., 2020), models for e-Learning (Al-araibi, Mahrin, & Yusoff, 2019), nursing education (Gibson et al., 2023), health care initiatives (Ben Charif et al., 2021; Chen et al., 2023), sample size requirements for Delphi study panels , and nursing competency standards (Boyer et al., 2019; Xu, Dong, et al., 2022). In these Delphi studies, four point-scales (Gibson et al., 2023; Rajhans et al., 2020), five point-scales (Boyer et al., 2019; Chen et al., 2023; Rasmussen et al., 2023; Xu, Dong, et al., 2022) and ten point-scales were used (Ben Charif et al., 2021).

### 6.9.5 Data collection in the study

The Delphi phase of this study used four rounds of questionnaires to explore and describe nursing informatics in collaboration with domain experts, with a focus on undergraduate curricula development and competency in nursing informatics. Questionnaire dissemination and response rates for each questionnaire in this study will now be described.

#### *6.9.5.1 First Round Questionnaire*

In this study, the First Round Questionnaire (refer to *Appendix C3*) was initially developed from a scoping review of contemporary literature to identify key concepts. Following completion of pilot testing, the *First Round Questionnaire* for the Delphi study was reviewed by the researcher and the PhD supervisors, and the questionnaire was emailed to the Delphi study participants in March 2024. 19 items were included in the questionnaire. This process was closely aligned with the requirements as described by Skulmoski (2007), Hasson & Keeney (2011), Keeney et al. (2011), Davidson (2013), Chalmers & Armour (2019), Niederberger & Spranger (2020), Spranger et al. (2022) and Drumm et al. (2022).

#### *6.9.5.2 Second Round Questionnaire*

In this study, both descriptive analysis and reflexive thematic analysis were used to analyse the First Round Questionnaire. Descriptive analysis was used to describe demographic data of the participants, including the country of residence and how they identified their nursing role(s). Reflexive thematic analysis was used to identify themes in the data. The *Second Round Questionnaire* was then developed to consolidate definitions of key terms, enhance understanding of specific concepts and to address issues raised in the initial questionnaire (refer to *Appendix C4*).

The questionnaire was reviewed by the PhD supervisors and then disseminated to the participants (n=56) via email.

#### *6.9.5.3 Third Round Questionnaire*

In this study, following reflexive thematic analysis of the Second Round Questionnaire, the *Third Round Questionnaire* was developed to explore the identified themes in a more in-depth manner (refer to *Appendix C5*). The purpose of the Third Round Questionnaire was to consolidate recommendations for undergraduate nursing curriculum that prepares students for the use of nursing informatics in the clinical setting. This aspect of the Delphi study required the participants to respond to a questionnaire, where the enablers and barriers identified in the First Round Questionnaire were rated from *Strongly disagree* to *Strongly agree*, in a five-point Likert-type scale. A free text section was included in each section for participants to provide additional information. The questionnaire also addressed the specific content to be addressed as part of the curriculum using a Likert-type scale. The use of a five point-scale was chosen to aid in ease of completion and to increase response rates. The Third Round Questionnaire was reviewed by the PhD supervisors and then disseminated to the participants (n=52) via Qualtrics - a web-based survey tool (Flinders University, 2022).

#### *6.9.5.4 Fourth Round Questionnaire*

In this study, following descriptive statistical analysis and reflexive thematic analysis of the Third Round Questionnaire and in adherence with the Delphi Study Protocol (refer to *Appendix B2*), a 75% threshold for consensus was sought for all variables, and where this could not be reached, these survey variables were deleted from this study. The *Fourth Round Questionnaire* was reviewed by the PhD supervisors and then disseminated to the participants (n=51) via Qualtrics (refer to *Appendix C6*).

### 6.9.6 Minimising non-response

Hsu and Sandford (2007b), in *Minimizing Non-Response in The Delphi Process: How to Respond to Non-Response*, noted the importance of setting a clear deadline to respond to the Delphi survey, with a number of Delphi studies identifying a 7 day (Campbell et al., 2020), 14 day (Ben Charif et al., 2021; Fink-Hafner et al., 2019; McCormack et al., 2022), 21 day (Blaschke, O'Callaghan, & Schofield, 2017), or 28 to 30 day (Rasmussen et al., 2023; Simmons, Barker, & Barnett, 2023; Vorstenbosch, Masoliver-Gallach, & Escuder-Romeva, 2022) time frame for return of questionnaires.

#### *6.9.6.1 Non-response from participants*

Non-response from participants must be factored into Delphi studies with the understanding that participant attrition is expected due to survey fatigue (Chalmers & Armour, 2019; Drumm, Bradley,

& Moriarty, 2022), distraction between rounds (Donohoe & Needham, 2009; Fink-Hafner et al., 2019; Keeney, Hasson, & McKenna, 2011), long-term commitment (Donohoe & Needham, 2009; Shang, 2023), and the iterative nature of the Delphi process (Khodyakov et al., 2023; Shang, 2023). Keeney, Hasson and McKenna (2011) noted that there are no specific guidelines regarding an acceptable response rate for Delphi studies but noted that a number of authors have suggested a 70% response rate is necessary to maintain rigour. As Hsu and Sandford (2007b), in *Minimizing Non-Response in The Delphi Process: How to Respond to Non-Response*, noted:

> Controlling for non-response by encouraging active participation which promotes participants to respond is essential to conducting an effective and meaningful Delphi investigation. After all, the feedback of only one or two individuals can become more opinion and preference rather than fact and expertise. (p. 5)

Therefore, it is essential that response (or non-response) rates are clearly articulated (Chalmers & Armour, 2019; Jünger et al., 2017), and that strategies are used to reduce non-responses from participants. Mitigation strategies for non-response include up-to-date communications with participants, clearly established timelines, the use of reminders and communicating findings (Hsu & Sandford, 2007b; Keeney, Hasson, & McKenna, 2011; Shang, 2023) and professional recognition of participants' contributions (Khodyakov et al., 2023). Khodyakov et al. (2023), in *RAND Methodological Guidance for Conducting and Critically Appraising Delphi Panels*, recommend recruiting a larger sample of participants than required, using personalised communication and addressing participants by name, explaining the Delphi technique, ensuring correct email addresses are used, limiting questions in each round, limiting the number of questionnaire rounds, keeping participants informed of any changes to the study process, using incentives and determining a priori whether participants who miss a round will continue to participate.

#### *6.9.6.2 Use of reminders*

Retention of participants is a crucial factor in the Delphi technique, with participant fatigue identified as impacting response rates (Davidson, 2013; Drumm, Bradley, & Moriarty, 2022; Keeney, Hasson, & McKenna, 2001). To increase response rates, reminders may be used (Chalmers & Armour, 2019; Humphrey-Murto & de Wit, 2019); however, it is essential that undue pressure is not placed on participants and that the right to withdraw from the study is recognised (Keeney, Hasson, & McKenna, 2001). The role of the researcher, in this context, is to maintain communication with participants (Avella, 2016; Hasson, Keeney, & McKenna, 2000), thereby encouraging engagement in the research process.

#### *6.9.6.3 Minimising non-response in the study*

In this study, in adherence with the above recommendations. Sampling of participants was initially identified as requiring 40 participants - nurse informaticians and experts in nursing informatics (n=20) and nurse educators (n=20) - with the understanding that attrition throughout this study may result in a smaller population overall. (refer to *6.8.2 Delphi study participants*). The recruitment strategy resulted in 61 participants, with nurse educators (n=27), nurse informaticians (n=20) and experts in nursing informatics (n=15) (please note that some participants identified more than one role).

Each participant was contacted individually via email prior to the commencement of this study and the communication identified the participant by name. The Delphi technique was described in the recruitment process, including the anticipated number of rounds (refer to *Appendices C1 & C2*). Pilot testing of the First Round Questionnaire (refer to *6.7.1 Pilot testing of questionnaire*) was used to limit questions and ensure clarity.

Questionnaire rounds were considered based on the achievement of consensus, data saturation and data redundancy. Participants were informed of the study process and informed regarding the next stage of this study via email.

As per the Delphi Study Protocol (refer to *Appendix B2*) - Participants who did not return the survey instruments or respond to reminder emails were removed from this study in accordance with the Delphi Study Protocol (refer to *Appendix B2*). The response rates to all rounds of the Delphi study were recorded in the Delphi Study Flow Chart (refer to *Figure 6.1*) and are detailed in *6.9.5 Data collection in the study.* The total attrition rate for the Delphi study phase was 16.4%.

## 6.10 Data analysis in Delphi studies

The Classical Delphi technique starts with open-ended questions to generate and facilitate ideas and to elicit opinion which can generate large amounts of data (Keeney, Hasson, & McKenna, 2011; Procter & Hunt, 1994); therefore, careful analysis is required (Hasson, Keeney, & McKenna, 2000). Delphi studies typically include qualitative and quantitative data and may use content analysis (Arakawa & Bader, 2022; Spranger et al., 2022), thematic analysis (Naserrudin et al., 2022; Simmons, Barker, & Barnett, 2023; Woodcock et al., 2020) descriptive analysis (Rasmussen et al., 2023; Xu, Dong, et al., 2022; Zareshahi, Mirzaei, & Nasiriani, 2022) or inferential statistics (Khodyakov et al., 2023; Konopka et al., 2022; Rasmussen et al., 2023), with most studies using a combination of analysis approaches. Powell (2002, p. 379), in *The Delphi technique: myths and realities*, noted that “methods of data analysis appear to vary according to the purpose of the Delphi study, structure of the rounds, types of questions and numbers of participants”. Approaches to analysing data in Delphi studies are now be described.

### 6.10.1 Qualitative data analysis methods in Delphi studies

#### *6.10.1.1 Content analysis*

Content analysis is “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” and provides a means of systematically coding and categorising large quantitative and qualitative data sets (Krippendorff, 2019, n.p.). This method of data analysis is characterised as a systematic approach to analysing textual data, which moves away from analytical constructs (rules of inference) to answering the research questions. These constructs may be sourced from previous research, existing theories/ practices or the experiences of experts (Gheyle & Jacobs, 2017; Krippendorff, 2019; White & Marsh, 2006). Previous studies, using both the Delphi technique and content analysis, have included indicators of disaster recovery (Jordan & Javernick-Will, 2013), health leadership (Fletcher & Marchildon, 2014), competency standards for district nurses (Irvine, 2005), and forecasts for types of digital healthcare and anticipated workforce requirements (Lee, Hammarén, & Kanste, 2024).

Originally a quantitative method, content analysis has become increasingly used in qualitative studies, with types of content analysis broadly defined as quantitative content analysis and qualitative content analysis (Graneheim, Lindgren, & Lundman, 2017; Humble & Mozelius, 2022; Kleinheksel et al., 2020). *Quantitative content analysis* relies on the enumeration of coded texts, and typically involves the generation of a hypothesis, sampling of data sets and an *a priori* coding scheme (Gheyle & Jacobs, 2017; Krippendorff, 2019; White & Marsh, 2006). *Qualitative content analysis* involves the development of analytical categories though in-depth reading of texts, creating interpretations and developing narratives of the phenomenon of interest (Gheyle & Jacobs, 2017; Krippendorff, 2019; White & Marsh, 2006). The approach reduces the volume of data, categorises the data and seeks meaning from the data, by using the stages of decontextualisation, recontextualisation, categorisation and compilation (Bengtsson, 2016). Combined approaches using both quantitative and qualitative content analysis are also evident in the literature (Devi, 2009), with Krippendorff (2019, n.p.), in *Content Analysis: An Introduction to Its Method*, cautioning that “all *Coding* of Text involves qualitative judgments or identifications, so that the distinction between qualitative and quantitative approaches is largely one of emphasis, often falsely identified with being interpretive versus scientific”. Gheyle and Jacobs (2017, n.p.), in *Content Analysis: a short overview*, also question this dichotomy, defining content analysis as “a range of methods on a continuum”, from quantitative approaches with the coding of data into pre-determined categories and using statistical analyses, to qualitative approaches which code content in a more inductive manner.

#### *6.10.1.2 Thematic analysis*

Thematic analysis “is a method for identifying, analysing and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 80) and unlike content analysis which can be defined as quantitative content analysis or qualitative content analysis (Gheyle & Jacobs, 2017; Krippendorff, 2019; White & Marsh, 2006), thematic analysis is a purely qualitative method of data analysis (Braun et al., 2019; Humble & Mozelius, 2022; Neuendorf, 2019). Braun & Clarke (2019, 2021b, 2021a, 2022b, 2023; n.d.-b, n.d.-a) describe thematic analysis as a family of methods, rather than a singular method, all of which require coding and theme development, the capture of manifest/semantic and/or latent meaning and the use of inductive and/or deductive reasoning. Previous studies, using both the Delphi technique and thematic analysis, have included priorities for professional development for Registered Nurses working in aged care facilities (Cooper et al., 2017), measuring outcomes of nursing practice (Sim et al., 2018), health promotion and health education in nursing (Whitehead, 2008), competencies in health education (Moynihan et al., 2015) and social media competencies for health professionals (Yilmaz et al., 2022).

Braun and Clarke (2022b, p. 6) have identified three main schools of thematic analysis – *coding reliability*, *codebook* and *reflexive*, with each name reflecting “the key characteristics of coding in each type and thus only captur(ing) one element of differences across the approaches, and indeed the practice of doing TA”. The authors refer to their approach to thematic analysis as *Reflexive Thematic Analysis* which emphasises the researcher’s role in knowledge production, with the researcher actively engaged in coding and generation of themes, and coding as an active and reflexive process which is inherently linked to the researcher (Braun & Clarke, 2019, 2021b, 2021a, 2022b, 2022a, 2023; n.d.-b, n.d.-a, n.d.-c); importantly, “researcher subjectivity is the primary “tool” for reflexive TA; subjectivity is not a problem to be managed or controlled, it is a resource for research” (Braun & Clarke, 2022b, p. 8). The authors emphasise that *coding reliability thematic analysis* (differs from reflexive thematic analysis) as it is limited by post-positivist assumptions, themes are identified rather than actively generated by the researcher, coding uses *a priori* codebooks, the researcher is considered a risk to the validity of the analysis, and quality of the analysis is determined through inter-rated reliability, rather than deep data engagement and a systematic data analysis process (Braun & Clarke, 2022a; n.d.-b). *Codebook thematic analysis* (differs from reflexive thematic analysis) in the use of codebooks, codes and themes being organised hierarchically to guide coding for the identification of themes, and the quality of the analysis being established through audit trails, multiple researchers coding and comparing with measures of inter-coder reliability (Braun & Clarke, 2022a; n.d.-b).

A key difference between reflexive thematic analysis, and other types of thematic analysis, that is emphasised by Braun and Clarke (2006; 2022a, 2023; n.d.-b; Braun, Clarke, & Hayfield, 2022; SAGE, 2022) is regarding how themes are conceptualised. The authors (Braun & Clarke, 2022a, p.

296) criticise the notion of emerging themes, as if they are waiting to be discovered, stating “it suggests the researcher did not play an active role in the creation of themes; that themes exist fully formed in data and are ‘harvested’ by the researcher during data analysis.” Braun and Clarke (2023, p. 2) also differentiate between topic summaries and themes, noting that what is often defined as a theme is a collection of data identifying a common topic, rather than “capturing a core idea or meaning (what is shared and unites the observations in the theme is meaning), and the telling of an interpretative story about it”. These distinctions are reflected in the name of this thematic analysis approach – *reflexive thematic analysis* – as the researcher engages with the data in a reflexive manner through critically reflecting on the assumptions and research design choices which inform the knowledge they produce (Braun & Clarke, 2022a). Previous studies, using both the Delphi technique and Braun and Clarke’s reflexive thematic analysis method, have included the development of a tool for measuring child neglect (Haworth, Montgomery, & Schaub, 2023), measurement plans for health improvement projects (Woodcock et al., 2020), user experience in simulation settings (Jacobs, Foote, & Williams, 2023) and research priorities for respiratory nursing (Kelly et al., 2018).

#### *6.10.1.3 Comparisons of content analysis and thematic analysis*

Although sometimes used interchangeably or confused (Braun & Clarke, 2021b; Sandelowski & Leeman, 2012; Vaismoradi, Turunen, & Bondas, 2013), *content analysis* and *thematic analysis* are distinct methods of data analysis, with the key differences identified by Neuendorf (2019), in *Content analysis and thematic analysis*, as the historical origins of the methods, with content analysis originating from the positivist paradigm and thematic analysis from the constructivist paradigm; the development of codes being *a priori* in content analysis but inductive in thematic analysis; and the conclusion of content analysis usually providing statistical summaries and analysis of the coding and the conclusion of thematic analysis aligned with saturation of themes and the frequency of the themes not identified as a main goal. Similarities include the use of coding (the use of symbols or abbreviations to represent text content), the identification of manifest and latent content (Neuendorf, 2019) and the use of deductive and inductive reasoning (Humble & Mozelius, 2022). The methodological decision regarding whether to use content analysis or thematic analysis, is addressed by Braun and Clarke (2021b, p. 38) who advise that “researchers do not need to go on a ‘hallowed method’ quest” and that was is important, is to select a method that aligns with the purpose of the research study and that there is coherency in the overall research design.

#### *6.10.1.4 Qualitative data analysis in the study*

Reflexive thematic analysis was used to analyse the qualitative Delphi data in this study, with qualitative data collected in all rounds of the questionnaires. The decision to use reflexive thematic analysis was underpinned by the researcher’s aim to develop patterns of meaning from the participants’ responses to the Delphi study questions. Using reflexive thematic analysis “involves a reflexive, recursive engagement with the dataset, to produce a robust analysis” with each phase facilitating rigorous researcher engagement and interrogation of the data (Braun & Clarke, n.d.-d). The decision to use this approach is underpinned by the practical guidance available on the method, the use of the method in previous nursing research, the inductive development of codes, and the focus on in-depth narratives of participants’ experiences.

There are six phases of reflexive thematic analysis and underpinning these six phases, is the understanding that whilst sequential, analysis typically requires moving back and forth between phases (Braun & Clarke, 2021b, 2021a, 2022b; n.d.-d).

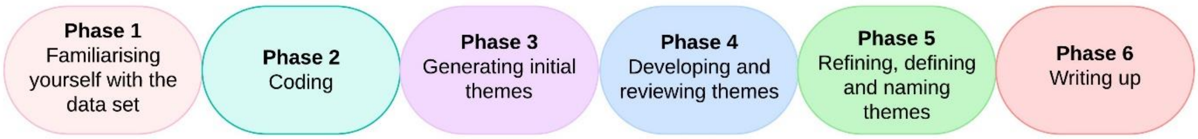



**Figure 6.2 Reflexive Thematic Analysis Phases**

*Note:* Based of the work of Braun, V., & Clarke, V. (2022). *Thematic Analysis: A Practical Guide*. SAGE Publications Ltd.

The six phases of reflexive thematic analysis is now discussed as applied in this study.

#### *6.10.1.4.1 Phase 1 - Familiarising yourself with the data set*

Phase 1 requires the reading and rereading of data with the researcher becoming immersed and familiar with the content, making notes regarding initial analytical insights of the individual data and its relationship with the entire data set. Braun and Clarke (2022a), in *Thematic Analysis: A Practical Guide*, describe three practices in this phase – immersion, critical engagement and note taking. *Immersion* is the process of becoming deeply familiar with the data and identifying “the rich diversity of meaning, particularly interesting or intriguing elements, as well as possible patternings across the dataset” (Braun & Clarke, 2022a, p. 43). The step requires the reading and rereading of the data and the development of a broad understanding of the data (Braun & Clarke, 2022a). *Critical engagement* occurs as the researcher stops simply reading the information and starts to identify patterns of meaning and the researcher’s reaction to the data (Braun & Clarke, 2022a). The authors recommend considering the following questions:

> How does the person make sense of whatever it is they are discussing?
>
> Why might they be making sense of things in this way (and not in another way)?
>
> In what different ways do they make sense of the topic?
>
> How ‘common-sense’ or socially normative is this depiction or story?

> How would I feel if I was in that situation? (Is this different from or similar to how the person feels, and why might that be?)
>
> What assumptions do they make in describing the world?
>
> What kind of world is 'revealed' through their account?
>
> (Braun & Clarke, 2022a, p. 44).

At the same time, during the critical engagement stage, the researcher should consider the following questions:

> Why might I be reacting to the data in this way?
>
> What ideas does my interpretation rely on?
>
> What different ways could I make sense of the data?
>
> (Braun & Clarke, 2022a, p. 44).

*Note taking* occurs throughout the analysis process and is a means of recording information obtained throughout the familiarisation process (Braun & Clarke, 2022a; Meehan, 2021). These notes may not only be textual but also made include voice memos, images or 'doodles', and are for the researcher's use only to assist in remembering key thoughts and reflections (Braun & Clarke, 2022a; Meehan, 2021).

In this study, in analysing the *First Round Questionnaire*, the questionnaires were uploaded to NVivo™ (Version 14), with the questions used to divide the participant responses into sections to aid in ease of reading and immersion; however, it is important to note, that these sections were not pre-identified themes or a codebook. NVivo™ was used to develop six sections to guide the analysis process and act as an *aide-mémoire*, with each phase of the data analysis process clearly identified, as recommended by Meehan (2021), in *Conducting Reflexive Thematic Analysis using NVivo*. During immersion in the data, two memo files were developed – one which outlined the researcher's thoughts in note form and the other which cited seminal quotes from the data. Critical engagement with the data occurred following immersion and involved considering the questions detailed above and starting to identify themes. Note taking occurred throughout the data analysis.

#### *6.10.1.4.2 Phase 2 – Coding*

*Phase 2* involves generating codes to capture important aspects of the data that may be relevant to the research question(s). This requires coding of the entire dataset, with two or more rounds, and subsequently collating all of the codes and identifying relevant data extracts (Braun & Clarke, 2022a; n.d.-d; Meehan, 2021). Braun and Clarke (2022a, p. 49) recommend moving from Phase One to Phase Two once the researcher is familiar with the data, with the acknowledgement that there is no right time to move to coding, and stating – "don't wait until you feel you understand everything that’s going on in your dataset, before moving to coding”. The coding process requires that sections of data that are meaningful or relate to the research question(s) are identified and coded; this process can involve identifying both explicit and latent meaning and moves beyond summarising to analysing the data (Braun & Clarke, 2022a, 2023; Meehan, 2021).

In this study, in analysing the *First Round Questionnaire*, questionnaires were reread, and sections of the data were allocated to relevant codes. These codes closely resembled those that were developed during the initial note taking in Phase 1. Each questionnaire was then reread to ensure that relevant sections of data were allocated to the appropriate code. In analysing the *First Round Questionnaire*, these codes focused on nursing informatics (definitions, significance and use), computer and digital literacy (definitions, differences, concept and relevance of the digital native, improving own computer and digital literacy, and assessing student computer and digital literacy), enablers and barriers for undergraduate education on nursing informatics, and education (formal education relating to nursing informatics, informal education relating to nursing informatics, continual professional development relating to nursing informatics, and recommendations for undergraduate education on nursing informatics). A mind map was developed with each of the codes and underlying elements.

#### *6.10.1.4.3 Phase 3 - Generating initial themes*

This phase requires examining the established codes and collated data extracts, and developing potential themes (Braun & Clarke, 2022a; n.d.-d; Meehan, 2021). “Where codes typically capture a specific or a particular meaning, themes describe broader, shared meanings” (Braun & Clarke, 2022a, p. 35). In *Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a knowing researcher*, Braun and Clarke (2023, p. 2) differentiate between *themes* and *topic summary themes*, identifying themes as “meaning-based interpretative stories” which may draw together apparently unrelated topics but with a core meaning and topic summary themes typically mapping closely to the questions asked in data collection. Following the identification of potential themes, the relevant data is collated to determine the viability of each theme with the use of mind mapping identified as a useful means of visualising the themes (Braun & Clarke, 2022a; Meehan, 2021).

In this study, in analysing the *First Round Questionnaire*, initial themes were developed and were informed by the codes from Phase 2. The mind map developed in Phase 2 was useful in generating initial themes and provided a means of identifying connections between codes. Adhering to Braun and Clarke’s (2022a, p. 86) recommendation to avoid developing “a highly particularised, multi-layered model demarcating meaning, sub-meaning, sub-sub-meaning, and so forth”; the mind map actual worked to simplify and reduce the layers of coding, to more clearly reflect the patterned meanings in the data. A modified mind map, identifying initial themes, was then developed. “A good theme name is a short phrase, or perhaps a heading and subheading, that captures the essence of the theme and engages the reader" (Braun & Clarke, 2022a, p. 112).

So, in the essence of engaging theme names, the initial themes were:

- What is nursing informatics and why is it important?
- What do I need to know about nursing informatics?
- How can I learn about nursing informatics?
- Everyone knows how to use a computer!

##### *6.10.1.4.4 Phase 4 - Developing and reviewing themes*

Phase 4 involves comparing the themes against the coded datasets to establish whether a coherent story of the data has been established and whether this addresses the research question(s) (Braun & Clarke, 2022a). During this phase, the viability of the initial themes are checked against the coded data extracts and the entire dataset – some may be divided, combined or discarded (Braun & Clarke, 2022a; Meehan, 2021), with themes defined as “pattern of shared meaning underpinned by a central concept or idea” (Braun & Clarke, n.d.-d). As previously stated, these themes move beyond topic summaries and provide a rich and nuanced story of the dataset, which when combined “tell an *overall* story that addresses the research question” (Braun & Clarke, 2022a, p. 97). Braun and Clarke (2022a) also address contradictory data items and advise that different themes can be contradictory but that a theme should not have internal contradictions. It is recommended that if there is enough shared data highlighting a contradiction, then this can be developed as a theme (on its own).

In this study, in analysing the *First Round Questionnaire*, each of the themes were reviewed, to check whether they provided a clear shared meaning of the central concepts. Coded extracts and the original dataset were revisited, with some extracts removed and some added from the original dataset. Contradictory statements were reviewed to establish whether there was sufficient shared data to warrant a new theme or whether they should be removed. To establish whether the themes told a story relevant to the research questions, the research questions were aligned with the relevant themes. This information was also used to start to develop further questions to be asked in subsequent questionnaires to ensure that the shared meaning accurately reflected the participants’ opinions and experiences. A mind map was developed to aid in clearly identifying each theme and sub-theme. Further discussion of *Phase 4 - Developing and reviewing themes*, as applied to each Delphi questionnaire, is addressed in *Chapter 7: Phase 2 - Delphi study findings.*

##### 6.10.1.4.5 Phase 5 - Refining, defining and naming themes

This phase requires an in-depth analysis of each theme (Braun & Clarke, 2022a; Meehan, 2021). Braun and Clarke (2022a) explain that Phase 5 and the final phase of reflexive thematic analysis often occur concurrently and blend into each other. This phase requires the writing up of each theme, with the theme definition “outlining the scope, boundaries and core concept of the theme” (Braun & Clarke, 2022a, p. 108). Braun and Clarke (2022a) recommend the following criteria in writing a definition for a theme – the central concept of the theme, the specific boundaries of the theme, the unique nature of the theme and the contribution of the theme the data analysis.

In the study, in analysing the *First Round Questionnaire*, each of the existing themes were defined with consideration of the criteria (as described above). The coding, from Phase 4, was revisited and refined with further removal of contradictory statements which did not achieve saturation in the data set and similar codes were combined to provide a more cohesive story of the data. A mind map was developed from this process and acted as an *aide memoire* when defining each theme. Further discussion of Phase 5 - Refining, defining and naming themes, as applied to each Delphi questionnaire, is addressed in *Chapter 7: Phase 2 - Delphi study findings.*


**Figure 6.3 NVivo™ Mind Map**

#### *6.10.1.4.6 Phase 6 - Writing up*

The final phase involves the integration of the analysis with data extract examples and literature to provide a rich narrative of the phenomenon of interest (Braun & Clarke, 2022a; Meehan, 2021). Braun and Clarke (2022a) emphasise, that unlike statistical or quantitative research where reporting typically occurs following analysis, the process of writing up in reflexive thematic analysis involved ongoing refining of the data analysis to create a narrative that is weaved together with data extracts and existing literature (Braun & Clarke, n.d.-d).

In this study, in analysing the First Round Questionnaire, the fours themes - *What is nursing informatics and why is it important?*; *Everyone knows how to use a computer!*; *How can I learn about nursing informatics?*; and *What do I need to know about nursing informatics?* – were developed into narratives that integrated the analysis of the data with data extracts and contemporary literature. Underpinning each of these themes were the research questions: 1) Can a distinct body of knowledge of nursing informatics be developed?; 2) Can operational definitions for nursing informatics be achieved through consensus?; and 3) Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? Braun and Clarke (2022a) recommend five sources, using reflexive thematic analysis, to provide examples of writing up in a reflexive thematic analysis style (Braun, Clarke, & Rance, 2014; Braun, Clarke, & Terry, 2014; Braun, Clarke, & Weate, 2017; Clarke, Braun, & Hayfield, 2015; Hayfield et al., 2019), these publications were used to inform the writing up stage of the analysis. Further discussion of Phase 6 – Writing up, as applied to each Delphi questionnaire, is addressed in Chapter 7: Phase 2 - Delphi study findings. (Please note - further information regarding data analysis using NVivo™ is available on request).

### 6.10.2 Quantitative data analysis methods in Delphi studies

*Chapter 4: Research methods – Phase 1 – Scoping Review* describes the use of *descriptive statistics*, in particular *frequency counts.* Descriptive statistics are “statistical procedures for summarising, organising and communicating characteristics of samples of data” (Cooksey, 2020, p. 8), and are expressed numerically and in tabular or graphic formats (Fisher & Marshall, 2009). Inferential statistics “are used to make inferences about a general population using data obtained from a study sample” (Keeler & Curtis, 2024). Both types of statistics can be used in Delphi studies and depending on the level of measurement, non-parametric and parametric tests may be applied.

#### *6.10.2.1 Levels of measurement*

The type of statistics used depends on the level of measurement. It is important to note, that some authors use different terminology to describe these forms of measurement (Fisher & Marshall, 2009; Mishra et al., 2018; UCLA: Statistical Consulting Group, n.d.), including:

*Nominal levels of measurement* are reported by identifying the percentage of variables in each category, using frequency distribution, the measure of central tendency – the mode expressing the most frequently occurring value, the measure of dispersion and cross tabulations (Byrne, 2007; Fisher & Marshall, 2009; Stewart & Stewart, 2016).

*Ordinal levels of measurement* are used to assign variables into a hierarchical or rank order (for example participants' age groups) without consistency with the distances between categories. Ordinal levels of measurement are reported as frequencies, proportions, percentages, rank-ordered distribution, with the median expressing the middle value of the rank-ordered distribution, and summary statistics (Byrne, 2007; Fisher & Marshall, 2009; Stewart & Stewart, 2016).

*Interval (continuous/numerical) levels of measurement* assign variables to scales with increments of equivalent distance with an arbitrary, meaningless or non-existent zero point (for example participants' temperature). Interval levels of measurement are reported as central tendency (mean, mode and median), range (minimum and maximum) and spread (percentages, inter-quartile ranges and standard deviations (Byrne, 2007; Fisher & Marshall, 2009; Stewart & Stewart, 2016).

*Ratio levels of measurement level* assign variables to scales with increments of equivalent distance and an absolute zero point in the scale (for example participants' income). Ratio levels of measurement are reported as central tendency (mean, mode and median), range (minimum and maximum) and spread or level of dispersion (percentages, inter-quartile ranges and standard deviations) (Byrne, 2007; Fisher & Marshall, 2009; Stewart & Stewart, 2016).

In this study, nominal and ordinal levels of measurement were obtained during the questionnaire rounds and were analysed manually and with the use of data analysis software. Further descriptions of the use of nominal and ordinal data, in the study, are addressed in *6.10.2.6 Quantitative data analysis in the study*.

#### *6.10.2.2 Parametric and non-parametric tests*

To present statistical data for meaningful understanding, two specific methods are applied – non-parametric and parametric tests. *Non-parametric tests* are used when data scales are nominal or ordinal and make no or limited assumptions about the distribution of dependent variables (Cooksey, 2020; Hopkins, Dettori, & Chapman, 2018; Vrbin, 2022). *Parametric tests* are typically used when interval or ratio scales of measurement are obtained and are based on assumptions about the studied population (Cooksey, 2020; Hopkins, Dettori, & Chapman, 2018; Vrbin, 2022). The decision to select parametric versus non-parametric tests is dependent on the type of data and the representativeness of the sample (Hopkins, Dettori, & Chapman, 2018), with representativeness defined as "the degree of similarity of a study population compared to an external population" (Jaehn et al., 2020, p. 1).

In this study, non-parametric tests were performed due the collection of nominal and ordinal data. Further descriptions of the use of non-parametric tests, in the study, are addressed in *6.10.2.6 Quantitative data analysis in the study*.

#### *6.10.2.3 Descriptive and inferential statistics*

Descriptive statistics refer to statistics that only describe the study sample data (Stommel, Dontje, & Zuccarini, 2014) and provide summaries of this data (Mishra et al., 2019). *Inferential statistics* use data to make inferences about the population being studied (Keeler & Curtis, 2024; Marateb et al., 2014; Vrbin, 2022), with the decision to use inferential statistics based on whether analysis is required to describe the studied population or to extrapolate these findings to the broader population (Byrne, 2007; Fisher & Marshall, 2009; Guetterman, 2019). In this study, descriptive statistics were used to provide summaries of the study participants' responses and data. The following section will address the types of descriptive statistical measures.

The three main types of descriptive statistics are measures of central tendency, measures of dispersion and measures of frequency (Cooksey, 2020; Mishra et al., 2019), with descriptive statistics making use of non-parametric tests, which make no or limited assumptions about the distribution of dependent variables and are used for nominal and ordinal levels of measurement (Vrbin, 2022). Non-parametric tests used in descriptive statistics include the Wilcoxon Signed Rank Test, Mann-Whitney U Test, Kruskal-Wallis Test and the Friedman Test (Cooksey, 2020; du Prel et al., 2010; Moss, n.d.) and measures of central tendency, measures of dispersion and measures of frequency are determined.

*Measures of central tendency* are summary measures that aim to describe a data set with a single value – mean, mode or median (Cooksey, 2020; El Morr et al., 2022; Mishra et al., 2019). The *mean* is the sum value of each observation in the data set and is calculated by adding together all of the values and then dividing by the numbers of observations (Cooksey, 2020; El Morr et al., 2022; Guetterman, 2019). The *mode* is the most commonly occurring value in the data set (ABS, n.d.-a; Cooksey, 2020; El Morr et al., 2022). The median is the middle value in the distribution of the data set and is calculated by arranging the data set values in numerical order and determining the middle (median) value (Cooksey, 2020; El Morr et al., 2022; Mishra et al., 2019).

*Measures of dispersion* (or measures of variation) are measurements of the variation of a data set and demonstrate the homogeneity or heterogeneity of the data (Mishra et al., 2019; Rees, 2016). Common measurements of dispersion include variance, standard deviation, standard error and range (Byrne, 2007; El Morr et al., 2022), with other measurements including quartile and interquartile range and percentile (Mishra et al., 2019). *Standard deviation* measures how far values are spread out from the median value, with variance measuring the variability of the data

(Mishra et al., 2019; Moore, McCabe, & Craig, 2016; Rees, 2016). *Standard error* measures the difference between the means of the sample and the mean of the population (Cooksey, 2020; Mishra et al., 2019; Moore, McCabe, & Craig, 2016). *Range* is the difference between the smallest and largest value in a data set (Cooksey, 2020; Fisher & Marshall, 2009; Moore, McCabe, & Craig, 2016).

*Measures of frequency* (or frequency distributions) count the frequency of occurring variables (Cooksey, 2020; Rees, 2016; Stewart & Stewart, 2016). *Absolute frequencies* describe the number of times a variable occurs and is the simplest method of describing frequencies (ABS, n.d.-b). *Relative frequencies* describe the frequency that a specific value of a variable occurs in comparison to the total number of values for that variable (ABS, n.d.-b; Cabrera & McDougall, 2002). Relative frequencies are expressed using ratios, percentages, rates and proportions (ABS, n.d.-b). *Ratios* measure the frequency of one variable in relation to another variable (ABS, n.d.-b; LaMorte, 2022; Statistique Canada (Statistics Canada), 2021). *Percentages* measure a variable in relation to  a whole population and are expressed as a part of one hundred (ABS, n.d.-b; Statistique Canada, 2021). *Rates*, are a type of ratio, that compare two measurements of different units (ABS, n.d.-b; Statistique Canada, 2021). *Proportions*, are a type of ratio, that measure a value of a variable in comparison to the whole variable (ABS, n.d.-b; Statistique Canada, 2021).

In this study, descriptive statistics were used to analyse participants' responses. Further descriptions of the use of descriptive statistics, in the study, are addressed in *6.10.2.6 Quantitative data analysis in the study*.

#### 6.10.2.4 Analysis of Likert scales and Likert-type scales

Likert scales have been acknowledged as providing "a convenient way to measure unobservable constructs" (Jebb, Ng, & Tay, 2021, p. 1). Likert-type questionnaires use the same structure as the Likert scale but each question is analysed individually, rather than as a composite scale and analysed as a whole (Guerra, Gidel, & Vezzetti, 2016; Jebb, Ng, & Tay, 2021; Tanujaya, Prahmana, & Mumu, 2023). Analysis of *Likert scales* and *Likert-type scales* can use both descriptive and inferential statistics; however, the method of analysis has been subject to considerable debate (Carifio & Perla, 2007; Kero & Lee, 2016; Norman, 2010). Carifio and Perla (2008), in *Resolving the 50-year debate around using and misusing Likert scales*, identified the debate as centring around whether Likert scales used ordinal or interval levels of measurement and the subsequent requirement for non-parametric versus parametric tests and asserted that Likert scales use interval data and therefore required parametric tests. In a methodological literature review. Harpe (2015), noted Rensis Likert's original discussion of analysis as aligning with an interval level of measurement and recommended that the choice of statistical test be justifiable and relevant to the context of the study, but noted the general consensus to use parametric statistical tests. Jamieson (2004) noted that response categories are organised in rank order, but the intervals between each value are not assumed to be equal, meaning that they are categorised as ordinal data and therefore require non-parametric tests; whereas, Wu and Leung (2017), in *Can Likert Scales be Treated as Interval Scales?—A Simulation Study*, noted that despite using ordinal levels of measurement, some studies have found parametric tests useful. To evaluate the use of parametric and non-parametric statistical methods on Likert scales, Mircioiu and Atkinson (2017, p. 10) applied both types of analysis and concluded that "parametric and non-parametric analyses lead to similar conclusions regarding statistical significance", this finding was supported by Norman (2010), in *Likert scales, levels of measurement and the ''laws'' of statistics*, who asserted that:

> Parametric statistics can be used with Likert data, with small sample sizes, with unequal variances, and with non-normal distributions, with no fear of ''coming to the wrong conclusion''. These findings are consistent with empirical literature dating back nearly 80 years. The controversy can cease. (p. 631)

A further discussion has centred around whether Likert scales and Likert-type scales require different methods of analysis, with recommendations that the individual items associated with Likert-type scales should use descriptive statistical methods (Batterton & Hale, 2017; Bishop & Herron, 2015; Boone & Boone, 2012), and Alkharusi (2022, p. 14) stating that "Likert-type items can be analyzed by using frequencies, or finding the mode and the median, or applying non-parametric data analysis approaches".

Reflecting these disparate opinions, authors have recommended that Likert and Likert-type scales be analysed using non-parametric statistics, including the measure of central tendency – mode, and median and the measure of dispersion (Harpe, 2015; Joshi et al., 2015) or parametric statistics, including the central tendency - mean and the standard deviation (Carifio & Perla, 2008; Chen & Liu, 2020; Tanujaya, Prahmana, & Mumu, 2023). Importantly, Guetterman (2019) advises, that despite decision-making regarding the type of statistical analyses, analysis must always start with descriptive statistics.

#### *6.10.2.5 Statistical analysis in Delphi studies*

Keeney, Hasson and McKenna (2011, p. 84), when addressing data analysis in Delphi studies, noted the predominant use of descriptive statistics, with "measures of central tendency (mean, mode and median) and level of dispersion (standard deviation and inter-quartile range) in order to present information concerning the collective judgements of respondents"; however, the use of the mean is queried by some Delphi researchers, as the nominal and ordinal data collected in Delphi questionnaires does not meet the standard requirements for calculation of the mean. The use of these descriptive statistical methods are viewed as providing participants with information about the collective opinion and enabled participants to evaluate their responses with the group opinion

(Hasson, Keeney, & McKenna, 2000). Examples of statistical analysis used in published Delphi studies, have included frequency and percentage (Denecke et al., 2023; Gibson et al., 2023), the mean (Heuzenroeder et al., 2022; Shinners et al., 2021), the median (Ben Charif et al., 2021; Konopka et al., 2022), the inter-quartile range and deviation (Chianchana, 2021; Denecke et al., 2023), and the standard deviation (Al-araibi, Mahrin, & Yusoff, 2019; Xu, Dong, et al., 2022).

### *6.10.2.6 Quantitative data analysis in the study*

Descriptive statistics were used to analyse the quantitative Delphi data in this study in consultation with a statistical consultant. The First Round Questionnaire collected nominal data through demographic questions, the Third Round Questionnaire collected ordinal data through Likert-type questions, and the Fourth Round Questionnaire collected nominal data through demographic questions. (Please note: further information regarding the quantitative data analysis is available on request). The findings from the quantitative data analysis are detailed in *Chapter 7: Phase 2 - Delphi study findings,* using both text and tables.

#### *6.10.2.6.1 Statistical consultant*

To prepare for statistical analysis, consultation with a statistician can assist in determining the best way to analyse and interpret research data (American Statistical Association (ASA), 2020; Cabrera & McDougall, 2002). “Statistical practice involves contingent procedures and artful decision making, not the rote application of accepted formulas as is sometimes assumed” (McGinn, 2010, p. 35); however, most researchers do not have the time to develop expertise in statistical data analysis (Cabrera & McDougall, 2002) and students may experience anxiety associated with the application of appropriate statistical methods (Baglin, Hart, & Stow, 2017) Therefore, the use of a statistical consultant can assist the researcher in applying the appropriate analyses as required by the scientific method (Baglin, Hart, & Stow, 2017; Flinders University, 2024c; McGinn, 2010).

In this study, the researcher consulted domain experts regarding the appropriate application of statistical analyses including the Flinders University Statistical Consultant Dr. Pawel Skuza to discuss the analysis of the Likert-type questionnaire. Prior to the meeting, the research questions, methods of data collection and de-identified data were forwarded to Dr. Skuza and the researcher completed a brief literature review of statistical methods (which forms part of this chapter). A determination was made, following discussions between Dr. Skuza and the researcher and PhD supervisors, to calculate the measures of central tendency using the mean, to calculate the measures of frequency using absolute and relative frequencies, and to collapse the data sets to two levels and reanalyse the data. Emphasised in these discussions was the importance of maintaining a research diary to allow replication of the statistical analyses. Following the initial meeting, the researcher completed these statistical tests and forwarded them to Dr. Skuza.

In the second meeting, between Dr. Skuza and the researcher, discussions regarding the previously outlined statistical measures were revisited. Troubleshooting regarding the use of the IBM (International Business Machines) SPSS™ (Statistical Package for the Social Sciences) software and Excel spreadsheets was addressed, and a determination was made to perform the Mann Whitney U test and the Kruskal-Wallis Test for stakeholder-group analysis. The development of tables and graphs was discussed with recommendations from Dr. Skuza for how to best display the analysed data. Following this meeting, the researcher completed these statistical tests and forwarded them to Dr. Skuza for confirmation.

In the final meeting, between Dr. Skuza and the researcher, the output from the stakeholder-group analysis was evaluated with recommendations for how to best display the analysed data. The support and recommendations of Dr. Skuza confirmed the applicability of the statistical analyses used for the Delphi study. It is important to note, that Dr. Skuza did not vet the statistical results or accompanying discussion. The statistical analysis methods used in this study will now be addressed.

##### *6.10.2.6.2 Uploading data sets to IBM SPSS™*

Following data collection of the Third and Fourth Round Questionnaires, the Qualtrics data sets were uploaded to IBM SPSS™. Descriptive statistics were used to analyse the participants' responses in consultation with Dr. Skuza and with resources, including the IBM SPSS™ website (IBM, n.d.-b) and *SPSS Survival Manual: A Step by Step Guide to Data Analysis using IBM SPSS* (Pallant, 2016).

##### *6.10.2.6.3 Research diary*

Turkiewicz et al. (2018, p. 1410), in *Statistical mistakes and how to avoid them – lessons learned from the reproducibility crisis*, noted that "rigorous scientific reasoning, correct study design, and consistent statistical analyses along with their complete reporting are prerequisites for reliable, reproducible science". The key components for reproducible analysis are the availability of raw data sets and documentation to reproduce the statistical tests and analyses (Gentleman & Temple Lang, 2007; Peng, 2015), which provide transparency and evidence of objective, reliable results (Goodman, Fanelli, & Ioannidis, 2016; Resnik & Shamoo, 2017). A recommendation from Dr. Skuza was to create a research diary using the Syntax option on IBM SPSS™ with each computation recorded and with notes made regarding the researcher's thought processes. This document also allowed the researcher to revisit analyses to develop additional tables and to perform additional statistical tests. (Please note - syntax files and raw data are available on request).

#### *6.10.2.6.4 Cleaning of data sets*

Prior to analysis of data, the data set must be checked for errors or omissions and is completed by checking each variable to ensure it is within range and then locating errors and either correcting or deleting the value (IBM, n.d.-a; Pallant, 2016). In this study, the original, unedited data file was saved prior to cleaning of the data sets; this was to safeguard the raw data set. The first requirement was to clean the data sets – removing incomplete questionnaire responses and deleting data sets from Qualtrics which were not relevant for statistical analyses. Missing data was defined as incomplete questionnaire responses or no response given to a question; these are highlighted in the accompanying statistical tables and were factored into the statistical analyses. Any identifying participant details were removed, with an established code used to identify participants, thereby maintaining participant confidentiality (refer to *6.5.3 Safeguarding personal information*).

#### *6.10.2.6.5 Demographic data*

Descriptive statistics can be used in *demographic sample profiling*, as described by Keeney, Hasson and McKenna (2011), using a *nominal level of measurement* which categorises data in no inherent order to the categories (Cooksey, 2020; Fisher & Marshall, 2009; UCLA: Statistical Consulting Group, n.d.). The purpose of these measurements is to describe the panel and their characteristics (Keeney, Hasson, & McKenna, 2011). In the First Round Questionnaire, nominal levels of measurement were analysed using measures of central tendency (the mode) and measures of frequency (ratio). This analysis categorised the role of the participants - nurse informatician, expert in nursing informatics or nurse educator, and their country of residence. The purpose of these measurements was to provide sufficient information, to enhance the generalisability or transferability of the study findings to similar populations.

At the time of analysis of the Third Round Questionnaire, a decision was made to revisit the question of the job descriptors identified by each participant, as some participants had identified more than one job descriptor. Participants were contacted via email and asked to identify their primary job descriptor. This was to assist in the stakeholder-group analysis using the Kruskal-Wallis test. Records were maintained regarding participant selection of original job descriptors for inclusion in other analyses if required.

In the Fourth Round Questionnaire demographic data regarding the gender of all participants was collected. This data, in addition to the demographic data collected in the First and Third Round Questionnaires was collated and used in stakeholder-group analysis of the Likert-type questions obtained in the Third Round Questionnaire. The stakeholder-group analysis was addressed following the completion of the Fourth Round Questionnaire.

#### *6.10.2.6.6 Likert-type scale data*

In this study, the *Third Round Questionnaire* utilised Likert-type scales to collect ordinal data for analysis. As previously discussed, whilst ordinal level data is often aligned with non-parametric statistics, some schools of thought support the use of parametric statistics when analysing Likert-type questionnaires. Consideration was required regarding the aim of this study and the questionnaires, and which analysis method would provide the necessary data to support the aim of the Delphi study *to explore and describe nursing informatics in collaboration with domain experts, with a focus on undergraduate curricula development and competency in nursing informatics*. Therefore, the determination was made to use descriptive statistics to support the participants' recommendations for the development of undergraduate nursing curricula related to nursing informatics, with acknowledgement of the need to focus on the voices of these experts in exploring the phenomenon of interest. The use of the measures of central tendency, measures of dispersion, measures of frequency, collapsing data sets and stakeholder-group analysis, as applied in this study, will now be discussed.

#### *6.10.2.6.7 Measures of central tendency*

*Measures of central tendency* are summary measures that aim to describe a data set with a single value – mean, mode or median. In this study, the measures of central tendency were measured using the *mean* for the Likert-type questionnaire. The mean is calculated by adding together all of the values and then dividing by the numbers of observations. The mean was calculated using IBM SPSS and the mode was calculated manually. The calculated mean values were then organised in hierarchical order from lowest to highest values. Whilst it has been noted that Likert-type data is ordinal, the use of the mean to identify the central tendency of the data has been applied in other Delphi studies with Likert scales or Likert-type scales (Al-araibi, Mahrin, & Yusoff, 2019; Haworth, Montgomery, & Schaub, 2023; Xu, Dong, et al., 2022); with Hsu and Sandford (2007a, p. 4), in *The Delphi Technique: Making Sense of Consensus*, noting measures of central tendency, including the mean, "present information concerning the collective judgments of respondents".

#### *6.10.2.6.8 Measures of dispersion*

*Measures of dispersion* measure the variation of a data set and demonstrate the homogeneity or heterogeneity of the data. The Interquartile Range (IQR) is a measure of variability (Larson, 2006; Stewart & Stewart, 2016; Vetter, 2017) that "gives a much more stable picture of the variability of scores and, like the median, is relatively insensitive to the biasing effects of extreme data values" (Cooksey, 2020, p. 102). The interquartile range represents the range of values from the 75$^{th}$ percentile to the 25$^{th}$ percentile (Pallant, 2016; Schindler, 2015) and is an alternative measure to standard deviation, not linked with symmetry (Riffenburgh & Gillen, 2020). However, on initial analysis of the data and in consultation with Dr. Skuza, it was determined that due to the overall level of agreement and minimal dispersion across most of the variables, the analysis provided negligible information to inform the study findings and was therefore not included in the analysis of this study.

#### *6.10.2.6.9 Measures of frequency*

*Measures of frequency* count the frequency of occurring variables. In this study, the measures of frequency were calculated using absolute and relative frequencies, including percentages and proportions. *Absolute frequencies* were measured by identifying the number of times a particular value for a variable occurred. *Relative frequencies* were measured by using percentages. *Percentages* were calculated by comparing the individual value of variables in relation to the whole variable and expressed as a part of one hundred. In this study, absolute and relative frequencies were calculated using IBM SPSS™ and manually.

#### *6.10.2.6.10 Collapsing data sets*

This study used five response categories for the Likert-type scale – strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree and strongly agree. Following the initial descriptive analysis, the data sets were collapsed to two response categories with one category containing the strongly disagree, somewhat disagree and neither agree nor disagree responses and the second category containing the somewhat agree and strongly agree responses. The purpose of collapsing data sets is to consolidate sparse data (DiStefano, Shi, & Morgan, 2021; Jeong & Lee, 2016; Tsai, Wind, & Estrada, 2024) and to increase the clarity of data for easier identification of trends (Grimbeek et al., 2005). “Changing the number of categories (through collapsing) for an item – or many items on a scale – can improve results” (DiStefano, Shi, & Morgan, 2021, p. 247) and reduce the ambiguity of participant responses (Grimbeek et al., 2005). In this study, following collapsing of the five categories into two levels, the descriptive statistical measures (as previously described) were repeated, with comparative tables using the five response and two response categories. These measures were calculated using IBM SPSS™.

#### *6.10.2.6.11 Stakeholder-group analysis*

*Stakeholder-group analysis* is a term that was coined in organisational and management literature in the 1970s with recognition that key stakeholder characteristics can influence decision-making processes (Brugha & Varvasovszky, 2000); since this time, stakeholder-group analysis has been used in health research (Franco-Trigo et al., 2020; Jindal et al., 2019; Rahja et al., 2020). Beiderbeck et al. (2021, p. 14) in *Preparing, conducting, and analyzing Delphi surveys: Cross-disciplinary practices, new directions, and advancements*, recommended using both consensus and dissent analysis, stating: “we see consensus and dissent analyses as two sides of the same medal. Although both directions might ask for different analysis steps, measures, and thresholds, we recommend applying both perspectives to the Delphi dataset”. The authors identified a range of dissent analyses, including stakeholder - group analysis, and recommended pre-determined groups or emerging groups (with similar group responses) could be analysed (Beiderbeck et al., 2021). Dissent analysis, including stakeholder-group analysis, allows for a more in-depth and nuanced analysis and interpretation of divergent viewpoints within Delphi studies (Warth, von der Gracht, & Darkow, 2013). Tests used in stakeholder-group analysis, include the Mann-Whitney U test (Beiderbeck et al., 2021; Warth, von der Gracht, & Darkow, 2013), the Kruskal-Wallis test (Meyer et al., 2022; Willems & Faulk, 2019), or both tests (Rześny-Cieplińska, Szmelter-Jarosz, & Moslem, 2021; Susanti et al., 2021; Vo et al., 2023).

##### *6.10.2.6.12 The Mann-Whitney U test*

The *Mann-Whitney U test* is a non-parametric test that evaluates "the difference between two independent groups of participants on the basis of ranked scores on a dependent variable rather than scores at the interval or ratio-level of measurement" (Cooksey, 2020, p. 292). The Mann-Whitney U Test "converts the scores on the continuous variable to ranks across the two groups. It then evaluates whether the ranks for the two groups differ significantly" (Pallant, 2016, n.p.). To run this test two variables are required – one a categorical variable with two groups and one continuous variable (Verma & Abdel-Salam, 2019). Pallant (2016), in *SPSS Survival Manual: A Step by Step Guide to Data Analysis using IBM SPSS*, recommends reporting the Mann-Whitney U value, the standardised test statistic, the significance level and the mean rank.

Sullivan and Feinn (2012), in addressing statistical significance, state:

> While a *P* value can inform the reader whether an effect exists, the *P* value will not reveal the size of the effect. In reporting and interpreting studies, both the substantive significance (effect size) and statistical significance (*P* value) are essential results to be reported. (p. 279)

IBM SPSS™ does not calculate an effect size for the Mann-Whitney U test (Pallant, 2016), which measures the strength of the difference between groups or variables, or the influence of an independent variable (Pallant, 2016; Pek & Flora, 2018; Vetter, 2017); however, the *Glass rank biserial correlation coefficient r* can be used, with the following equation:

$$r_g = \frac{2(M_1 - M_2)}{n_1 + n_2}$$

(Glass, 1965; Gray & Kinnear, 2012)

In addressing the reporting of effect size, Pek and Flora (2018, p. 210) advise that all results should "be completely reported such that both statistically significant and nonsignificant results are presented…presenting all tests conducted, regardless of their significance, avoids creating the false impression that the study only had statistically significant findings". Therefore, even effect sizes which are not significant should be presented.

In this study, the Mann-Whitney U Test was performed to identify any divergence in the responses of two gender groups (male and female) and the country of practice (Australia and other countries) and was completed as part of the Fourth Round Questionnaire analysis. It important to note that in collecting the demographic data, participants were able to self-select their gender from *female, male, other or prefer not to say*; however, only female and male were selected, thereby meeting the assumptions of the Mann-Whitney U Test. Statistical analysis was recorded in tabular and graphic formats and included the Mann-Whitney $U$, the mean rank ($M_{rank}$), the mean value ($M$), the standardised test statistic ($z$-score), the significance ($p$-value) and the Glass rank biserial correlation coefficient $r_g$. The Mann-Whitney U test was calculated using IBM SPSS with the correlation coefficient calculated manually and with the guidance of Dr. Skuza.

#### *6.10.2.6.13 The Kruskal-Wallis test*

The *Kruskal-Wallis test* is a non-parametric test used to evaluate more than two groups of participants (Cooksey, 2020; Hopkins, Dettori, & Chapman, 2018; Pallant, 2016). and is considered an extension of the Mann-Whitney U test (IBM, 2021b; IBM, 2021a; Verma & Abdel-Salam, 2019). To run this test there "there should be more than two independent categories of the independent variable to test the group differences" with a dependent variable of at least an ordinal level (Verma & Abdel-Salam, 2019, p. 162). Pallant (2016) recommends reporting the Chi-Square value, the degrees of freedom, the significance level and the mean rank. *Chi-Square tests* are "one of the most utilized statistical analyses for answering questions about the association or difference between categorical variables" (Franke, Ho, & Christie, 2012, p. 448), with the chi-square distribution approximating the distribution of $H$ (the Kruskal-Wallis test statistic) (Ostertagová, Ostertag, & Kováč, 2014); IBM SPSS™ reports the Kruskal-Wallis test $H$. The Cohen's $d$ is a standardised effect size measure (Cumming, 2012; Goulet-Pelletier & Cousineau, 2018; Kalinowski & Fidler, 2010) and can be used to calculate the effect size for the Kruskal-Wallis test (Lenhard & Lenhard, 2022), with various tools used for its calculation including *Psychometric – Computation of effect sizes* (Lenhard & Lenhard, 2022; Psychometrica, 2022).

In this study, the primary stakeholder-group analysis examined the divergent responses between the three professional groups (nurse educator, nurse informatician and experts in nursing informatics), thereby meeting the assumptions of the Kruskal-Wallis test. This analysis was completed as part of the Fourth Round Questionnaire analysis. Statistical analysis was recorded in a tabular format and included the Kruskal-Wallis test ($H$), the degrees of freedom ($df$), the significance ($p$-value), the mean rank ($M_{rank}$), the mean ($M$) and Cohen's $d$. The Kruskal-Wallis test was calculated using IBM SPSS™ with Cohen's *d* calculated using the *Psychometrica* resource with the guidance of Dr. Skuza.

#### *6.10.2.6.14 Reporting of statistical analysis in Delphi studies*

A previously identified, Delphi studies have used a wide range of statistical analyses (refer to *6.10.2.5 Statistical analysis in Delphi studies*). In analysing the quantitative data, for this study, and determining how these findings should be reported, the researcher reviewed a number of recent Delphi studies used in nursing research (Chen et al., 2023; Gibson et al., 2023; Xu, Dong, et al., 2022) and reviewed the reporting of statistical analyses. Chen et al. (2023, p. 2195) identified the use of IBM SPSS 23.0 with the use of numbers and percentages used for categorical data, with "expert positive coefficient, expert authority degree, expert intention and the degree of coordination…calculated and expressed by effective recovery, authority coefficient (Cr), coefficient of variation (CV) and coefficient of coordination (Kendall's W)". Gibson et al. (2023) identified the use of descriptive statistics, but no further information was given; however, frequency counts and percentages were noted in descriptions of the demographic data of the participants. Heuzenroeder et al. (2022) identified the use of consensus (but not how this was determined) and the calculation of the mean and frequency of responses. Rutledge et al. (2021) did not address quantitative analysis; however, the Delphi study focused on previously published work. Finally, Xu, Dong, et al. (2022, p. 5) identified the use of IBM SPSS 26.0 with descriptive statistics "of the mean, standard deviation, coefficient of variation (CV), and consensus level of agreement (CLA)", with the authority coefficient and Kendall's coefficient of concordance.

The variance in statistical analysis and reporting in Delphi studies has been a criticism of the method, with Sackman (1974, p. 70), in *Delphi Assessment: Expert Opinion, Forecasting and Group Process*, questioning whether consensus was achieved authentically and how descriptive statistical analysis was presented, recommending "higher standards, more consistent with scientific method in the collection, analysis, and use of questionnaire data". Keeney, Hasson and McKenna (2001, p. 198), in *A critical review of the Delphi technique as a research methodology for nursing*, noted that "the lack of guidance leads to a variety of approaches and can result in different Delphi studies interpreting and reporting in different way(s): this could affect the integrity of the method". This lack of consistency underpinned the development of a best practice guideline by Jünger et al. (2017, p. 700), *Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review*; with the authors noting that "the identified variations in the level of detail in reporting make it difficult for the reader to appraise to quality of the study design, its conduct and the resulting outcomes". In acknowledgement of these challenges, the researcher applied these recommendations to the Delphi study (refer to *6.4 Application of reporting guidelines to study*); however, this guideline does not specify a particular method of analysis, instead referring to "appropriate use of statistics, transparent reporting of results" (Jünger et al., 2017, p. 687). Therefore, in adherence with Hasson and Keeney's (2011) recommendation to address trustworthiness in the Delphi technique, as described by Lincoln and Guba (1985), and Skulmoski, Hartman & Krahn's (2007) recommendation for the use of an audit trail, the researcher has sought to demonstrate methodological rigor and coherent decision-making. Explicit descriptions of the statistical analyses used in this study, supported by literature and developed in consultation with the Flinders University Statistical Consultant Dr Pawel Skuza, meet these criteria.

### 6.10.3 Use of research software

Data analysis can be undertaken manually or by research software, with both qualitative and quantitative data analysis software available. An overview of the software, for both types of data, is briefly described below.

#### *6.10.3.1 Qualitative data analysis software*

Allsop et al. (2022, p. 143), in *Qualitative Methods with NVivo Software: A Practical Guide for Analyzing Qualitative Data*, noted that *Qualitative Data Analysis Software (QDAS)* "has seen significant development and advancement that allows researchers to document reliability, rigor, and replicability, when intentionally utilized to do so" and that contrary to the computer doing the data analysis, the programs aid the human researcher in the analysis process. It is important to note that QDAS does not analyse the data but assists the researcher in managing large data sets, time consuming transcription, and can increase the speed of the analysis process (Allsop et al., 2022; Salmona & Kaczynski, 2016; Zamawe, 2015).

#### *6.10.3.2 Quantitative data analysis software*

Similarly, quantitative data analysis can be undertaken manually or with the assistance of statistical software; however, Albers (2017, p. 3), in *Introduction to Quantitative Data Analysis in the Behavioral and Social Sciences*, cautions that "statistics is only a single tool among many that are required for a data analysis", with Cooksey (2020, p. 45) noting that the use of statistical software packages, "in no way relieves the researcher of the responsibility of learning about statistics, how and when they should be used, and how they should be interpreted". Statistical software programs assist in complex computations (Wetcher-Hendricks, 2011) and can perform a range of statistical tests (Albers, 2017; Cooksey, 2020; Vrbin, 2022).

#### *6.10.3.3 Data analysis software used in the study*

In this study, NVivo™, a qualitative data analysis software tool developed by QSR International (2023) was used. NVivo™ is Computer Assisted Qualitative Data Analysis Software (CAQDAS) developed during the 1980s at La Trobe University (Richards, 2002; Shermon, 2020). It was "originally called NUD*IST (standing for Non numerical Unstructured Data Indexing Searching and

Theorizing software)" and following several iterations became NVivo ("a play on the Latin in vivo - meaning "within a living organism") (Shermon, 2020). This software "allows researchers to import, organize, explore, connect and collaborate on their data" (Lumivero, 2024).

In this study, IBM SPSS™ (Statistical Package for the Social Sciences) was used to analyse the quantitative data from the Delphi study. IBM SPSS™ is a statistical software platform (IBM, n.d.-b). In 1968, Nie, Bent and Hull, at the University of Chicago, developed the SPSS software program to analyse data, with SPSS Inc. becoming an independent company in 1975 and acquired by IBM in 2009 (Frey, 2017). In 2009, the program became briefly knowns as PASW (Predictive Analytics Software) but was changed back to IBM SPSS in 2010 (Pallant, 2016). A comprehensive statistical software program (Frey, 2017), SPSS can conduct descriptive and inferential statistics, including "analytical reporting, graphics and statistical modelling" (Flinders University, 2023d).

### 6.10.4 Tension between reflexive thematic analysis and statistical analyses

Braun and Clarke (2022a, p. 142) have argued against the use of frequency counts in the reporting of themes in reflexive thematic analysis, stating that "critical qualitative research focuses on constructions rather than truths". However, as described in *Chapter 6: Research methods – Phase 2 – Delphi study*, the classical Delphi technique typically uses a range of data analysis approaches, including descriptive analyses for the purpose of demographic sample profiling (Keeney, Hasson, & McKenna, 2011) and to establish the relative importance of identified items (Rasmussen et al., 2023; Xu, Dong, et al., 2022; Zareshahi, Mirzaei, & Nasiriani, 2022). In consideration of this tension, the researcher has referred to Braun & Clarke's (2022a, p. 142) recommendation to "embrace partiality, and refuse to nail down a final, absolute analysis" and to recognise that the frequency of a data-item is not the only aspect which shapes a theme (Braun & Clarke, 2021c). Therefore, whilst descriptive statistics, including frequency counts are included in the analysis of the current Delphi study (as described in *Chapter 6: Research methods – Phase 2 – Delphi study*), frequency counts were not used to determine themes.

## 6.11 Triangulation

One of the major issues in mixed-methods research has been concerns about validity and quality of the findings (Creswell & Plano Clark, 2018). Proponents of mixed-methods research have identified inherent triangulation in the approach, as "the findings of qualitative and quantitative methods/ approaches are integrated in order to gain a fuller understanding of the phenomenon under investigation" (Tashakkori & Newman, 2010, p. 514), which can be helpful in providing validation of findings, comprehensive data and enhancing understanding of the phenomenon (Bekhet & Zauszniewski, 2012). A key rationale for the use of a mixed-methods approach has been triangulation, through the comparison of qualitative and quantitative data sets (Creswell &

Plano Clark, 2018; Hong et al., 2020); in fact, in earlier iterations, mixed-methods research was termed methodological triangulation (Morse, 1991), and mixed-methods designs were termed concurrent triangulation, simultaneous triangulation and sequential triangulation (Creswell & Plano Clark, 2018).

Triangulation describes a study in which various research approaches, methodologies and/or methods are used to increase the trustworthiness of the study finding (Williamson, 2005). Rather than being a precise concept, it describes strategies systematically used to overcome issues of validity or biases throughout the research process, with Denzin (2017) discussing four methods of triangulation – data triangulation, investigator triangulation, theoretical triangulation and methodological triangulation. *Data triangulation* uses different data collection sources *investigator triangulation* uses multiple researchers to collect and analyse data, *theoretical triangulation* uses a number of theoretical approaches and *methodological triangulation* is divided into *within method triangulation,* which uses different data collection methods within a single paradigm or *across method triangulation*, which uses both qualitative and quantitative approaches to collect and analyse data (Arias Valencia, 2022; Denzin, 2017; Flick, 2011, 2017). Flick (2017), in *Mantras and Myths: The Disenchantment of Mixed-Methods Research and Revisiting Triangulation as a Perspective*, also addressed the concept of *systematic triangulation of perspectives*, where perspectives (rather than paradigms) are combined.

Triangulation originally referred to a multiple methods approach in qualitative studies and not a mixed-methods approach using both qualitative and quantitative research methods (Denzin, 2012), with discussion of triangulation in qualitative research extending back to the late 1950s and 1960s (Campbell & Fiske, 1959; Webb, 1966). Subsequently, triangulation was used to justify the use of mixed-methods research and applied to the use of both qualitative and quantitative research methods; however, this has been problematic, with Morgan (2019, p. 6), in *Commentary—After Triangulation, What Next?,* noting triangulation's "long history of multiple meanings and insufficient clarity". The need to enhance the validity and reliability of mixed-methods research had resulted in extensive discourse regarding the concept of triangulation (Arias Valencia, 2022; Flick, 2011, 2017; Morgan, 2019) and Denzin (2012, p. 85) noted that the term triangulation "has been used, abused, and misinterpreted'. In 2017, Fetters & Molina-Azorin (2017), identified the need to develop new language for mixed-methods research, noted the problematic nature of the term *triangulation*, and recommended the term *integrating through comparing*, stating:

> While similar to, and potentially synonymous with triangulation when used just to compare both qualitative and quantitative data, it differs as not requiring an exacting nuance of data being confirmatory, and by not having multiple uses as has evolved for the term ''triangulation'' (Fetters & Molina-Azorin, 2017, p. 299)

The most common form of triangulation, is *methodological triangulation*, which can be sequential or simultaneous, with *sequential triangulation*, where the results of the first phase of the study inform the implementation of the second phase and *simultaneous triangulation*, where data is collected at the same time and results are only compared following analysis of the two data sets (Halcomb & Andrew, 2005). The selection of the particular methodological triangulation approach must be informed by the nature of the research and the rationale for each phase of the study (Halcomb & Andrew, 2005). It is important to note that the researcher's understanding of the selected methods, cohesion between the data sets, coherent justification for the study methodology and bias control procedures must be made explicit (Arias Valencia, 2022; Heale & Forbes, 2013).

In this study, *methodological triangulation* was used to gain a fuller understanding of the phenomenon under investigation, with *across method* and *sequential triangulation* methods used. The application of these triangulation methods is described in *Chapter 8: Integration of findings.*

## 6.12 Conclusion

This chapter has presented the Delphi study technique used in this study, in adherence with the reporting guidelines from *Conducting and REporting DElphi Studies (CREDES)* (Jünger et al., 2017), including the development of an *a priori* Delphi Study Protocol with pilot testing of the Delphi questionnaire, a transparent and explicit discussion of the Delphi study data collection and data analysis procedures. Data collection adhered to the Delphi study data collection procedure as described by Skulmoski (2007), Hasson & Keeney (2011), Keeney et al. (2011), Davidson (2013), Chalmers & Armour (2019), Niederberger & Spranger (2020), Spranger et al. (2022) and Drumm et al. (2022). Data analysis adhered to a reflexive thematic analysis approach as developed by Braun and Clarke (Braun, 2021; Braun & Clarke, 2006; 2019, 2021b, 2021a, 2022b, 2022a, 2023; n.d.-d, n.d.-b, n.d.-a, n.d.-c; Braun, Clarke, & Hayfield, 2022; SAGE, 2023) and descriptive statistics as described by Cooksey (2020), Fisher and Marshall (2009), Fowler, Jarvis and Chevannes (2002), Mishra et al. (2018), and Rumsey (2019). The discussion of the findings from the Delphi study are detailed in *Chapter 7: Phase 2 – Delphi study findings.*

# Chapter 7 Phase 2 – Delphi Study Findings

## 7.1 Introduction

Chapter 6 described the Delphi data collection process and the data analysis procedures, with the use of Delphi questionnaires, the management of data collection and the use of reflexive thematic analysis and descriptive analysis were discussed in detail. This chapter provides a transparent and explicit discussion of the findings from each round of the Delphi study. As described by Jünger et al. (2017, p. 702), the "methods of data analysis, processing and synthesis of experts' responses to inform the subsequent survey round and methodological decisions taken by the research team throughout the process" must be comprehensible; this chapter and the previous chapter meet these criteria.

## 7.2 Findings from the First Round Questionnaire

Data analysis of the Delphi study was undertaken throughout this study, from April 2024 to July 2024, and occurred following each questionnaire. The First Round Questionnaire required analysis of the demographic data and qualitative data (refer to *Appendix C3*). Demographic data had nominal levels of measurement which were analysed using measures of central tendency (the mode). The qualitative data was analysed using reflexive thematic analysis. The findings from this analysis will now be discussed.

### 7.2.1 Descriptive statistics

Descriptive statistics are used to summarise, organise and communicate characteristics of the data (Cooksey, 2020). In the First Round Questionnaire, nominal demographic data was collected and analysed using IBM SPSS™ measures of central tendency (mode) and frequency distribution (ratio). This data included whether the participant identified themselves as a nurse informatician, expert in nursing informatics or a nurse educator, and their country of residence. The purpose of these measurements was to provide sufficient information, to enhance the generalisability or transferability of the study findings to similar populations.

#### *7.2.1.1 Country of practice*

56 participants completed the First Round Questionnaire, with the majority identifying themselves as practicing in Australia (n=38). Other participants identified practicing in the United States of America, Canada, New Zealand, the United Kingdom, Finland and Qatar (n=18). This data is summarised in the table below.

**Table 7-1 Demographic data from First Round Questionnaire - Country of Practice**

| | |
|---|---|
| Australia | United States of America<br>Canada<br>New Zealand<br>United Kingdom<br>Finland<br>Qatar |
| n=38 | n=18 |

#### *7.2.1.2 Professional role*

Participants were asked to identify which role best described their area of nursing Informatics practice. The majority of participants identified their role as a nurse educator (n=27); other participants identified their role as nurse informatician (n=20) and expert in nursing informatics (n=15); however, some participants identified more than one role in their professional practice (n=7) and one participant (n=1) did not identify any role description.

**Table 7-2 Demographic data from First Round Questionnaire - Professional role**

| Nurse educator | Nurse informatician | Expert in nursing informatics |
|---|---|---|
| n=27 | n=20 | n=15 |

Note: some participants identified more than one role.

### 7.2.2 Reflexive thematic analysis

Reflexive thematic analysis seeks to provide a rich narrative of the phenomenon of interest with “the aim of capturing patterns, complexities, and contradictions in participants’ account” (Hayfield et al., 2019, p. 530). The researcher constructed four overarching themes which were evident in responses of the participants. The first theme, *What is nursing informatics and why is it important?*, explored the understanding of nursing Informatics and its relevance to contemporary nursing practice. The second theme, *What do I need to know about nursing informatics?*, addressed the types of digital health technologies the participants had used in their work and the Informatics competencies, recommendations, or guidelines that informed their practice. In the third theme, *How can I learn about nursing informatics?*, recommendations and the potential enablers and barriers for nursing informatics education in the undergraduate nursing curriculum were addressed. This theme also explored the ongoing professional development of Registered Nurses relating to nursing informatics. The final theme, *Everyone knows how to use a computer!*, considered computer and digital literacy as it related to both undergraduate nursing students and Registered Nurses.

#### 7.2.2.1 What is nursing informatics and why is it important?

The first theme – What is nursing informatics and why is it important? was underpinned by the questions – In your own words, how would you define or describe nursing informatics? and Is nursing informatics relevant to nursing? If so, how? It was evident that the participants understood the term nursing informatics; however, there was considerable variation in the specific elements identified in the definitions. This finding reflected previous studies which identified a range of definitions for nursing informatics, health informatics and related terms (Friedman, 2012; Hussey & Kennedy, 2016; Morawski, Fanberg, & Pitts, 2021), with Reid, Maeder, Button, et al. (2021, p. 111), in *Defining Nursing Informatics: A Narrative Review*, stating that “If the purpose of nursing informatics is to improve the safety and quality of patient care, then as a profession, nurses need to be provided with a clearer understanding of nursing informatics”.

The participants identified the inherent link between nursing and ICT across a broad spectrum of innovation, from digitisation of nursing records through to the collation, analysis and evaluation of nursing data to inform evidence-based practice and optimise patient care. As described by one participant:

> *NI manages and communicates data, information, and knowledge to enhance nursing care, education, research, and administration. For example, NI involves collecting, organizing, and managing healthcare data for better patient outcomes. Nurses use technology [to] provide nurses with point of care access to evidence-based practice guidelines, and clinical support tools to support decision-making.* (D09-1)

Participants referred to the definition developed by Staggers and Thompson (2002, p. 261), in *The Evolution of Definitions for Nursing Informatics: A Critical Analysis and Revised Definition*, “Nursing informatics is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice”. This definition was applied in *A Framework for Nursing Informatics in Australia* (Conrick et al., 2004), a strategic paper developed by Nursing Informatics Australia, to provide a blueprint for the development of nursing informatics’ capacity in Australia. Other participants aligned their definition with the *Data-Information-Knowledge-Wisdom (DIKW) framework*, adopted by the ANA (2008), which defined nursing informatics as “the specialty that integrates nursing science with multiple information and analytical sciences to identify, define, manage and communicate data, information, knowledge and wisdom in nursing practice”. This definition was also adopted by the Technology Informatics Guiding Education Reform Initiative (TIGER, 2009) during the development of recommendations for education reform , with a similar definition used by the American Nursing Informatics Association (ANIA, 2024b). The definition, developed by the International Medical Informatics Association – Nursing Informatics special interest group (2009), “Nursing informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families and communities worldwide", was identified by some participants; this definition was adopted by the Australian College of Nursing (ACN), Health Informatics Society of Australia (HISA) and Nursing Informatics Australia (NIA) (2017a) for the *Nursing Informatics Position Statement - Version 9* and the American Medical Informatics Association (2024).

The participants' responses to the importance or significance of nursing informatics focused on improving the safety and efficiency of health care, informing evidence-based practice and making nursing care more visible; with most participants aligning nursing informatics with contemporary practice, rather than as a specialty area. These findings reflected contemporary literature which has identified the growing need for nurses to engage with digital technologies, develop digital proficiency and competency, and have the capacity to meet contemporary healthcare challenges (Bichel-Findlay, Dixon, & Alexander, 2020; Booth, Strudwick, McBride, et al., 2021; Brommeyer et al., 2023; Button, Harrington, & Belan, 2014). It is important to note, that at this stage of the Delphi study, participants were not asked to identify challenges associated with the use of nursing informatics in clinical and management settings, although this was addressed regarding undergraduate nursing education.

*Improving the safety and efficiency of health care* was linked with enhancing the timeliness of healthcare, aiding in communication between multidisciplinary team members, improving patient flow through the healthcare system, enhancing cost efficiency and reducing errors. Booth, Strudwick, McBride, et al. (2021), in *How the nursing profession should adapt for a digital future*, identified the benefits of digital health technologies, including telenursing with triaging, monitoring and coaching of patients for chronic disease management and mobile applications which allow the nurses to provide timely responses for pain management. This was reflected in the participant responses. As one participant noted:

> *Nursing informatics have improved the quality of healthcare for patients in many ways, and has streamlined nursing processes by saving time, improving communication, and improving the storage of patient information*. (D59-1)

The concept of safe health care, with quality and continuous improvement was also evident:

> *It is all about the safety of the person receiving the health or care product or service. Its about quality and continuous improvement focused on improved health outcomes and experiences. (D22-1)*

As indicated by Bichel-Findlay, Dixon and Alexander (2020, p. 30), in *Nurses delivering care in a digitised environment*, "Digitisation presents an opportunity to increase the capacity to predict, improving the quality of care and resulting in increased patient safety'.

*Informing of evidence-based practice* was linked with access to up-to-date policies and procedures, access to evidence-based nursing resources and the collection of data to inform quality improvement resulting in changes to nursing practice.

> *Data is the key to provide better patient care, stay within hospital budget, be current with state and local regulatory agencies. Knowing how to use informatics and how it can be useful can make one a better Nurse.* (D51-1)

As identified by Hovenga and Hay (2000, p. 186), in *The role of Informatics to support evidence-based practice and clinician education*, “the notion that every health care intervention is based on valid and reliable research-based evidence is a myth as many interventions lack a solid scientific assessment of effectiveness”, with the authors recommending that information and communication technologies be used to support evidence-based practice. Similarly, the participants identified the role of nursing Informatics in informing nursing practice.

*Nursing informatics as part of contemporary practice*, rather than as a speciality area, was a common sub-theme throughout the participant responses:

> *Across the profession, through practice, education, administration, policy, and research, nurses are using information and technology to support patients, families, and communities.* (D07-1)

Contemporary practice and the use of nursing informatics was linked to efficiency of healthcare processes, communication within the multidisciplinary team and clinical decision-making. The use of nursing informatics also was seen as informing evidence-based practice and providing data to leverage change:

> *Yes, nursing informatics is very relevant to nursing practice. It plays a crucial role in enhancing patient care and improving healthcare outcomes. It helps nurses access patient information, access best practice guidelines/ clinical decision support tools used for patient care. By leveraging data nurses can identify areas for improvement, implement interventions based on the data collected.* (D09-1)

The connection between nursing informatics and contemporary nursing practice was highlighted by the Australian Nursing and Midwifery Accreditation Council (2014, p. 4), in *Health informatics and health technology - an explanatory note*, who stated “The guiding principle for all learning and teaching strategies related to informatics and technology in health is that being technically competent is a fundamental element of caring”. The use of nursing informatics was viewed as an integral aspect of nursing by many of the participants:

> *Nursing informatics is threaded throughout every aspect of nursing care. Nursing care and nursing informatics cannot be separated in my opinion.* (D16-1)

#### *7.2.2.2 What do I need to know about nursing informatics?*

The second theme, *What do I need to know about nursing informatics?,* addressed the types of digital health technologies the participants had used in their work and the Informatics competencies, recommendations, or guidelines that inform their practice, and were informed by the questions - *What types of digital technologies might I encounter?* and *What competency standards are relevant to nursing practice?*

A broad range of digital health technologies are now part of nursing practice (Reid, Button, et al., 2022), including EHRs or EMRs (Kutney-Lee et al., 2019; McCarthy et al., 2019; Raghunathan, McKenna, & Peddle, 2021), Telehealth and Telenursing (Nejadshafiee et al., 2020a; Park & Lee, 2023), and eHealth applications (apps) (García-Martín et al., 2021; Nezamdoust et al., 2022; Stevens et al., 2019). Similarly, the participants identified a wide range of digital health technologies used in their professional practice; these technologies were defined as information tools, communication tools and assessment tools. *Information tools* included databases, websites, online learning platforms, digital patient lists/ journey charts, clinical information systems and smart mobile applications. *Communication tools* included EHR/EMR, telehealth, radiology and pathology requests and results, electronic patient flow management, clinical handover tools, ChatGPT and smart mobile applications. And *assessment tools* included wearable technologies, simulation laboratories, monitoring technology, digital photography and decision-support tools. A number of information and communication technologies, not specifically identified as digital health technologies, were also mentioned by the participants, including online communication platforms, search engines, emails and word processing tools; these technologies, whilst not health technologies, were used in the nursing practice of many of the participants.

A significant sub-theme, underpinning knowledge about nursing informatics, identified the informatics competencies, recommendations, or guidelines that informed participants' nursing informatics knowledge and practice. The NMBA (2021, p. 8) defined *competence* as "the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/ or superior performance in a profession/occupational area", with competency frameworks serving to detail the desired characteristics of a competent workforce (Batt, Tavares, & Williams, 2020). Analysis of these frameworks were separated into country of origin and global competencies.

*Australia*: the *Nursing Informatics Position Statemen*t – Version 9 (Australian College of Nursing (ACN), Health Informatics Society of Australia (HISA), & Nursing Informatics Australia (NIA), 2017a, p. 7) and the *Nursing Informatics Position Statement* (ACN, HISA & NIA, 2017b), seminal documents developed by the Australian College of Nursing (ACN), Health Informatics Society of Australia (HISA) and Nursing Informatics Australia (NIA) were identified by participants as informing their nursing Informatics practice. A broad range of documents from the Australian Digital

Health Agency were identified, including the *Australian Digital Health Capability Framework* (ADHA & Australasian Institute of Digital Health (AIDH), 2023b), the *National Nursing and Midwifery Digital Health Capability Framework* (ADHA, 2020), National Digital Health Strategy 2023-2028 (ADHA, 2023b), and the Clinical Governance Framework for Digital Health (ADHA, 2023c). The Australian Digital Health Agency is a statutory authority responsible for the national digital health strategy and reporting to the State and Territory Health Ministers through the COAG Health Council (ADHA, 2024b). Other frameworks included the *National Informatic Standards for Nurses and Midwives* (Australian Nursing and Midwifery Federation (ANMF), 2015) and the *Nursing and Midwifery Board of Australia's Nursing codes and standards* (2016a, 2018).

*America*: American frameworks included the American Association of Colleges of Nursing (AACN) - *The Essentials of Baccalaureate Education for Professional Nursing Practice* (2008) and *Essentials Toolkit* (2021), the American Nurses Association's *Nursing Informatics: Scope and Standards of Practice* (2008, 2015, 2022), and the *American Nursing Informatics Association online resources* (ANIA, 2024a).

Canada: Canadian frameworks included the Canadian Association of Schools of Nursing (CASN) *Nursing Informatics Entry-to-Practice Competencies for Registered Nurses* (2012b), Canadian Nurses Association (CNA) and Canadian Nursing Informatics Association (CNIA), *Nursing Informatics: Joint Position Statement* (Canadian Nurses Association (CNA) & Canadian Nursing Informatics Association (CNIA), 2017), and Canada Health Infoway online resources (2024).

*New Zealand*: *Guidelines: Informatics for nurses entering practice* (Honey, Collins, & Britnell, 2018) was identified as providing recommendations for Nurses in New Zealand. This document aimed to "identify the key knowledge, skills and behaviours toward nursing informatics for nurses as they enter practice as a Registered Nurse (RN)" (Honey, Collins, & Britnell, 2018, p. 5).

United Kingdom: Sources from the United Kingdom included the *All-Ireland Nursing & Midwifery Digital Health Capability Framework* (Office of the Nursing & Midwifery Services Director (ONMSD) & Northern Ireland Practice and Education Council for Nursing and Midwifery, 2023), *Development of a core competency framework for clinical informatics* (Davies et al., 2021), and the National Health Service publication (2023) *Digital skills – health informatics competency standards, frameworks and tools for healthcare professionals.*

*Global:* A range of global sources were also identified, these included *ICNP* (International Classification of Nursing Practice) and *SNOMED CT* (Systematized Medical Nomenclature for Medicine–Clinical Terminology) resources (International Council of Nurses (ICN), 2021), *Technology Informatics Guiding Education Reform (TIGER) resources* (Hübner et al., 2018; O'Connor et al., 2017; Shaw et al., 2020; 2007, 2008, 2009, 2010), *Recommendations of the*

*International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics: Second Revision* (Bichel-Findlay et al., 2023), and the *International Computer Driving License* (ICDL, 2024).

Kavanagh and Sharpnack (2021), in *Crisis in Competency: A Defining Moment in Nursing Education*, noted that with the digital transformation of healthcare has come declining competency in new graduate nurses. The authors identified increasing access to technology, in the clinical setting and in classrooms, but noted the preparation to practice gap. Egbert et al. (2019, p. 353) commented on the gap between education and professional practice, stating "In order to improve the inclusion of health and nursing informatics into relevant curricula, clear, concrete and comprehensive statements must be made about what competencies are desirable and needed"; however, standardisation of nursing informatics competency standards globally remains a challenge to the development of nursing informatics understanding and application worldwide (Peltonen, Nibber, et al., 2019). These findings are reflected in the extensive list of Informatics competencies, recommendations, and guidelines that informed participants' nursing informatics knowledge and practice.

#### *7.2.2.3 How can I learn about nursing informatics?*

The participants' insights into the relevance of nursing informatics, the digital health technologies that may be encountered in the workplace and the competency standards that guide their practice, were linked with learning about nursing informatics. Therefore, the third theme was identified as *How can I learn about nursing informatics?* Recommendations and the potential enablers and barriers for nursing informatics education in the undergraduate nursing curriculum were addressed in the sub-theme *Learning as an undergraduate nursing student*. The ongoing professional development of Registered Nurses relating to nursing informatics was addressed under the sub-theme of *Learning as a Registered Nurse.*

The sub-theme, *Learning as an undergraduate nursing student*, focused on the enablers and barriers for Nursing Informatics in undergraduate nursing education. Barriers to the use of nursing informatics have included poor computer literacy (Moule, Ward, & Lockyer, 2010), a lack of health informatics education in the undergraduate nursing sector (Borycki et al., 2013; Cummings et al., 2016), and uncertainty about nursing informatics (Larson, 2017). In *Are Future Nurses Ready for Digital Health: Informatics Competency Baseline Assessment*, Kleib et al. (2022) identified key barriers for workplace readiness in a digital health environment, including limited use of EHRs in tertiary settings, varying degrees of access to EHRSs on clinical placement, limited exposure to digital health technologies, apart from EHRs, and a lack of understanding of the importance of digital technology usage by undergraduate nursing students. These challenges were identified by

Reid, Button, et al. (2022), in *Nursing informatics and undergraduate nursing curricula: A scoping review protocol*:

> Despite the early adoption of Nursing Informatics in Australia in the 1980s, there remain barriers to Nursing Informatics engagement and proficiency, including poor computer literacy, limited professional development and a lack of undergraduate informatics education. (p. 1)

*Enablers* for the integration of nursing informatics into undergraduate nursing education, identified by the participants, included the curriculum, resources, faculty, governance, the nursing profession and university hierarchy. The curriculum was identified as the key contributing factor to undergraduate nursing informatics education:

> *Principally, nursing informatics is part of nursing. Therefore, providing foundational curriculum in undergraduate education to prepare nurses for this reality is critical*. (D07-1)

> *DH/NI is not an add-on it is integral to safe, effective and efficacious health care.* (D26-1)

The participants identified that the *curriculum* needed to reflect current workforce requirements for digital competence, be informed by relevant competency standards and be underpinned by the development of computer and digital literacy skills. Some participants recommended integration of nursing informatics throughout the curriculum whilst others preferred a standalone educational module or topic. Recommendations were also made to embed a broad range of nursing informatics tools and competencies into undergraduate nursing education, rather than only focusing on EHRs:

> *Not so much about specific technologies or systems but focus on principles which will they take them further in their careers*. (D19-1)

*Resources* were also identified as a key requirement to responding to curriculum requirements with access to EHRs and other digital health technologies, buy-in from technology vendors, sufficient funding, technical support and simulation suites capable of reflecting contemporary health settings recommended to support the integration of nursing informatics into undergraduate nursing education.

*Faculty* who both understood nursing informatics and received relevant professional development were viewed as essential:

> *Well educated and suitably prepared nurse educators. They need to be familiar with technical jargon, have a conceptual understanding of technologies in use and their limitations. Graduate nurses need to be able to communicate their data/information needs and work collaboratively with ICT professionals to ensure applications developed meet not only their specific needs but also the needs of the digital health ecosystem as a whole.* (D20-1)

Support from *university hierarchy* through workload allocations and time for professional development, research into nursing informatics, and recognition of the importance of nursing informatics and governance through the development of a standardised undergraduate nursing curriculum, nursing informatics competencies and the support of peak nursing bodies also underpinned the enablers for the integration of nursing informatics in undergraduate nursing education.

*Barriers* for the integration of nursing informatics into undergraduate nursing education, identified by the participants, included a lack of understanding of nursing informatics, a lack of standardised nursing informatics competencies, resistance to change, a lack of resources, a lack of university support and varying levels of computer and digital literacy.

*A lack of understanding of nursing informatics* and its importance to contemporary nursing was identified as a barrier to nursing informatics education:

> *The biggest barrier is the lack of understanding and relevance of nursing informatics by universities. They often run informatics courses separately to core undergraduate courses such as Nursing. These two often never meet and intersect to demonstrate how informatics and healthcare for nursing can co-exist. Undergraduate nursing education if often delivered based on the 'way it was always done'. Often, the courses only briefly touch on the use of* technology but never as an integral part of delivering healthcare by nurses. (D25-1)

These findings are supported by the literature which has highlighted the need to clearly define nursing informatics as a body of knowledge (Asiri, 2016), with Gonen, Sharon and Lev-Ari (2016, p. 3) noting that "the opposition to implementing informatics may also stem from a lack of understanding of how informatics can contribute to the quality of nurses' work". Reid et al. (2024), in *Nursing Informatics: Competency Challenges for Nursing Faculty*, also noted the continuing confusion regarding nursing informatics, linking a lack of clear nursing informatics understanding with faculty resistance to the use of digital technologies.

A lack of standardised Informatics competencies, particularly within the Australian context were identified:

> *Lack of standardised informatics competencies for entry to practice at a national level– major barrier and subsequently leads to inconsistent preparation. Each institution is left to interpret what informatics involves and what should be taught.* (D36-1)

These findings reflect the current literature, with Cummings et al. (2016), in *Embedding Nursing Informatics Education into an Australian Undergraduate Nursing Degree*, identifying the lack of relevant nursing Informatics competencies leading to a lack of consistency in the national nursing curriculum and Raghunathan, McKenna and Peddle (2023a, p. 8) stating that "until such national initiatives are available to drive comprehensive curriculum reform, informatics integration is likely to remain fragmentary within undergraduate curricula".

*Resistance to change*, from faculty, students, nurses in the clinical setting and university hierarchy, associated with the changes to nursing practice and teaching methodologies were identified:

> *Chiefly, most people are afraid of change. There is also a constant cycle of new systems and people can be change weary or exhausted. "Why change what's working". Another one (I) hear, is "all this time in front of a computer is taking away the time we can care for our patients". The counter argument above is that proper learning has the potential to actually save time, overall.* (D11-1)

*A lack of resources* coupled with *a lack of university support* impacted the perceived likelihood of nursing informatics being successfully integrated into undergraduate nursing education:

> *Lack of access to clinical facility EMRs- due to current state of play, some hospitals not using digital systems, existence of hybrid documentation systems, limited or restricted student access due to data security and patient privacy concerns*. (D36-1)

Linked with a lack of university support was the perceptions of an overcrowded curriculum:

> *Overcrowded nursing curriculum – questions around where do we fit in informatics and how to fit it in?* (D36-1)

> *I keep hearing that the curriculum is full, but I don't think nursing informatics is ever a standalone subject, it can be when people are moving into further education and training.* (D37-1)

Finally, varying levels of computer and digital literacy, within faculty, students and nurses in the clinical setting, were another barrier to effectively implementing nursing informatics education into tertiary and clinical settings:

> *People also think they know, when their knowledge is scant or ad hoc. They do not know what they don't know. By using a range of computer or digital software, there is an assumption they know and do not take ethical, legal and security issues seriously enough as they do not realise risks*. (D26-1)

> *If student nurses do not have a prior foundation in data literacy, it makes for a high bar to for them to surpass when in nursing school.* (D43-1)

Stunden et al. (2024, p. 10), in *Nursing students' preparedness for the digitalised clinical environment in Australia: An integrative review*, identified this concern and stated "Australian nursing students lack the required digital literacy and ICT skills to cope with the everchanging innovative trends in technology". Reid, Button and Brommeyer (2023, p. 573) noted "Digital literacy is an essential requirement for undergraduate nursing students and nurses and is linked with safe, evidence-based patient care" and recommended that digital literacy competencies be developed for entry to practice Registered Nurses and nurse educators.

The sub-theme, *Learning as a Registered Nurse*, focused on nursing informatics education already completed by the participants and the education they would like to do in the future. Formal education included Certificates in Information technology through to Masters and PhD programs in nursing informatics, health informatics and health administration. Other formal education routes include CHIA (Certified Health Informatician Australasia) and ICDL (International Computer Driving License) certification and credentialling by nursing organisations. Informal education included working with experts, vendor training, short courses, conferences and workshops, participation in professional groups and reading, with some participants identifying on the job experience:

> *I worked for 10 years in a telecommunication company where I was able to develop skills in general computer applications as required in my employment.* (D33-1)

> *Most of my training was done on the job. Technical training, data analytics, system design and build, project Management, organizational change management*. (D43-1)

Participants identified wishing to pursue further professional development, associated with nursing informatics, including artificial intelligence, Chatbots, clinical devices, cybersecurity, data analytics and governance, machine learning, robots and telehealth:

> *I feel like my biggest informatics deficiency right now is related to artificial intelligence and machine learning and I am actively pursuing professional development in these areas to improve my knowledge.* (D16-1)

#### *7.2.2.4 Everyone knows how to use a computer!*

The final theme, from the First Round Questionnaire, focused on computer and digital literacy; the naming of this theme reflected some participants' statements about everyone knowing how to use a computer when they came to university. The implications of computer and digital literacy were explored under the sub-themes – *What is computer literacy?*, *What is digital literacy?*, *What is a digital native and does it matter?*, *How should student computer and digital literacy be developed?* and *How could I improve my computer and digital literacy?*

In the sub-theme, *What is computer literacy?*, participants predominantly identified computer literacy as the ability to navigate and perform functions on a computer:

> *The ability and knowledge to use a computer program and multiple platforms (eg: Word, Excel). Understanding of simple skills to navigate a computer.* (D03-1)

> *For me computer literacy means not only being able to operate and navigate computer hardware but also the ability to perform basic problem solving up to the ability to clear bowser cache.* (D04-1)

> *Computer literacy means being able to turn the computer on and then be able to use the functions you require proficiently. Not to be scared of new things and being able to adapt given that there are so many updates and systems change frequently.* (D21-1)

However, some participants extended this definition to include a continuum from novice to expert, as described by Benner (1982), a nursing theorist and academic and based on the Dreyfus Model of Skill Acquisition:

> *I would suggest there is a novice to expert continuum. Novice would be knowing how to turn on a piece of tech and generally find what you need, through to understanding how the back end influences the front end and knowing the point of care impact health tech has.* (D22-1)

The sub-theme of *What is digital literacy?* explored the perceived differences between computer and digital literacy, with most participants identifying digital literacy as deeper level thinking than computer literacy and with the ability to find evaluate and communicate data:

> *Digital literacy is a broader term, compared to computer literacy. It relates to the knowledge and thinking of how we use, apply, and evaluate the information and technology that computer software and hardware enables.* (D07-1)

> *Computer literacy refers to the ability to use technologies effectively. It focuses on the technical aspects of using the technologies.  Digital literacy is the ability to find, evaluate, create, and communicate data, information using technologies.* (D09-1)

> *Digital literacy goes beyond computer literacy to include the ability to find, evaluate, utilise, share, and create content using information technologies and the Internet. It is about understanding digital content and tools in a wider context.* (D23-1)

The digital native, a term first coined in 2001 by the US author Marc Prensky (2001b, 2001a, 2006, 2009), has been used to describe young people born after 1980 who have been surrounded by digital technologies their entire lives. The average of nurses, globally, is 35.44 years (Kharazmi, Bordbar, & Bordbar, 2023), thereby meeting the criteria for Prensky's definition; therefore, the sub-theme *What is a digital native and does it matter?* explored perceptions of the computer and digital literacy competency of undergraduate nursing students. Reactions to the concept of the digital native demonstrated an understanding of the term:

> *Honestly, the idea of digital native I have found to be a somewhat older term (as of 2024). It's a term that was floated around during the 2000-2010 range, when millennials were starting to come of age.  Gen Z are full 'digital natives' in this regard, because they have never known a world without the internet et al. related technologies.* (D08-1)

> *A young person who has been brought up in the digital world, they have been using computers throughout school, have had a mobile phone for many years, use the internet for any query. I look at my daughters, 29 and 33 years old, and now my grand-daughter, aged 3, and I would put them all into the digital native category as they are all using technology of some description, including the 3 year old.* (D52-1)

> *A digital native is an individual that has grown up with digital technology and quickly adapts and keeps abreast with the forever changing digital world.* (D60-1)

However, many of the participants identified the concept of the digital native as a myth and not reflecting reality, with comments regarding familiarity with technology not being associated with digital literacy or critical thinking:

> *That to me is a joke. Digital native assumes that a child born today understands technology and is computer literate. I find students often don't know how to use many computer/tech functions and systems when they come to university. That is not the issue what I find irritating is that you can only be a digital native if you are young born when computers were already integrated into the system. Everyone can learn, does it mean that people born before cars were invented were less capable of driving than those who were born when cars were part of everyday life?* (D18-1)

> *In my experience as an academic the term digital native is divisive and misleading in nursing education. Undergraduate nursing students are an eclectic group from many different backgrounds. To assume that any one group of students has skills or abilities required to be digitally competent is unsafe. For example, we assume that undergraduates have a basic level of mathematical skills yet we require them to undertake drug calculation learning activities and sit exams and many students still fail these exams. We should not assume that students have a required level of skill and ability with digital technologies based on their age.* (D50-1)

These findings, reflect the current literature with the myth of the digital native presenting "a challenge to educators and curricula alike, as exposure to digital technologies does not necessarily equate with digital literacy". Reid, Button and Brommeyer (2023, p. 584). Similarly, Brown and Czerniewicz (2010) criticised discussions of digital natives as creating a false dichotomy between (supposed) digital natives and digital immigrants.

Despite these reservations, most participants identified the need for nursing education to reflect the current cohort of students' exposure to digital technologies:

> *That said, digital natives in this regard inform nursing education, currently, by applying pressure to hegemonic inertia within structures. Since they don't know a world 'without' digital, their processes in life and work related to this new ontology of life/action.* (D08-1)

> *As more and more younger nurses enter into the workforce and learning institutions, there will be an increased expectation of use, and proficiency with, computers and digital technology. Case in point, the move from traditional face to face lectures in University, to online or stream able lectures. Moreover, things such as online quizzes or essays*. (D11-1)

> *I suspect teaching digital natives how to process information through paper based technologies (paper charts etc) is as foreign to them as is using digital charts for older experienced enrolled nurses that are more digitally naïve as students.* (D32-1)

The final sub-theme – *How can computer and digital literacy be developed?* related to the development of computer and digital literacy in undergraduate nursing and Registered Nursing populations. Participants identified that development of their own computer and digital literacy could be through time for self-learning, reading, experimentation, and conferences and courses:

> *If I was given dedicated time in my workload to focus on particular areas of my computer/digital literacy and I might also need training and hands on support depending on how technical the topic was. For example, I'm trying to teach myself Natural Language Processing (NLP) at the moment but it's slow going as I don't have a lot of free time and it's very technical as it combines linguistics and computational modelling neither of which I have studied before.* (D31-1)

> *Regular education about computer upgrades or technology advancements is always something I find helpful to improve my computer literacy, as well as repetitive use to get used to incorporating advancements into my daily work routines.* (D59-1)

Participants also addressed how student computer and digital literacy could be developed, with many participants recommending embedding computer and digital literacy requirements into undergraduate nursing assessments:

> *Assessments as such should target how students respond in critically important ways to digital information and processes, using their literacy skills of the digital world.* (D08-1)

> *This should be assessed throughout the whole nursing curriculum since these dynamic competencies take time to acquire and should be understood as a continuous development program for student to continue developing along their career.* (D24-1)

> *To not integrate across the curriculum would not be a real representation of their real-life working experience.* (D47-1)

Other recommendations included a foundational topic on computer and digital literacy, remediation through the undergraduate nursing degree, evaluating at set times in the curriculum and assessing beyond basic computer and digital literacy:

> *The bit that's always been missing for me (from what I can see of EMR training in health services) is the active learning through experiential learning- interacting with informatics and technology tools in a realistic way and added to with other modes, games etc. The learning modules I have seen and experienced are so passive, there is no way that completing them will substantially contribute to safety or confidence. The minimum at the least possible cost is the current situation- also a once and done approach. We wouldn't get someone to watch a CPR video and know how to perform CPR.* (D37-1)

Following the analysis of the First Round Questionnaire, the Second Round Questionnaire was developed (refer to *7.3 Findings from the Second Round Questionnaire*).

## 7.3 Findings from the Second Round Questionnaire

The Second Round Questionnaire required analysis of qualitative data (refer to *Appendix C4*). Descriptive statistics (frequency counts) and reflexive thematic analysis were used to analyse the participants' responses. Frequency counts were used to identify the degree of consensus between the participants and reflexive thematic analysis used the same six phase procedure as the First

Round Questionnaire (refer to *7.2.2 Reflexive Thematic Analysis*) (please note - further information regarding data analysis of the Second, Third and Fourth Round Questionnaires is available on request). The researcher worked with the four overarching themes identified in analysis of the First Round Questionnaire – *1) What is nursing informatics and why is it important?, 2) What do I need to know about nursing informatics?,* 3) *How can I learn about nursing informatics?,* and 4) *Everyone knows how to use a computer!.* The Second Round Questionnaire was developed to consolidate definitions of key terms, enhance understanding of specific concepts and to address issues raised in the initial questionnaire – namely, attempting to arrive at consensus regarding definitions of *nursing informatics*, *computer literacy* and *digital literacy*, considering whether the term nursing informatics is relevant in the contemporary healthcare environment, and attempting to arrive at a consensus regarding whether growing up with technology is linked with computer and digital literacy. Underlying the analysis were the original three research questions:

1. Can a distinct body of knowledge of nursing informatics be developed?

2. Can operational definitions for nursing informatics be achieved through consensus?

3. Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?

### 7.3.1 What is nursing informatics and why is it important?

Identified in the First Round Questionnaire, this theme was underpinned by two sub-themes – *What is nursing informatics?* And *Why is it important?* Participants provided a range of interpretations of the term *nursing informatics*; therefore, in the Second Round Questionnaire, participants were asked the following questions:

- In the first round questionnaire, nursing informatics was defined as: The use of nursing, computer and information science to better understand patient data for improved health outcomes and evidence based care and Managing and communicating data, information and knowledge to enhance nursing care, education, research and administration. In your opinion, should anything be added to this definition of Nursing Informatics?

- A question was raised regarding the relevance of the term nursing informatics and whether this was an outdated term that no longer reflected contemporary nursing practice in a digital environment. In your opinion, is the term nursing informatics relevant to contemporary nursing practice in a digital environment?

- What alternative terminology could be used?

The responses to these questions informed further development of the theme *What is nursing informatics and why is it important?*

Significant divergence of opinion was noted between participants, with n=24 supporting the definition and n=27 recommending changes to the definition. Changes to the definition included recommendations to change key terms (n=14) such as computer to digital and patient to healthcare user, to shorten the definition (n=5), to add additional information (n=9) including data security and ethical practice, and suggestions of different definitions (n=6):

> *Thinking about this again, I wonder if you might remove the word "patient" data for improved health outcomes. I wonder if the word is 'human' (inclusive of person, family, community and population).* (D07-2)

> *Nursing informatics is the use of digital technology to better understand patient care, improve health outcomes and evidence-based care, and manage and communicate data, information, and knowledge to enhance nursing care, education, research, and administration.* (D40-2)

Having established their understanding of nursing Informatics in the First Round Questionnaire, participants were asked to consider the understanding of nursing informatics by key stakeholders:

- In the first round questionnaire, a lack of understanding of Nursing Informatics was identified. In your opinion, is Nursing Informatics adequately understood by Educators? If not, why not.
- In your opinion, is Nursing Informatics adequately understood by Students? If not, why not.
- In your opinion, is Nursing Informatics adequately understood by University hierarchy? If not, why not.
- In your opinion, is Nursing Informatics adequately understood by nurses in the clinical setting? If not, why not.

The majority of participants (n=43) identified educators as having a limited understanding of nursing informatics; this was linked with resistance to change, a lack of professional development opportunities and a lack of recent clinical experience:

> *Most educators in Australia in nursing are professional academics. The realm of digital health and nursing informatics is evolving at exponential speed and the gap between educator's knowledge and clinical practice in informatics widens. I believe we need more industry partnerships with the education sector for a continuous and beneficial transfer of knowledge*. (D24)

> *I believe there is a gap in Educators' knowledge of Nursing Informatics. This may be related to educators' lack of exposure to rapid change in the field. Also, there is a need to increase expertise in nursing informatics for the Educators' workforce.* (D34)

However, some participants (n=9) identified that understanding of nursing informatics was increasing amongst educators:

> *Nursing Informatics, while gaining recognition, is still a relatively new field within healthcare. Educators may not fully understand its scope and significance due to: varied job descriptions, lack of standardization and limited exposure to the field.* (D14)

> *I believe Educators would at least be aware of this term, having worked for several years they are bound to have come across this and have some understanding of it but potentially may not have great depth of knowledge.* (D59)

> *I definitely believe that there is an awareness of nursing informatics. However, a large emphasis is associated to the electronic medical record data and data management.* (D60)

One participant also noted that educators may not link their contemporary nursing practice with the field of nursing informatics:

> *In my experience as an educator there is a lack of realisation that nursing informatics is part of what we do every day – using a digital format. There does not need to be specialised knowledge at a basic practice level, just a recognition.* (D39)

These findings were supported by the literature which has identified a lack of educator understanding of nursing informatics as a barrier to its effective integration into undergraduate nursing education (Gonen, Sharon, & Lev-Ari, 2016; Hamilton, Iradukunda, & Aselton, 2021; Procter, 2021), with Nagle, Kleib and Furlong (2020, p. 13) stating "educators' engagement and leadership support are vital for overcoming barriers and advancing informatics capacity in undergraduate education".

A number of participants (n=28) identified undergraduate nursing students as having a limited understanding of nursing informatics; this was linked with a lack of nursing informatics content in the curriculum, faculty with limited nursing informatics competency and a disconnect between digital health technologies and nursing informatics:

> *I don't think Nursing Informatics as a specific terminology is understood at all by Students. I suspect students understand the use of digital technology to deliver and enhance care but have never really considered Nursing Informatics as the term for this. Digital Natives such as undergraduate Nurses just see technology as a part of life and how it will help them in delivering the care.* (D25)

> *Most BN programs only focus on basic nursing skills. This is then reinforced by nursing placement where nurses largely try to involve students only in patient care and not in aspects of nursing management, administration or research etc where the data may have a wider professional impact*. (D50)

In explaining how nursing students' experiences have changed, one participant indicated:

*Current generation students are aware of informatics but probably an indirect sense. Most of them will by this point in 2024, never practice in a paper-based world (in bigger cities, rural areas still use a lot of hybrid/paper). So 'this' is now their reality. They understand informatics from a completely different ontology then what the proponents of nursing informatics advocate. Their lens on the topic will be vastly different from the scholarly definition/conceptualizations of informatics, because their reality has always included electronic records, mobile devices, and internet.* (D08)

Undergraduate nursing students' lack of understanding of nursing informatics has been extensively reported in the literature (Harerimana et al., 2021; O'Connor & LaRue, 2021), with Stunden et al. (2024, p. 10) noting that "Australian nursing students lack the required digital literacy and ICT skills to cope with the everchanging innovative trends in technology" and Kleib et al. (2022, p. 103) finding that "students have an inconsistent and fragmented understanding of DH [digital health] and NI [nursing informatics]".

A number of participants (n=27) identified university hierarchy as having a lack of understanding of nursing informatics:

*Much of nursing university is not nursing background which diminishes the capability to understand this. Hierarchy also implies a removal from the teaching and clinical working space which creates a disconnect from understanding the relevant information.* (D10)

*In my experience, a lot of what is covered in a nursing curriculum is not understood by university hierarchy. Work integrated learning is acknowledged but again the link/expectations with academic requirements within the nursing degree makes it difficult to fit it all in within the required timeframe. A topic/course on Nursing Informatics would be well placed in the transition to practice segment of the degree.* (D48)

However, as indicated by one participant, nurse educators need to promote the importance of nursing informatics within the tertiary setting:

*Probably not, but from a university perspective, I'm not clear why they would care. From a school/faculty of nursing, I'd hope they'd appreciate the importance. But from a university level, it's our job as educators to generate the value proposition. As per my response above to whether educators have understanding about informatics, I'm not confident we could generate a proper value proposition at most schools regarding the importance of informatics, and the need to fund education/training in this domain.* (D08)

Finally, participants were asked to consider whether nurses working in the clinical setting have an understanding of nursing informatics, with some (n=22) stating that nurses working in the clinical setting had a degree of nursing informatics competence and understanding:

*Yes, nurses in the clinical setting realize they cannot do their jobs adequately without the use of and understanding of the technology resources available to them.* (D16)

> *I think nurses have a basic understanding of the role of nursing informatics but probably don't want or need to know the how or why; as long as it works!* (D46)

But this finding was prefaced with the understanding of nursing informatics often being limited to the use of EHRs and other digital tools, rather than understanding the value of data analytics:

> *I think many understand the use of technology as it's a common experience to use technology these days. Nurses and Midwives use state of the art technology in their clinical settings. However, in most instances it's just to deliver basic care such as observations and writing notes into an EMR. Very few recognise the use of technology that can be used to increase efficiencies with delivery of healthcare care and the power of using the data. As we bring graduates into the healthcare fields who are digital natives, we'll find more people engaged in the use of technology. However, it's more than just using the technology that makes nursing informatics useful.* (D25)

> *Nurses understand their daily practice—how they use their information systems and devices. What is mostly still lost is the use of data. All the possibilities for how they could follow processes and analyze outcomes based on data are still seldom carried out.* (D40)

These findings are reflected in contemporary literature regarding the workforce preparedness of nurses to effectively engaged with nursing informatics (Chipps et al., 2022; Shin, Cummings, & Ford, 2018; Stunden et al., 2024), with Morris et al. (2023, p. 8), in *The Widening Gap between the Digital Capability of the Care Workforce and Technology-Enabled Healthcare Delivery: A Nursing and Allied Health Analysis*, stating "there is a gap between the digital capability of the current health workforce and the need for the rapid deployment of high-quality digital healthcare to patients with a wide range of health conditions".

### 7.3.2 Everyone knows how to use a computer!

Identified in the First Round Questionnaire, this theme encompassed three sub-themes which required further clarification – *What is computer literacy?, What is digital literacy?* and *What is a digital native and does it matter*? To obtain further data regarding these sub-themes, participants were asked the following questions:

- In the first round questionnaire, computer literacy was defined as: *The ability to navigate and perform functions on a computer and perform basic troubleshooting*. In your opinion, should anything be added to this definition?

- Digital literacy was defined as: A deeper level thinking than computer literacy with the use of various devices, platforms and software and the ability to find, evaluate, create, and communicate data, incorporating computer literacy within digital ecosystems. In your opinion, should anything be added to this definition?

- A question was asked regarding the term Digital Native and whether this accurately reflected the majority of undergraduate nursing students. Prensky (2001) used the term Digital Native to describe students who have grown up with digital technology and “think and process information fundamentally differently from their predecessors”. In your opinion, is growing up with technology linked with computer and digital literacy? Discuss.

The responses to these questions informed further development of the theme *Everyone knows how to use a computer!*

Significant divergence of opinion was noted regarding the definition of *computer literacy* in Round 2 - *The ability to navigate and perform functions on a computer and perform basic troubleshooting*, with n=20 agreeing on the definition and n=31 recommending changes to the definition, including the removal of basic troubleshooting (n=5), inclusion of digital security and ethical practice (n=6) and a broader description of computer devices (n=10). The relevance of the term computer literacy, in the contemporary digital environment was also addressed:

> *I would never use this definition as it’s too narrow for me and seems pointless in the age of many digital tools/platforms that are not computers being used which is why digital literacy is much more important.* (D31-2)

> *I think we should be talking about technologies more broadly together with supporting an understanding of computer processing. (D37-2)*

And the need to define computer literacy was questioned:

> *No need to define this in this study, this is a well established definition. Please don’t unnecessarily replicate definitions.* (D45-2)

The complexity regarding definitions of terms like *computer literacy* is evident in the literature over the past 40 years, with Noble (1984) noting the importance of defining computer literacy and wryly citing Watt (1983), who stated “No one can tell you exactly what it is but everyone is sure that it is good for us”. Similarly, McMillan (1996, p. 161), in *Literacy and computer literacy: Definitions and comparisons*, noted that “Literacy and computer literacy have much in common, besides the word *literacy*. Both have proven difficult, if not impossible, to conceptualize into specific, concise definitions”. Subsequently, Bawden (2001), in *Information and digital literacies: a review of concepts*, noted the contradictory definitions of computer literacy, with the rapidly evolving nature of digital technologies identified as being problematic in establishing a coherent definition of computer literacy (Jacob & Warschauer, 2018; Tsai, Liang, & Hsu, 2021).

Less divergence of opinion (than was identified with computer literacy) was noted regarding the definition of digital literacy in Round 2 - A deeper level thinking than computer literacy with the use of various devices, platforms and software and the ability to find, evaluate, create, and communicate data, incorporating computer literacy within digital ecosystems, with n=27 agreeing on the definition and n=24 recommending changes to the definition, including both human and non-human elements (n=3), addition of key words – knowledge, skills, attitudes and information (n=2), and the use of pre-existing definitions (n=2). The use of key terms was emphasised in one participant's response:

> *A deeper level of understanding than only functional computer literacy. The user is now quite familiar with the use of various devices, platforms and software and the ability to find, evaluate, create, and communicate data; incorporating advanced computer literacy within digital ecosystems, and usually on a daily basis, and/or within their own lifestyle.* (D11-2)

The links between computer literacy and digital literacy were also evident:

> *This definition is more inclusive and clearer. I think computer literacy is a sub-level of digital literacy, they are not stand alone. Computer refers to specific objects used. Digital refers to and includes higher/human processes/critical thinking and action when using digital tools.* (D26-2)

However, the relevance of the dichotomy between computer and digital literacy was also identified:

> *I am not sure the term "computer" works any more. As mentioned previously, its more about broader technology – though I am not entirely sure how to capture that in this definition.* (D22-2)

> *I think we should be talking about technologies more broadly together with supporting an understanding of computer processing.* (D37-2)

The question of whether computer literacy is now relevant as a standalone concept is apparent in the literature with the term used primarily in the 1980s (Bawden, 2008; Park, Kim, & Park, 2021), and with digital literacy encompassing more than the use of a computer (Koltay, 2011; Park, Kim, & Park, 2021). Eshet-Alkalai (2004, p. 96), in *Digital Literacy: A Conceptual Framework for Survival Skills in the Digital Era*, captured the essence of digital literacy:

> Digital literacy involves more than the mere ability to use software or operate a digital device; it includes a large variety of complex cognitive, motor, sociological, and emotional skills, which users need in order to function effectively in digital environments.

In the First Round Questionnaire, participants were asked to consider the concept of the *digital native* first described by Prensky (2001b, 2001a, 2006, 2009), with the relevance of the term a source of contention in the First Round Questionnaire (refer *to 7.2 Findings from the First Round* Questionnaire). In response to this, in the Second Round Questionnaire, participants were asked - *In your opinion, is growing up with technology linked with computer and digital literacy?* with n=26 linking growing up with technology as linking with computer and digital literacy:

> *Yes, digital technology has now become so important to ordinary daily function, that just about all schools will include a digital tablet and/or laptop computer for a student's schoolwork and assessments. As such, learning about various digital applications and functions has become an integrated part of the forthcoming generation of students. This, now innate function, will soon become an accepted norm, and to that effect, analogue processes and functions will be considered an outdated concept, with an expectation for digital workflows and practices in the workplace.* (D11-2)

> *Yes, I think generations that are considered digital natives are more comfortable with data and technology. They innately understand technology and data (data literacy) and its forms and limitations. This helps to set expectations of the technology/data and allows them to think of alternate ways to engage with technology and information.* (D43-2)

Assumptions about the specific attributes of different generations and their ability to engage with digital technologies is evident in the literature (Reid, Button, & Brommeyer, 2023), with Generation Y or Millennials (those born approximately 1981-1994) described as being able to obtain "instantaneous results" due to exposure to digital technologies from a young age and expectations of immediate access to information (Atkey & Kaminskil, 2020, p. 24) and Generation Z (those born approximately 1995-2010) described as "a unique and truly digital native generation" (Chicca & Shellenbarger, 2018, p. 180), diverse and tech-savvy (Shatto & Erwin, 2016), and hyperconnected to electronic devices and the internet (Hampton, Welsh, & Wiggins, 2020). With authors translating this exposure to digital technologies and noting that education for these digital natives requires a "flexible, collaborative and individualised learning" approach (Reid, Button, & Brommeyer, 2023, p. 579).

However, a similar number of participants (n=25) did not equate lifelong exposure to digital technologies with computer and digital literacy, with some participants cautioning that the presumption of exposure to digital technologies was flawed, as not all individuals would have access to the required digital technologies (n=6):

> *No because we cannot assume that every child has had a equal opportunity – some students may not have had access to the technology at home (mobile phone, laptop, gaming system for example), other may have had limited access to the Internet or it was something not adequately taught in elementary/high school.* (D13-2)

> *…there are many circumstances whereby the person may not be able to use it well…in a course I had in 2022, a number of overseas 1st year students had not used a computer at school at ALL. They did all of school, including final level exams with pen and paper. I and my deputy spent several weeks providing extra zoom classes for them to build some BASIC skills. Although the migration agents say students are computer literate, I think they assume if a student can use a mobile phone they are computer literate.* (D32-2)

The *digital divide*, the gap between those people with ease of access to digital technologies and those without access (Sanders & Scanlon, 2021), has often been overlooked with populations who lack access to digital technologies including rural residents (Hollman, Obermier, & Burger, 2021; Sanders & Scanlon, 2021), low-income households (Sanders & Scanlon, 2021; Wamuyu, 2017), people with lower levels of education (Park, Ramirez, & Sparks, 2021; Sanders & Scanlon, 2021), and those from developing nations (Mphahlele, Mokwena, & Ilorah, 2021; Ohemeng & Ofosu-Adarkwa, 2014; Wamuyu, 2017).

Similarly, the belief that exposure to technologies leads to familiarity with devices and a degree of computer literacy, was not viewed as translating to competence in the use of digital technologies (n=19):

> *Growing up with technology does provide a foundational familiarity and comfort with digital devices, which can facilitate the development of computer and digital literacy. Being a digital native does not automatically translate to proficiency in these literacies. Effective literacy involves critical thinking, ethical considerations, and adaptive skills that are often not innate and must be explicitly taught and developed. While there is a link, it does not guarantee comprehensive digital competency without structured education and training.* (D23-2)

> *I think the term digital native is a bit of a joke and I would never use it. Yes most (not all) students are exposed to some technology at a young age, but their digital knowledge and skills are still very basic, and most students have no clue how technology actually works, they can just click a few buttons on their smartphone to navigate around the Internet and social media and that's about the extent of their knowledge and skills in the digital realm. So, I think the link between growing up with technology and being digitally literate is very weak.* (D31-2)

These findings are evident in the literature, with discussion of the digital native described "as an academic form of a moral panic" (Reid, Button, & Brommeyer, 2023, p. 579), that is not adequately supported by the literature (Hills, Levett-Jones, & Lapkin, 2017; Walker et al., 2006). Evans and Robertson (2020, p. 274), in *The four phases of the digital natives debate*, noted that the term digital natives had been used in 15,800 articles in Google Scholar, stating that findings "are anything but consistent".

### 7.3.3 A new theme - Too many digital health terminologies?

As described in *6.4.2.2 Definition of consensus*, in adherence with the recommendations of Jünger et al. (2017), in Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review, the *a priori* criterion for consensus for how to proceed with certain items or topics in the next survey round was through establishing the stability of the groups response and agreement, and the procedures to be followed when consensus is (not) reached after one or more iterations was to delete or modify these survey items. Adherence to this procedure was reflected through revisiting the definitions of nursing informatics, computer literacy and digital literacy and whether growing up with technology is linked with computer and digital literacy. In noting the need to be cautious when establishing consensus to avoid skewing data or influencing participants' responses (Barrett & Heale, 2020; Hasson & Keeney, 2011; Niederberger & Spranger, 2020), the researcher modified the definitions of nursing informatics, computer literacy and digital literacy to reflect participants' responses and asked participants to respond to these definitions in the Second Round Questionnaire. Consensus, as defined in the Delphi Study Protocol (refer to *Appendix B2*), was not achieved due to the disparate responses regarding these key definitions, across two rounds of Delphi questionnaires. Consequently, a new theme Too many digital health terminologies? which described the tensions between terminologies, interpretations of these terminologies and how they added to the confusion regarding nursing informatics, was developed.

The theme reflected the differences in participants' opinions regarding key terminologies – namely nursing informatics, computer literacy and digital literacy, and was evident in both the First and Second Round Questionnaires. When discussing nursing informatics and alternative terminologies, participants stated:

> *I do not have an alternative suggestion. I think it would be hard to change when understanding of the current term is still not well established. (D47-2)*

> *Every 5 years the terminology for this domain changes. I just update as a per whatever becomes the commonplace idea, and link back to historical terms in terms of evolution. I think gone are the days of academics fighting over the primacy of a singular word/construct/idea, like it was popular back in the early 2000s with ehealth, informatics, et al.* (D08-2)

> *I struggled to provide a definition. It's a relatively nebulous concept and very broadly applied. I think that makes it difficult to define and has been applied to anything that relates to information systems, processes or activities.* (D29-2)

This confusion was highlighted by Friedman (2012, p. 224), in *What informatics is and isn't*, who identified "An expanding cloud of chaos" surrounding the word informatics. Similarly, Reid, Maeder, Button, et al. (2021) , in *Defining Nursing Informatics: A Narrative Review*, noted that confusion regarding Nursing Informatics was worsened by multiple definitions, with Becker (2021), in *The Roles and Challenges of Computing Terminology in Non-Computing Disciplines*, identifying that confusing, vague and constantly changing computing terminologies were a barrier to effective teaching and learning.

## 7.4 Results from the Third Round Questionnaire

Following data collection of the Third Round Questionnaire (n=51) (*Appendix C4*), descriptive statistics were used to analyse the data from questions 1, 3 and 5. The remaining questions, with text responses, were analysed using reflexive thematic analysis.

### 7.4.1 Descriptive statistics

The Third Round Questionnaire collected demographic and Likert-type data. Demographic data had nominal levels of measurement which were analysed using measures of central tendency (the mode) and measures of frequency (ratio). The Likert-type data had ordinal levels of measurement which were analysed using measures of central tendency (mean), measures of frequency (absolute frequencies and relative frequencies), and stakeholder-group analysis. The findings from this analysis will now be discussed.

#### *7.4.1.1 Professional role*

Participants' professional roles included 39.2% nurse educators, 31.4% nurse informaticians and 29.4% experts in nursing informatics. A total of 51 participants completed the Round Three Questionnaire which demonstrated that despite attrition throughout this study, the sample group remained above the originally planned 40 participants. Originally, only the participants' professional roles and country of practice were collected (in the First Round Questionnaire); however, due to some participants identifying multiple roles and some participants omitting information regarding their professional role, it was decided to revisit this question in the Third Round Questionnaire. It was later decided in consultation with Dr Pawel Skuza, that gender may be useful in stakeholder-group analysis and this question was added to the Fourth Round Questionnaire. Further discussion of demographic data combined from the First, Third and Fourth Round Questionnaires is addressed in *7.4 Results from the Third Round Questionnaire*.

#### *7.4.1.2 Enablers for the integration of nursing informatics into undergraduate nursing curriculum*

Participants were asked to consider a series of enablers for the integration of nursing informatics into undergraduate nursing education, with these enablers identified in the First and Second Round Questionnaires. A five-point Likert-type scale was used to collect this data with the measures of central tendency (mean), and the measures of absolute frequency (frequency counts) and relative frequencies (percentages) used to analyse the data. The data table (refer to *Table 7.3*) was sorted in order of ascending mean values to present information that demonstrated the collective opinions of the participants, with variables ranging from 3.59 - 4.49 (on a 5.00 scale). The variables, with higher means, indicated those enablers having the higher level of agreement. As was anticipated, due to the participants already addressing the possible enablers in the First and Second Round Questionnaires, the level of agreement was high. To consolidate and increase the clarity of data for easier identification of trends, collapsing of the data into two levels was performed (refer to *Table 7.4*) and a graphic display was developed (refer to *Table 7.5*). From these tables, the variables which fell below the *a priori* consensus threshold of 75% were identified and removed from the Round Four Questionnaire:

- Nursing informatics as a standalone topic
- Standardised undergraduate nursing curriculum
- Curriculum linked with workforce requirements
- University hierarchy support

Justification for the removal of these variables will now be addressed.

##### *7.4.1.2.1 Nursing informatics as a standalone topic*

*Nursing informatics as a standalone topic* received the lowest mean of 3.59 (refer to *Table 7.4*) in the initial analysis and the lowest consensus level of 60.8% in the collapsed levels analysis (refer to *Table 7.4*) out of all of the identified enablers in the Third Round Questionnaire; therefore, this variable did not progress to the Fourth Round Questionnaire. Nursing informatics as a standalone topic, as an enabler, was identified in the First and Second Round Questionnaires and was offered as an alternative to nursing informatics embedded throughout the curriculum. However, the responses in the Third Round Questionnaire indicated that nursing informatics as a standalone topic was seen by a number of participants (n=20) as being of less importance than other key enablers.

Nursing informatics, as a standalone or discrete topic (Kazawa et al., 2022; Luo & Kalman, 2018; O'Connor & LaRue, 2021) or embedded throughout the curriculum (Bonnel, Vogel Smith, & Hober, 2018; Cummings et al., 2020; Harerimana et al., 2021, 2022), has been addressed in previous studies, with the majority of studies supporting integration of nursing informatics content throughout the curriculum. As explained by Cummings et al. (2016, p. 321), in *Embedding Nursing Informatics Education into an Australian Undergraduate Nursing Degree*, in a study of a university program, “the core premise was that NI should become integrated throughout the degree, and not be viewed as additional or separate from the core unit content or context”. Therefore, it is unsurprising that the participants prioritised nursing informatics as a standalone topic as being the lowest priority enabler for the integration of nursing informatics into undergraduate nursing curriculum.

##### *7.4.1.2.2 Standardised undergraduate nursing curriculum*

*Standardised undergraduate nursing curriculum* had a mean of 3.88 (refer to *Table 7.3*) in the initial analysis and a consensus level of 68.6% in the collapsed levels analysis (refer to *Table 7.4*); as a result, this variable did not progress to the Fourth Round Questionnaire. Standardised undergraduate nursing curriculum, as an enabler, was identified in the First and Second Round Questionnaires and linked with university hierarchy support through governance. However, the responses in the Third Round Questionnaire indicated that standardised undergraduate nursing curriculum was seen by a number of participants (n=16) as being of less importance than other key enablers.

There has been a call for a global nursing approach (Holmgren & Eriksson, 2023; Kunaviktikul & Turale, 2020; Yatsu & Saeki, 2022), with concerns regarding the diverse quality of nursing education available globally (Kraft et al., 2017), and recommendations for “quality guidelines to direct nursing education and for greater harmonization of entry level nursing education globally” (Baker, Cary, & da Conceicao Bento, 2021, p. 86). Kunaviktikul and Turale (2020, p. 1), in *Internationalizing nursing curricula in a rapidly globalizing world*, stated that “nurse educators and leaders need to consider the critical importance of internationalizing nurses’ education at all levels, as well being committed to their roles in curricula reform and using innovative technology”. However, other authors have warned that the standardisation and globalisation of nursing education may also result in the homogenisation of nursing care and a focus on the dominant discourse to the detriment of the ‘other’ (Dorri, Abedi, & Mohammadi, 2020; Mc Cullough & Hatt, 2017). Resistance to the notion of a one-size-fits-all undergraduate curriculum may explain, to some extent, the participants lower prioritisation of standardised undergraduate nursing curriculum, as an enabler for the integration of nursing informatics into undergraduate nursing curriculum.

#### *7.4.1.2.3 Curriculum linked with workforce requirements*

*Curriculum linked with workforce requirements* had a mean of 3.96 (refer to *Table 7.3*) in the initial analysis and a consensus level of 68.6% in the collapsed levels analysis (refer to *Table 7.4*); as a result, this variable did not progress to the Fourth Round Questionnaire. University hierarchy support, as an enabler, was identified in the First and Second Round Questionnaires. However, the responses in the Third Round Questionnaire indicated that curriculum linked with workforce requirements was seen by a number of participants (n=14) as being of less importance than other key enablers.

The importance of building digital capacity in the nursing workforce is evident in the literature with a focus on the role of undergraduate nursing education in workplace readiness (Kleib et al., 2022; Morris et al., 2023; Stunden et al., 2024). Workforce capability has also been a cornerstone of the digital health strategy for Australia, with the *National Nursing and Midwifery Digital Health Capability Framework* (Australian Digital Health Agency (ADHA), 2020, p. 6), developed as “a guide for individuals and employers on the skills and knowledge required to deliver healthcare in a digital world” and with the goal of the *Australian Digital Health Agency’s Workforce Strategy 2021-2026* (ADHA, 2021, p. 8) to “build, strengthen and future proof” the Australian workforce. The participants recommendations for nursing informatics content in undergraduate nursing curriculum identified a wide array of suggested content, and this may, in part, explain why the enabler of curriculum linked with workforce requirements was not prioritised, as it is difficult to encapsulate exactly how to align curriculum with the needs of the workforce and solutions “vary and are context specific” (Booth, Strudwick, McBride, et al., 2021, p. 4).

##### *7.4.1.2.4 University hierarchy support*

*University hierarchy support* had a mean of 4.04 (refer to *Table 7.3*) in the initial analysis and a consensus level of 72% in the collapsed levels analysis (refer to *Table 7.4*); therefore, this variable did not progress to the Fourth Round Questionnaire. University hierarchy support, as an enabler, was identified in the First and Second Round Questionnaires and linked with workload allocations, time for professional development, research into nursing informatics, recognition of the importance of nursing informatics and governance through the development of a standardised undergraduate nursing curriculum. However, the responses in the Third Round Questionnaire indicated that the support of university hierarchy was seen by a number of participants (n=14) as being of less importance than other key enablers.

University hierarchy have been identified as having a key role in the integration of nursing informatics into nursing curricula through supporting nursing informatics initiatives (Foster & Sethares, 2017); conversely, university hierarchy have also been identified as creating a barrier to nursing informatics integration (Bove, 2020; Lilly, Fitzpatrick, & Madigan, 2015), with questions arising regarding the increasing commercialisation of tertiary education and its impact on collaboration between university hierarchy and faculty. Rowlands (2017, p. 64), in *Academic Governance in the Contemporary University: Perspectives from Anglophone nations*, warned that managerial modes of governance were reducing “academic agency in such areas as curriculum, assessment and research”; and that whilst managerial style governance may reduce waste and costs, there were inherent risks associated with this type of governance, including academics not determining curriculum or research priorities. Whilst noting that curriculum is impacted by *external factors*, including regulations and accreditation, characteristics of the academic setting, political climate, demographics, and financial support, and internal factors, including the organisational structure, internal economic situation, potential faculty and students, available resources, and the mission, purpose, philosophy and goals of the tertiary institution (Stimac DeBoor, 2022); “literature highlights that effective curriculum management must consider the stakeholders' needs to ensure collective success” and embrace shared responsibility between faculty and hierarchy (Riad, 2022, p. 89). The tension between the commercial needs of the university and the educational needs of future nurses and the nursing profession, may, in part, explain the participants lower prioritisation of the support of the university hierarchy, as an enabler for the integration of nursing informatics into undergraduate nursing curriculum.

##### *7.4.1.2.5 Enablers which met the consensus threshold*

The enablers which met the 75% consensus threshold are discussed in *Chapter 8: Integration of findings*.

**Table 7-3 Enabler for the integration of nursing informatics into undergraduate nursing education - in order from lowest to highest mean**

| Questions | Mean (Max=5) | Strongly disagree | | Somewhat disagree | | Neither agree nor disagree | | Somewhat agree | | Strongly agree | | Total (n=51) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count |
| Q1_11 NI as a standalone topic | 3.59 | 5 | 9.8 | 5 | 9.8 | 10 | 19.6 | 17 | 33.3 | 14 | 27.5 | 51 |
| Q1_17 Standardised undergraduate Nursing curriculum | 3.88 | 1 | 2.0 | 6 | 11.8 | 9 | 17.6 | 17 | 33.3 | 18 | 35.3 | 51 |
| Q1_8 Curriculum linked with workforce requirements | 3.96 | 2 | 0.0 | 3 | 5.9 | 11 | 21.6 | 14 | 27.5 | 21 | 41.2 | 51 |
| Q1_9 Curriculum linked with competency standards | 4.02 | 2 | 3.9 | 3 | 5.9 | 4 | 7.8 | 25 | 49.0 | 17 | 33.3 | 51 |
| Q1_4 University hierarchy support | 4.04 | 1 | 2.0 | 1 | 2.0 | 12 | 24.0 | 17 | 34.0 | 19 | 38.0 | 50 |
| Q1_16 Development of NI competencies | 4.08 | 1 | 2.0 | 2 | 3.9 | 7 | 13.7 | 23 | 45.1 | 18 | 35.3 | 51 |
| Q1_2 Technical support | 4.10 | 2 | 3.9 | 2 | 3.9 | 6 | 11.8 | 20 | 39.2 | 21 | 41.2 | 51 |
| Q1_12 Use of NI in clinical placements | 4.10 | 1 | 2.0 | 3 | 5.9 | 7 | 13.7 | 19 | 37.3 | 21 | 41.2 | 51 |
| Q1_15 Professional development of university faculty | 4.16 | 0 | 0.0 | 3 | 5.9 | 9 | 17.6 | 16 | 31.3 | 23 | 45.1 | 51 |
| Q1_13 Use of NI in simulation/ lab classes | 4.24 | 2 | 3.9 | 0 | 0.0 | 4 | 7.8 | 23 | 45.1 | 22 | 43.1 | 51 |
| Q1_18 Recognition of NI from peak Nursing bodies | 4.31 | 2 | 3.9 | 1 | 2.0 | 4 | 7.8 | 16 | 31.4 | 28 | 54.9 | 51 |
| Q1_3 Simulation resources | 4.32 | 1 | 2.0 | 1 | 2.0 | 3 | 6.0 | 21 | 42.0 | 24 | 48.0 | 50 |
| Q1_10 Linking NI with contemporary nursing practice | 4.33 | 2 | 3.9 | 3 | 5.9 | 4 | 7.8 | 9 | 17.6 | 33 | 64.7 | 51 |
| Q1_5 Range of digital health technologies | 4.35 | 1 | 2.0 | 2 | 3.9 | 4 | 7.8 | 15 | 29.4 | 29 | 56.9 | 51 |
| Q1_14 Faculty who understand NI | 4.37 | 1 | 2.0 | 3 | 5.9 | 5 | 9.8 | 9 | 17.6 | 33 | 64.7 | 51 |
| Q1_7 NI embedded throughout curriculum | 4.39 | 3 | 5.9 | 1 | 2.0 | 4 | 7.8 | 8 | 15.7 | 35 | 68.6 | 51 |
| Q1_1 Access to digital health technologies | 4.41 | 2 | 3.9 | 1 | 2.0 | 3 | 5.9 | 13 | 25.5 | 32 | 62.7 | 51 |
| Q1_6 Digital literacy development | 4.49 | 0 | 0.0 | 1 | 2.0 | 5 | 9.8 | 13 | 25.5 | 32 | 62.7 | 51 |

**Table 7-4 Enablers for the integration of nursing informatics into undergraduate nursing education - two levels - in order of presentation in Third Round Questionnaire**

| Questions | Collapsed levels | Count | Column N % | Total (n=51) |
|---|---|---|---|---|
| Q1_1_2L Access to digital health technologies | Disagree | 6 | 11.8 | 51 |
| | Agree | 45 | 88.2 | |
| Q1_2_2L Technical support | Disagree | 10 | 19.6 | 51 |
| | Agree | 41 | 80.4 | |
| Q1_3_2L Simulation resources | Disagree | 5 | 10.0 | 50 |
| | Agree | 45 | 90.0 | |
| Q1_4_2L University hierarchy support | Disagree | 14 | 28.0 | 50 |
| | Agree | 36 | 72.0 | |
| Q1_5_2L Range of digital health technologies | Disagree | 7 | 13.7 | 51 |
| | Agree | 44 | 86.3 | |
| Q1_6_2L Digital literacy development | Disagree | 6 | 11.8 | 51 |
| | Agree | 45 | 88.2 | |
| Q1_7_2L NI embedded throughout curriculum | Disagree | 8 | 15.7 | 51 |
| | Agree | 43 | 84.3 | |
| Q1_8_2L Curriculum linked with workforce requirements | Disagree | 16 | 31.4 | 51 |
| | Agree | 35 | 68.6 | |
| Q1_9_2L Curriculum linked with competency standards | Disagree | 9 | 17.6 | 51 |
| | Agree | 42 | 82.4 | |
| Q1_10_2L Linking NI with contemporary nursing practice | Disagree | 9 | 17.6 | 51 |
| | Agree | 42 | 82.4 | |
| Q1_11_2L NI as a standalone topic | Disagree | 20 | 39.2 | 51 |
| | Agree | 31 | 60.8 | |
| Q1_12_2L Use of NI in clinical placements | Disagree | 11 | 21.6 | 51 |
| | Agree | 40 | 78.4 | |
| Q1_13_2L Use of NI in simulation/ lab classes | Disagree | 6 | 11.8 | 51 |
| | Agree | 45 | 88.2 | |
| Q1_14_2L Faculty who understand NI | Disagree | 9 | 17.6 | 51 |
| | Agree | 42 | 82.4 | |
| Q1_15_2L Professional development of university faculty | Disagree | 12 | 23.5 | 51 |
| | Agree | 39 | 76.5 | |
| Q1_16_2L Development of NI competencies | Disagree | 10 | 19.6 | 51 |
| | Agree | 41 | 80.4 | |
| Q1_17_2L Standardised undergraduate Nursing curriculum | Disagree | 16 | 31.4 | 51 |
| | Agree | 35 | 68.6 | |
| Q1_18_2L Recognition of NI from peak Nursing bodies | Disagree | 7 | 13.7 | 51 |
| | Agree | 44 | 86.3 | |

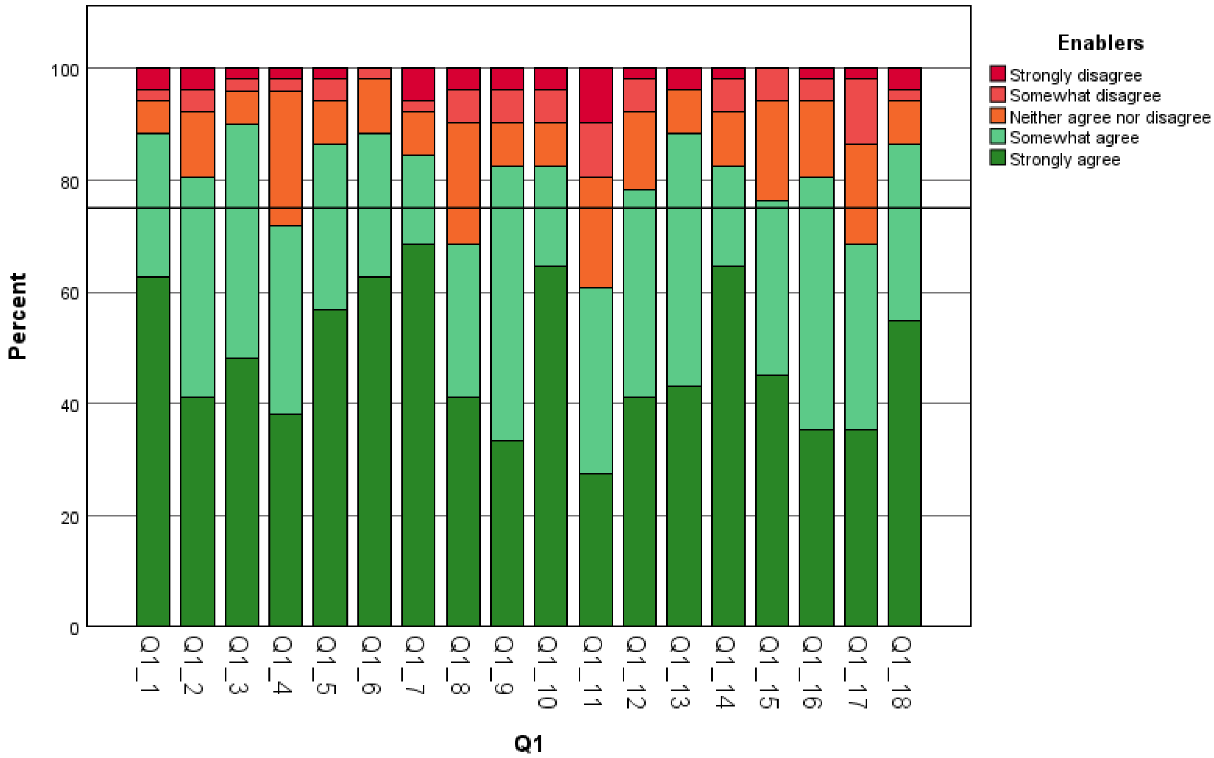
Disagree = Strongly, somewhat and neither agree or disagree

Agree = Somewhat and strongly

Note: enablers below the 75% consensus threshold are highlighted.

**Table 7-5 Stacked bar graph of enabler for the integration of nursing informatics into undergraduate nursing education - in order of questions**

*Note: 75% consensus threshold indicated*




### *7.4.1.3 Barriers to the integration of nursing informatics into undergraduate nursing education*

Participants were asked to consider a series of barriers to the integration of nursing informatics into undergraduate nursing education, with these barriers identified in the First and Second Round Questionnaires. A five-point Likert-type scale was used to collect this data with the measures of central tendency (mean), and the measures of absolute frequency (frequency counts) and relative frequencies (percentages) used to analyse the data. The data table (refer to *Table 7.6*) was sorted in order of ascending mean values to present information that demonstrated the collective opinions of the participants, with variables ranging from 3.53 - 4.47 (on a 5.00 scale). The variables, with higher means, indicated those barriers having the higher level of agreement. As was anticipated, due to the participants already addressing the possible barriers in the First and Second Round Questionnaires, the level of agreement was high. To consolidate and increase the clarity of data for easier identification of trends, collapsing of the data into two levels was performed (refer to *Table 7.7*) and a graphic display was developed (refer to *Table 7.8*). From these tables, the variables which fell below the *a priori* consensus threshold of 75% were identified and removed from the Round Four Questionnaire:

- Varying levels of digital literacy – students

- Lack of technical support for students & faculty
- Resistance to change - university hierarchy
- Resistance to change – faculty

Justification for the removal of these variables will now be addressed.

##### *7.4.1.3.1 Varying levels of digital literacy – students*

*Varying levels of digital literacy – students* received the lowest mean of 3.53 (refer to *Table 7.6*) in the initial analysis and the lowest consensus level of 52.9% in the collapsed levels analysis (refer to *Table 7.7*) out of all of the identified barriers in the Third Round Questionnaire; consequently, this variable did not progress to the Fourth Round Questionnaire. Varying levels of digital literacy – students, as a barrier, was identified in the First and Second Round Questionnaires. However, the responses in the Third Round Questionnaire indicated that varying levels of digital literacy – students were seen by a number of participants (n=24) as being of less importance than other key enablers.

Digital literacy has been identified as an essential skill for the nursing profession (Callinici, 2017); however, digital literacy does not necessarily correlate with digital competence in the clinical setting (Brown, Morgan, et al., 2020; Reid, Button, & Brommeyer, 2023) or in education (Kirschner & De Bruyckere, 2017; Lokmic-Tomkins, Choo, et al., 2022; Reid, Button, & Brommeyer, 2023). Previous studies have identified the varying digital literacy levels or a lack of digital literacy in undergraduate nursing students as a barrier to the effective integration and use of nursing informatics (Bonnel, Vogel Smith, & Hober, 2018; Raghunathan, McKenna, & Peddle, 2021; Theron et al., 2019) with assumptions about the *digital native* associated with only superficial levels of understanding of nursing informatics (Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Lam et al., 2016). Considering the importance placed on digital literacy throughout this study, it was of note that the varying literacy levels of students was not prioritised as a barrier to the integration of nursing informatics in undergraduate nursing education; however, this may reflect some participants adherence to the belief or assumptions regarding the inherent digital capabilities of the digital native.

##### *7.4.1.3.2 Lack of technical support for students & faculty*

*Lack of technical support for students & faculty* had a mean of 3.73 (refer to *Table 7.6*) in the initial analysis and a consensus level of 64.7% in the collapsed levels analysis (refer to *Table 7.7*); as a result, this variable did not progress to the Fourth Round Questionnaire. Lack of technical support for students & faculty, as a barrier, was identified in the First and Second Round Questionnaires and linked with a lack of university support. However, the responses in the Third Round

Questionnaire indicated that lack of technical support for students & faculty was seen by a number of participants (n=18) as being of less importance than other key enablers.

Previous studies have identified a lack of technical support, associated with inadequate infrastructure, poor functionality of systems, poor internet connectivity, and limited development, purchase and maintenance of hardware and software, as a barrier to integrating nursing informatics into undergraduate nursing curriculum (Baxter & Andrew, 2018; Forman, Flores, & Miller, 2020; Oh et al., 2019). Currently, “as of April 2024, there were 5.44 billion internet users worldwide, which amounted to 67.1 percent of the global population” (Petrosyna, 2024), with one-third of the global population having no internet access in 2022, and larger gaps in internet speed (World Bank Group, 2024) and increased costs (Chaqfeh et al., 2023) noted in low-income countries. However, for the participants in the study, *The Digital Quality of Life (DQL) Index 2023* categorised by internet affordability, internet quality, electronic infrastructure, electronic security and electronic government, ranked Finland as second in the world, the United Kingdom 15th, the United States of America 19th, Canada 22nd, New Zealand 27th, Australia 30th and Qatar 48th, with improvements to the DQL Index noted for Australia, New Zealand and Canada over the preceding 12 month period (Surfshark, 2024). These rankings may explain why a lack of technical support, including infrastructure, connectivity and functionality, were identified by the participants as a lower priority barrier for the integration of nursing informatics into undergraduate nursing curriculum.

#### *7.4.1.3.3 Resistance to change - university hierarchy*

*Resistance to change - university hierarchy* had a mean of 3.94 (refer to *Table 7.6*) in the initial analysis and a consensus level of 64.7% in the collapsed levels analysis (refer to *Table 7.7*); as a consequence, this variable did not progress to the Fourth Round Questionnaire. Resistance to change - university hierarchy, as a barrier, was identified in the First and Second Round Questionnaires, and associated with the changes to nursing practice and teaching methodologies. However, the responses in the Third Round Questionnaire indicated that Resistance to change - university hierarchy was seen by a number of participants (n=18) as being of less importance than other key enablers. As resistance to change also informs the next barrier - Resistance to change – faculty – these two barriers will be addressed in the next section.

#### *7.4.1.3.4 Resistance to change – faculty*

*Resistance to change - faculty* had a mean of 4.04 (refer to *Table 7.6*) in the initial analysis and a consensus level of 70.06% in the collapsed levels analysis (refer to *Table 7.7*); as a consequence, this variable did not progress to the Fourth Round Questionnaire. Resistance to change - faculty, as a barrier, was identified in the First and Second Round Questionnaires, and associated with the changes to nursing practice and teaching methodologies. However, the responses in the Third

Round Questionnaire indicated that resistance to change - faculty was seen by a number of participants (n=15) as being of less importance than other key enablers.

Resistance to change, often associated with technological stress, has been identified as a barrier to the integration of nursing informatics into undergraduate nursing education (Bonnel, Vogel Smith, & Hober, 2018; Forman, Armor, & Miller, 2020b; Forman, Flores, & Miller, 2020; Hamilton, Iradukunda, & Aselton, 2021). Due to the frequently changing nature of many organisations, employees may “develop negative attitudes and exhibit adverse reactions toward change - a phenomenon known as resistance to change” (Rehman et al., 2021, p. 1). Resistance to change is of interest to organisations, as the process of change may be adversely impacted by ongoing resistance to change (Rehman et al., 2021; Shimoni, 2017); however, DuBose and Mayo (2020, p. 635), in *Resistance to change: A concept analysis*, noted that whilst often identified as “pathological”, “resistance is a normal consequence whenever there is a threat to one's baseline status from a proposed change”. Within this study, resistance to change from university hierarchy and faculty was noted but was identified as a lower priority barrier for the integration of nursing informatics into undergraduate nursing curriculum. This may be, in part, to the ongoing integration of nursing informatics in the clinical setting and the ongoing discussion regarding the need for university education to reflect the realities of clinical practice.

##### *7.4.1.3.5 Barriers which met the consensus threshold*

The barriers which met the 75% consensus threshold are discussed in *Chapter 8: Integration of findings*.

**Table 7-6 Barriers to the integration of nursing informatics into undergraduate nursing education - in order from lowest to highest mean**

| Questions | Mean | Strongly disagree | | | Somewhat disagree | | Neither agree nor disagree | | Somewhat agree | | Strongly agree | | Total (n=1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Count | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count |
| Q3_9 Varying levels of digital literacy - students | 3.53 | 2 | 0 | 0.0 | 12 | 23.5 | 10 | 19.6 | 11 | 21.6 | 16 | 31.4 | 49 |
| Q3_5 Lack of technical support for students & faculty | 3.73 | 2 | 2 | 3.9 | 3 | 5.9 | 13 | 25.5 | 22 | 43.1 | 11 | 21.6 | 51 |
| Q3_2 Lack of access to digital health technologies - placement | 3.90 | 2 | 2 | 3.9 | 7 | 13.7 | 4 | 7.8 | 19 | 37.3 | 19 | 37.3 | 51 |
| Q3_12 Resistance to change - university hierarchy | 3.94 | 0 | 0 | 0.0 | 3 | 5.9 | 15 | 29.4 | 15 | 29.4 | 18 | 35.3 | 51 |
| Q3_8 Overfull curriculum | 3.96 | 1 | 1 | 2.0 | 5 | 9.8 | 7 | 13.7 | 20 | 39.2 | 18 | 35.3 | 51 |
| Q3_11 Resistance to change - faculty | 4.04 | 0 | 0 | 0.0 | 4 | 7.8 | 11 | 21.6 | 15 | 29.4 | 21 | 41.2 | 51 |
| Q3_6 Lack of incentive to include NI | 4.04 | 2 | 2 | 3.9 | 2 | 3.9 | 6 | 11.8 | 23 | 45.1 | 18 | 35.3 | 51 |
| Q3_15 Lack of understanding of NI - nurses in the clinical setting | 4.08 | 3 | 3 | 5.9 | 4 | 7.8 | 4 | 7.8 | 15 | 29.4 | 25 | 49.1 | 51 |
| Q3_14 Lack of understanding of NI - university hierarchy | 4.18 | 0 | 0 | 0.0 | 3 | 5.9 | 9 | 17.6 | 15 | 29.4 | 24 | 47.1 | 51 |
| Q3_1 Costs/ funding | 4.18 | 0 | 0 | 0.0 | 3 | 6.0 | 6 | 12.0 | 20 | 40.0 | 21 | 42 | 50 |
| Q3_13 Lack of understanding of NI - faculty | 4.20 | 0 | 0 | 0.0 | 3 | 5.9 | 8 | 15.7 | 16 | 31.4 | 24 | 47.1 | 51 |
| Q3_4 Lack of professional development - faculty | 4.29 | 0 | 0 | 0.0 | 1 | 2.0 | 8 | 15.7 | 17 | 33.3 | 25 | 49.1 | 51 |
| Q3_10 Varying levels of digital literacy - faculty | 4.35 | 0 | 0 | 0.0 | 1 | 2.0 | 5 | 9.8 | 20 | 39.2 | 25 | 49.1 | 51 |
| Q3_3 Lack of access to current digital health technologies - university | 4.35 | 0 | 0 | 0.0 | 2 | 3.9 | 6 | 11.8 | 15 | 29.4 | 28 | 54.9 | 51 |
| Q3_7 Lack of integration of NI throughout curriculum | 4.47 | 0 | 0 | 0.0 | 1 | 2.0 | 4 | 7.8 | 16 | 31.4 | 30 | 58.8 | 51 |

**Table 7-7 Barriers to the integration of nursing informatics into undergraduate nursing education - two levels - in order of presentation in Third Round Questionnaire**

| Questions | Collapsed levels | Count | Column N % | Total (n=51) |
|---|---|---|---|---|
| Q3_1_2L Costs/ funding | Disagree | 9 | 18.0% | 51 |
| | Agree | 41 | 82.0% | |
| Q3_2_2L Lack of access to digital health technologies - placement | Disagree | 13 | 25.5% | 51 |
| | Agree | 38 | 74.5% | |
| Q3_3_2L Lack of access to current digital health technologies - university | Disagree | 8 | 15.7% | 51 |
| | Agree | 43 | 84.3% | |
| Q3_4_2L Lack of professional development - faculty | Disagree | 9 | 17.6% | 51 |
| | Agree | 42 | 82.4% | |
| Q3_5_2L Lack of technical support for students & faculty | Disagree | 18 | 35.3% | 51 |
| | Agree | 33 | 64.7% | |
| Q3_6_2L Lack of incentive to include NI | Disagree | 10 | 19.6% | 51 |
| | Agree | 41 | 80.4% | |
| Q3_7_2L Lack of integration of NI throughout curriculum | Disagree | 5 | 9.8% | 51 |
| | Agree | 46 | 90.2% | |
| Q3_8_2L Overfull curriculum | Disagree | 13 | 25.5% | 51 |
| | Agree | 38 | 74.5% | |
| Q3_9_2L Varying levels of digital literacy - students | Disagree | 24 | 47.1% | 51 |
| | Agree | 27 | 52.9% | |
| Q3_10_2L Varying levels of digital literacy - faculty | Disagree | 6 | 11.8% | 51 |
| | Agree | 45 | 88.2% | |
| Q3_11_2L Resistance to change - faculty | Disagree | 15 | 29.4% | 51 |
| | Agree | 36 | 70.6% | |
| Q3_12_2L Resistance to change - university hierarchy | Disagree | 18 | 35.3% | 51 |
| | Agree | 33 | 64.7% | |
| Q3_13_2L Lack of understanding of NI - faculty | Disagree | 11 | 21.6% | 51 |
| | Agree | 40 | 78.4% | |
| Q3_14_2L Lack of understanding of NI - university hierarchy | Disagree | 12 | 23.5% | 51 |
| | Agree | 39 | 76.5% | |
| Q3_15_2L Lack of understanding of NI - nurses in the clinical setting | Disagree | 11 | 21.6% | 51 |
| | Agree | 40 | 78.4% | |

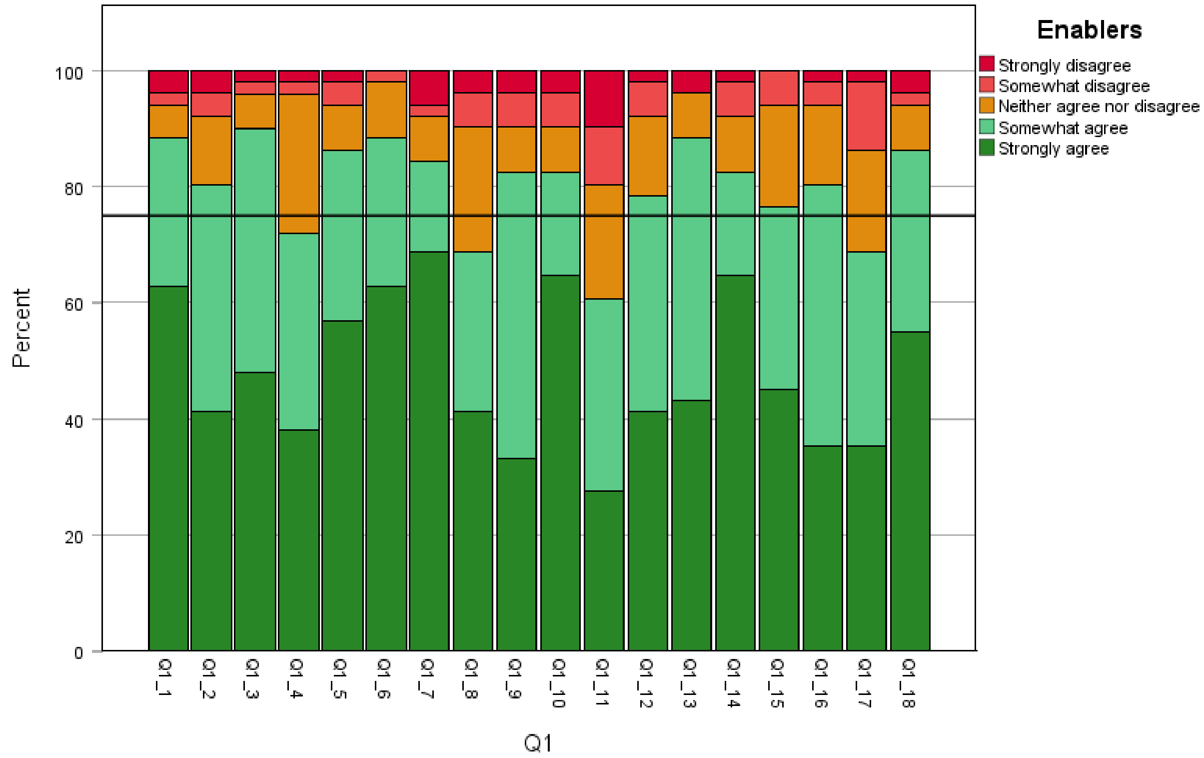
Disagree = Strongly, somewhat and neither agree or disagree

Agree = Somewhat and strongly

Note: barriers below the 75% consensus threshold are highlighted.

**Table 7-8 Stacked bar graph of enablers for the integration of nursing informatics into undergraduate nursing education - in order of questions**

*Note: 75% consensus threshold indicated*




### *7.4.1.4 Specific nursing informatics content required in undergraduate nursing education*

Participants were asked to consider which specific nursing informatics content should be included in undergraduate nursing education, with recommendations for this content identified in the First Round Questionnaire. A five-point Likert-type scale was used to collect this data with the measures of central tendency (mean), and the measures of absolute frequency (frequency counts) and relative frequencies (percentages) used to analyse the data. The data table (refer to *Table 7.9*) was sorted in order of ascending mean values to present information that demonstrated the collective opinions of the participants, with variables ranging from 4.39 - 4.90 (on a 5.00 scale). The variables, with higher means, indicated the content recommendations having the higher level of agreement. As was anticipated, due to the participants already addressing content recommendations in the First and Second Round Questionnaires, the level of agreement was high. To consolidate and increase the clarity of data for easier identification of trends, collapsing of the data into two levels was performed (refer to *Table 7.10*) and a graphic display was developed (refer to *Table 7.11*). The *a priori* consensus threshold of 75% was met for each of these recommendations. The specific nursing informatics content recommended by the participants is discussed in *Chapter 8: Integration of findings*.

**Table 7-9 Nursing informatics content recommendations for undergraduate nursing education - in order from lowest to highest mean**

| Questions | Mean | 1 Strongly disagree | | 2 Somewhat disagree | | 3 Neither agree nor disagree | | 4 Somewhat agree | | 5 Strongly agree | | Total (n=51) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count | Row N % | Count |
| Q5_2 Artificial Intelligence | N=4.39 | 0 | 0.0 | 0 | 0.0 | 7 | 13.7 | 17 | 33.3 | 27 | 52.9 | 51 |
| Q5_1 Adopting new and emergent technologies | N=4.40 | 0 | 0.0 | 0 | 0.0 | 7 | 13.7 | 16 | 32.0 | 27 | 54.0 | 50 |
| Q5_6 Digital devices | N=4.45 | 0 | 0.0 | 0 | 0.0 | 4 | 7.8 | 20 | 39.2 | 27 | 52.90 | 51 |
| Q5_10 Telehealth | N=4.48 | 0 | 0.0 | 0 | 0.0 | 6 | 12.0 | 14 | 28.0 | 30 | 60.0 | 50 |
| Q5_4 Data management | N=4.53 | 0 | 0.0 | 1 | 2.0 | 3 | 5.9 | 15 | 29.4 | 32 | 62.7 | 51 |
| Q5_5 Data security and privacy | N=4.71 | 0 | 0.0 | 1 | 2.0 | 1 | 2.0 | 10 | 19.60 | 39 | 76.5 | 51 |
| Q5_7 Digital health | N=4.73 | 0 | 0.0 | 0 | 0.0 | 3 | 5.9 | 8 | 15.7 | 40 | 78.4 | 51 |
| Q5_9 EMM - electronic medication management systems | N=4.84 | 0 | 0.0 | 0 | 0.0 | 1 | 2.0 | 6 | 11.8 | 44 | 86.3 | 51 |
| Q5_3 Digital literacy | N=4.90 | 0 | 0.0 | 0 | 0.0 | 1 | 2.0 | 3 | 5.9 | 47 | 92.2 | 51 |
| Q5_8 EMR/ EHR - electronic health records | N=4.90 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 5 | 9.80 | 46 | 90.2 | 51 |

**Table 7-10 Nursing informatics content recommendations for undergraduate nursing education - two levels - in order of presentation in the Third Round Questionnaire**

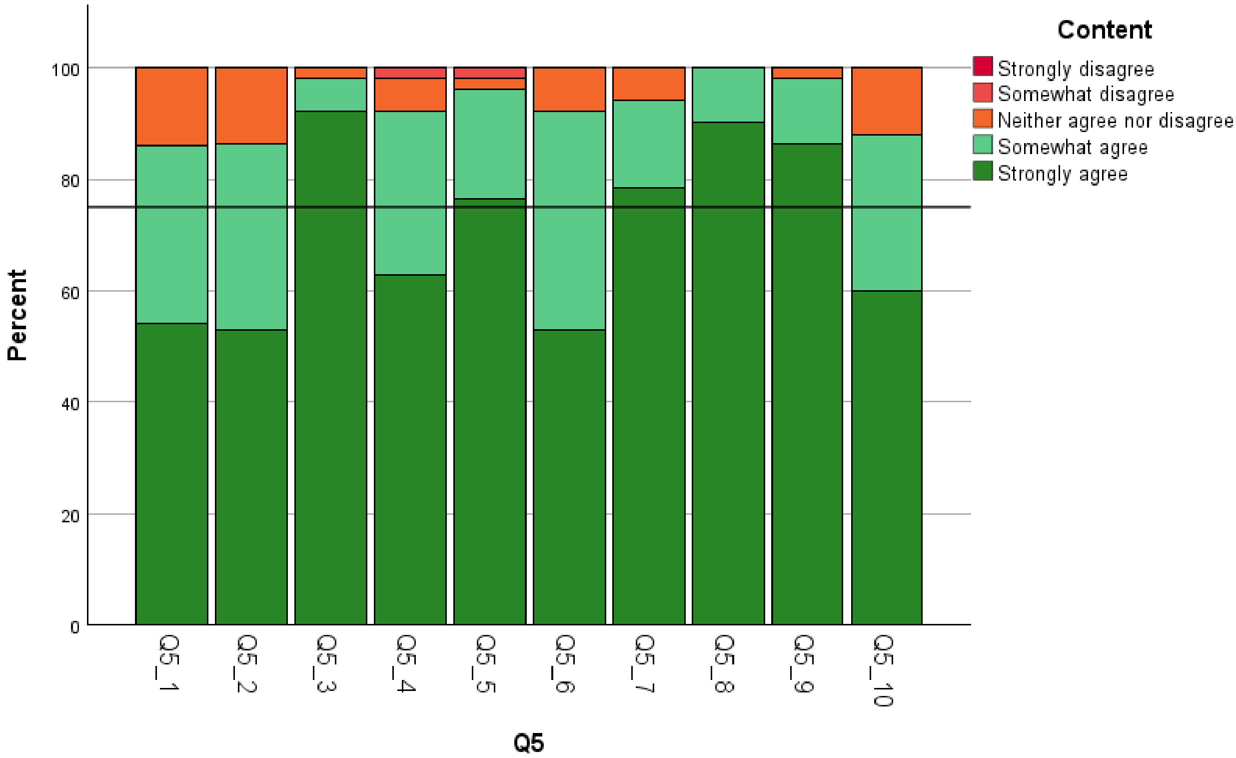
| Questions | Collapsed levels | Count | Column N % | Total (n=51) |
|---|---|---|---|---|
| Q5_1_2L Adopting new and emergent technologies | Disagree | 7 | 14.00% | 50 |
| | Agree | 43 | 86.00% | |
| Q5_2_2L Artificial Intelligence | Disagree | 7 | 13.73% | 51 |
| | Agree | 44 | 86.27% | |
| Q5_3_2L Digital literacy | Disagree | 1 | 1.96% | 51 |
| | Agree | 50 | 98.04% | |
| Q5_4_2L Data management | Disagree | 4 | 7.84% | 51 |
| | Agree | 47 | 92.16% | |
| Q5_5_2L Data security and privacy | Disagree | 2 | 3.92% | 51 |
| | Agree | 49 | 96.08% | |
| Q5_6_2L Digital devices | Disagree | 4 | 7.84% | 51 |
| | Agree | 47 | 92.16% | |
| Q5_7_2L Digital health | Disagree | 3 | 5.88% | 51 |
| | Agree | 48 | 94.12% | |
| Q5_8_2L EMR/ EHR - electronic health records | Disagree | 0 | 0.00% | 51 |
| | Agree | 51 | 100.00% | |
| Q5_9_2L EMM - electronic medication management systems | Disagree | 1 | 1.96% | 51 |
| | Agree | 50 | 98.04% | |
| Q5_10_2L Telehealth | Disagree | 6 | 12.00% | 50 |
| | Agree | 44 | 88.00% | |

Disagree = Strongly, somewhat and neither agree or disagree

Agree = Somewhat and strongly

**Table 7-11 Stacked bar graph of nursing informatics content recommendations for undergraduate nursing education - in order of questions**

*Note – 75% consensus threshold indicated*




### 7.4.2 Reflexive thematic analysis

As part of the Third Round Questionnaire, the participants were asked three free-text questions:

- Q2 In your opinion, are there any other enablers for the use of Nursing Informatics in undergraduate nursing education?
- Q4 In your opinion, are there any other barriers for the use of Nursing Informatics in undergraduate nursing education?
- Q6 In your opinion, is there any other specific content (regarding Nursing Informatics) that should be addressed in undergraduate nursing education?

The responses to these questions were uploaded to IBM SPSS™ with the quantitative data but were analysed using a reflexive thematic analysis approach (as previously described). These three questions built on the third theme identified in the First and Second Round Questionnaires: *How can I learn about nursing informatics?* This theme included the potential enablers and barriers for the integration of nursing informatics education in undergraduate nursing education, and recommendations for nursing informatics content in undergraduate nursing education. The revisiting of these concepts allowed participants to identify any key concepts that they may have considered relevant to the discussion of enablers, barriers and recommended nursing informatics content.

#### *7.4.2.1 Further enablers for the integration of nursing informatics into undergraduate nursing education*

The free text responses regarding further enablers for the integration of nursing informatics in undergraduate nursing education (n=17) identified enablers not identified in Question 1 (n=10); these included the need for nursing informatics champions or superusers in clinical and education settings, clearer career pathways for nursing informatics, recommendations for specific nursing informatics resources and the development of an open source EMR, informatics education across health care disciplines and baseline assessment of student nursing informatics competency levels. These enablers will be briefly addressed in *Chapter 8: Integration of findings.*

#### *7.4.2.2 Further barriers to the integration of nursing informatics into undergraduate nursing education*

The free text responses regarding further barriers to the integration of nursing informatics in undergraduate nursing education (n=13) identified barriers not identified in Question 3 (n=2) – a lack of curriculum recommendations and resources and a lack of visibility of nursing informatics in the nursing codes and standards. These barriers will be briefly addressed in *Chapter 8: Integration of findings.*

#### *7.4.2.3 Further recommendations for specific nursing informatics content required in undergraduate nursing education*

The free text responses regarding further recommendations for specific NI content required in undergraduate nursing education (n=20) identified recommendations not identified in Question 3 (n=9), including data literacy, human-centred design, workforce metrics, standardised nursing terminologies, use of data for quality improvement and clinical decision support systems. These recommendations will be briefly addressed in *Chapter 8: Integration of findings.*

## 7.5 Fourth Round Questionnaire

Following data collection of the Fourth Round Questionnaire (n=49) (*Appendix C6*), descriptive statistics were used to analyse the demographic data, with this data used in stakeholder-group analysis. The remaining questions, with text responses, were analysed using reflexive thematic analysis.

### 7.5.1 Descriptive statistics

The Fourth Round Questionnaire collected demographic data and free text responses. Demographic data had nominal levels of measurement which were analysed using measures of central tendency (the mode) and measures of frequency (ratio). The demographic data was then applied to the Likert-type data from the Third Round Questionnaire and stakeholder-group analysis was performed. The findings from this analysis will now be discussed.

### 7.5.2 Demographic data

The Fourth Round Questionnaire also sought additional demographic data and asked participants how they would describe their gender – female, male, other or prefer not to say. The participant profiles (refer to *Table 7.12*) identified a greater proportion of females, which was not unexpected, as the *AHPRA and National Boards Annual Report 2022/23* (Australian Health Practitioner Regulation Agency (AHPRA), 2023), identified that 88.12% of employed nurses and midwives in Australia identified as female and 11.88% identified as male. The changing nature of the nursing workforce has been explored by many researchers, whilst predominantly viewed as a female profession, nursing roles were traditionally performed by males throughout history until the mid-19$^{th}$ century and the arrival of Florence Nightingale (Christensen, 2017; Mulkey, 2023); although, O'Lynn and Tranbarger (2007) noted that other complex factors were at play, including political reforms leading to the defunding of hospitals by religious organisations, resulting in considerable reductions in wages and the hiring of untrained nurses. Since this time, nursing has often been considered "a second choice of occupation for men than for women" (Curtis, Robinson, & Netten, 2009, p. 850); with a disparity between representation in senior roles noted by Smith et al. (2021, p. 2485), in *Professional success of men in the nursing workforce: An integrative review*, who stated that "men were indeed more successful, indicated by higher representation in senior positions, high-status nursing specialties and professional development opportunities". This may, in part, suggest why 39.2% of the Delphi participants were male, as the recruitment procedure required participants in nursing informatics or education, both of which require experience and professional development.

The majority of participants identified their country of practice as Australia (n=35), with New Zealand, Canada, the United States of America, the United Kingdom, Finland and Qatar identified as the other countries of professional practice. It was anticipated that the majority of participants would be located in Australia due to the research and the researcher also being located in Australia, however, the wide spread of locales increased the value of the findings globally. For the purpose of stakeholder-group analysis, it was decided to analyse country of practice (as it related to enablers, barriers and content recommendations) using the Mann-Whitney U test, with stakeholders divided into two groups – participants practicing in Australia and nurses practicing in other countries. Please note – discussion of stakeholder-group analyses is addressed below.

**Table 7-12 Demographic data from the First, Third and Fourth Round Questionnaires**

| Demographics | | Frequency | Percent |
|---|---|---|---|
| **Gender** | Male | 20 | 40.8 |
| | Female | 29 | 59.2 |
| **Job description** | Nurse educator | 20 | 39.2 |
| | Nurse Informatician | 16 | 31.4 |
| | Expert in NI | 15 | 29.4 |
| **Country of practice** | 0 Australia | 35 | 68.6 |
| | New Zealand | 16 | 31.4 |
| | Canada | | |
| | USA | | |
| | United Kingdom | | |
| | Finland | | |
| | Qatar | | |

Note: Gender statistics reflect 2 non-responses to Fourth Round Questionnaire

#### *7.5.2.1 Stakeholder-group analysis – Gender and enablers for the integration of nursing informatics into undergraduate nursing education*

Comparison of the responses, according to gender, of the enablers for the integration of nursing informatics into undergraduate nursing education were analysed using stakeholder-group analysis. The Mann-Whitney U test was used in this analysis (refer to *Table 7.13*). The use of nursing informatics in clinical placement was scored higher by female participants ($M_{rank}$ = 28.00, $M$ = 4.30, n = 29), than by male participants ($M_{rank}$ = 20.65, $M$ = 3.75, n = 20), with a medium effect size $r_g$ = -0.30. Similarly, professional development of university faculty was scored higher by female participants ($M_{rank}$ = 28.16, $M$ = 4.30, n = 29), than by male participants ($M_{rank}$ = 20.43, $M$ = 3.85, n = 20), with a medium effect size $r_g$ = -0.32. It is important to note that all enablers were scored higher by the female participants ($M$ = 4.19 - 4.52), than by the male participants ($M$ = 3.75 – 4.45). The mean ($M$) was scored out of 5, reflecting the ordinal ranks within the five-point Likert-type scale. These findings indicated that female participants viewed the use of nursing informatics in clinical placement and professional development of university faculty as higher priorities (than the male participants). The disparities in gendered responses were not the specific purpose of this study; however, this could be addressed in future research, with a view to identifying whether this finding related to these participants only or is indicative of wider-spread disparities.

**Table 7-13 Gender and enablers for the integration of nursing informatics into undergraduate nursing education**

| Questions | Gender | | | | Statistical Tests of 2 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Mann-Whitney U | Standardised Test Statistic | Asymptotic Significance (2-tailed) | Glass rank biserial correlation coefficient |
| | Groups | N | Mean Rank | Mean | *U* | *z* | *p* | $r_g$ |
| Q1_1 Access to digital health technologies | Male | 20 | 24.75 | 4.40 | 285.00 | -0.12 | 0.904 | -0.02 |
| | Female | 29 | 25.17 | 4.41 | | | | |
| | Total | 49 | | | | | | |
| Q1_2 Technical support | Male | 20 | 21.15 | 3.80 | 213.00 | -1.68 | 0.093 | -0.27 |
| | Female | 29 | 27.66 | 4.30 | | | | |
| | Total | 49 | | | | | | |
| Q1_3 Simulation resources | Male | 20 | 23.30 | 4.20 | 256.00 | -0.56 | 0.579 | -0.08 |
| | Female | 28 | 25.36 | 4.37 | | | | |
| | Total | 48 | | | | | | |
| Q1_5 Range of digital health technologies | Male | 20 | 21.95 | 4.20 | 229.00 | -1.41 | 0.158 | -0.21 |
| | Female | 29 | 27.10 | 4.48 | | | | |
| | Total | 49 | | | | | | |
| Q1_6 Digital literacy development | Male | 20 | 24.63 | 4.45 | 282.50 | -0.18 | 0.856 | -0.03 |
| | Female | 29 | 25.26 | 4.52 | | | | |
| | Total | 49 | | | | | | |
| Q1_7 NI embedded throughout curriculum | Male | 20 | 23.78 | 4.25 | 265.50 | -0.61 | 0.540 | 0.08 |
| | Female | 29 | 25.84 | 4.44 | | | | |
| | Total | 49 | | | | | | |
| Q1_9 Curriculum linked with competency standards | Male | 20 | 23.13 | 3.80 | 252.50 | -0.83 | 0.409 | -0.13 |
| | Female | 29 | 26.29 | 4.19 | | | | |
| | Total | 49 | | | | | | |
| Q1_10 Linking NI with contemporary nursing practice | Male | 20 | 24.23 | 4.25 | 274.50 | -0.37 | 0.714 | -0.05 |
| | Female | 29 | 25.53 | 4.30 | | | | |
| | Total | 49 | | | | | | |
| Q1_12 Use of NI in clinical placements | Male | 20 | 20.65 | 3.75 | 203.00 | -1.89 | 0.059 | -0.30 |
| | Female | 29 | 28.00 | 4.30 | | | | |
| | Total | 49 | | | | | | |
| Q1_13 Use of NI in simulation/ lab classes | Male | 20 | 23.58 | 4.15 | 261.50 | -0.64 | 0.525 | -0.10 |
| | Female | 29 | 25.98 | 4.30 | | | | |
| | Total | 49 | | | | | | |
| Q1_14 Faculty who understand NI | Male | 20 | 22.48 | 4.20 | 239.50 | -1.21 | 0.225 | -0.17 |
| | Female | 29 | 26.74 | 4.44 | | | | |
| | Total | 49 | | | | | | |
| Q1_15 Professional development of university faculty | Male | 20 | 20.43 | 3.85 | 198.50 | -1.99 | 0.047 | -0.32 |
| | Female | 29 | 28.16 | 4.30 | | | | |
| | Total | 49 | | | | | | |
| Q1_16 Development of NI competencies | Male | 20 | 23.85 | 3.90 | 267.00 | -0.50 | 0.616 | -0.79 |
| | Female | 29 | 25.79 | 4.22 | | | | |
| | Total | 49 | | | | | | |
| Q1_18 Recognition of NI from peak Nursing bodies | Male | 20 | 22.60 | 4.25 | 242.00 | -1.10 | 0.270 | -0.17 |
| | Female | 29 | 26.66 | 4.37 | | | | |
| | Total | 49 | | | | | | |

### *7.5.2.2 Stakeholder-group analysis – Professional role and enablers for the integration of nursing informatics into undergraduate nursing education*

Comparison of the responses, according to professional role, of the enablers for the integration of nursing informatics into undergraduate nursing education were analysed using stakeholder-group analysis. The Kruskal-Wallis test was used in this analysis (refer to *Table 7.14*). This analysis did not identify any results of significance with a small effect size also noted. However, a wide range of responses to nursing informatics being embedded throughout the curriculum were noted (nurse educator – $M_{rank}$ = 22.38, $M$ = 4.05, n = 20; nurse informatician - $M_{rank}$ = 29.59, $M$ = 4.73, n = 16; expert in nursing informatics – $M_{rank}$ = 27.00, $M$ = 4.40, n = 15). This finding indicated that nurse educators viewed the integration of nursing informatics throughout the curriculum as less of a priority than nurse informaticians or experts in nursing informatics. This result was unsurprising, as it reasonable that nurses who specialise in nursing informatics would view it as a priority in undergraduate nursing curriculum; whereas nurse educators would be aware of all of the other content required in the curriculum. These findings are reflected in literature, with Procter (2021, p. 166) noting that many nurse educators "lack the knowledge and skills to include informatics within their curriculum sessions", despite being highly competent in their own areas of expertise. Honey and Procter (2017, p. 38), in *The Shifting Sands of Nursing Informatics Education: From Content to Connectivity*, asked "Is there an argument for considering nursing informatics as a seamless attribute to the nursing role rather than something extra-ordinary?"; so too, the question could be asked, shouldn't nursing informatics be integrated into all aspects of nursing education and viewed as simply another facet of contemporary nursing practice?

**Table 7-14 Professional role and enablers for the integration of nursing informatics into undergraduate nursing education**

| Questions | Professional description | | | | Statistical Tests of 3 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Kruskal-Wallis | Degrees of freedom | Significance | Cohen's *d* |
| | Groups | N | Mean Rank | Mean | *H* | *df* | *p* | *d* |
| Q1_1 Access to digital health technologies | Nurse educator | 20 | 26.25 | 4.37 | 0.09 | 2.00 | 0.958 | 0.41 |
| | Nurse Informatician | 16 | 26.44 | 4.47 | | | | |
| | Expert in NI | 15 | 25.20 | 4.33 | | | | |
| | Total | 51 | | | | | | |
| Q1_2 Technical support | Nurse educator | 20 | 29.25 | 4.32 | 2.18 | 2.00 | 0.336 | 0.12 |
| | Nurse Informatician | 16 | 25.38 | 4.07 | | | | |
| | Expert in NI | 15 | 22.33 | 3.80 | | | | |
| | Total | 51 | | | | | | |
| Q1_3 Simulation resources | Nurse educator | 20 | 22.58 | 4.16 | 2.96 | 2.00 | 0.228 | 0.29 |
| | Nurse Informatician | 15 | 30.20 | 4.60 | | | | |
| | Expert in NI | 15 | 24.70 | 4.20 | | | | |
| | Total | 50 | | | | | | |
| Q1_5 Range of digital health technologies | Nurse educator | 20 | 24.43 | 4.32 | 1.17 | 2.00 | 0.558 | 0.27 |
| | Nurse Informatician | 16 | 28.94 | 4.53 | | | | |
| | Expert in NI | 15 | 24.97 | 4.20 | | | | |
| | Total | 51 | | | | | | |
| Q1_6 Digital literacy development | Nurse educator | 20 | 25.00 | 4.37 | 0.88 | 2.00 | 0.644 | 0.31 |
| | Nurse Informatician | 16 | 28.47 | 4.67 | | | | |
| | Expert in NI | 15 | 24.70 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q1_7 NI embedded throughout curriculum | Nurse educator | 20 | 22.38 | 4.05 | 3.26 | 2.00 | 0.196 | 0.33 |
| | Nurse Informatician | 16 | 29.59 | 4.73 | | | | |
| | Expert in NI | 15 | 27.00 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q1_9 Curriculum linked with competency standards | Nurse educator | 20 | 22.98 | 3.79 | 2.73 | 2.00 | 0.255 | 0.25 |
| | Nurse Informatician | 16 | 30.47 | 4.33 | | | | |
| | Expert in NI | 15 | 25.27 | 4.00 | | | | |
| | Total | 51 | | | | | | |
| Q1_10 Linking NI with contemporary nursing practice | Nurse educator | 20 | 23.45 | 4.11 | 1.79 | 2.00 | 0.408 | 0.13 |
| | Nurse Informatician | 16 | 29.13 | 4.60 | | | | |
| | Expert in NI | 15 | 26.07 | 4.27 | | | | |
| | Total | 51 | | | | | | |
| Q1_12 Use of NI in clinical placements | Nurse educator | 20 | 23.60 | 3.89 | 1.06 | 2.00 | 0.588 | 0.28 |
| | Nurse Informatician | 16 | 28.25 | 4.20 | | | | |
| | Expert in NI | 15 | 26.80 | 4.13 | | | | |
| | Total | 51 | | | | | | |
| Q1_13 Use of NI in simulation/ lab classes | Nurse educator | 20 | 24.83 | 4.11 | 0.74 | 2.00 | 0.691 | 0.33 |
| | Nurse Informatician | 16 | 28.41 | 4.47 | | | | |
| | Expert in NI | 15 | 25.00 | 4.13 | | | | |
| | Total | 51 | | | | | | |
| Q1_14 Faculty who understand NI | Nurse educator | 20 | 24.80 | 4.26 | 0.42 | 2.00 | 0.810 | 0.37 |
| | Nurse Informatician | 16 | 26.00 | 4.40 | | | | |
| | Expert in NI | 15 | 27.60 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q1_15 Professional development of university faculty | Nurse educator | 20 | 26.18 | 4.11 | 1.41 | 2.00 | 0.494 | 0.22 |
| | Nurse Informatician | 16 | 28.75 | 4.27 | | | | |
| | Expert in NI | 15 | 22.83 | 4.00 | | | | |
| | Total | 51 | | | | | | |
| Q1_16 Development of NI competencies | Nurse educator | 20 | 23.20 | 3.89 | 3.49 | 2.00 | 0.175 | 0.36 |
| | Nurse Informatician | 16 | 31.31 | 4.47 | | | | |
| | Expert in NI | 15 | 24.07 | 3.93 | | | | |
| | Total | 51 | | | | | | |
| Q1_18 Recognition of NI from peak Nursing bodies | Nurse educator | 20 | 25.98 | 4.32 | 0.00 | 2.00 | 0.998 | 0.42 |
| | Nurse Informatician | 16 | 25.88 | 4.40 | | | | |
| | Expert in NI | 15 | 26.17 | 4.13 | | | | |
| | Total | 51 | | | | | | |

#### *7.5.2.3 Stakeholder-group analysis – Country of practice and enablers for the integration of nursing informatics into undergraduate nursing education*

Comparison of the responses, according to country of practice, of the enablers for the integration of nursing informatics into undergraduate nursing education were analysed using stakeholder-group analysis. The Mann-Whitney U test was used in this analysis (refer to *Table 7.15*). This analysis did not identify any results of significance with a small effect size also noted. However, two results of interest were noted - simulation resources were scored higher by Australian participants ($M_{rank}$ = 27.43, $M$ = 4.41, n = 34), than by participants from all other countries ($M_{rank}$ = 21.41, $M$ = 4.07, n = 16), with a small effect size $r_g$ = -0.24. This finding indicated that Australian participants viewed simulation resources as a higher priority (than participants from all other countries). Exploring the disparities in access to simulation resources was not the specific purpose of this study; however, this could be addressed in future research, with a view to identifying whether Australian undergraduate nursing students receive the same access to nursing informatics simulation resources, as the students in other countries and whether this impacts learning outcomes. In contrast, curriculum linked with competency standards was scored lower by Australian participants ($M_{rank}$ = 24.04, $M$ = 3.85, n = 29), than participants from all other countries ($M_{rank}$ = 30.28, $M$ = 4.40, n = 20), with a small effect size $r_g$ = -0.24. This finding indicated that participants from all other countries prioritised the use of nursing informatics competency standards to inform the curriculum as a higher priority (than Australian participants). This finding may reflect the current lack of nursing informatics competency standards in use in Australia; as identified by Raghunathan, McKenna and Peddle (2023a)

> …although the health workforce roadmap and nursing accreditation standards in Australia stipulate informatics development, the absence of national entry-to-practice informatics competency guidelines complicates efforts in standardisation of curricula to ensure consistent graduate preparation. (p.8)

**Table 7-15 Country of practice and enablers for the integration of nursing informatics into undergraduate nursing education**

| Questions | Country | | | | Statistical Tests of 2 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Mann-Whitney U | Standardised Test Statistic | Significance | Glass rank biserial correlation coefficient |
| | Groups | N | Mean Rank | Mean | *U* | *z* | *p* | $r_g$ |
| Q1_1 Access to digital health technologies | Australia | 35 | 27.09 | 4.41 | 242.00 | -0.90 | 0.369 | 0.14 |
| | Other | 16 | 23.63 | 4.33 | | | | |
| | Total | 51 | | | | | | |
| Q1_2 Technical support | Australia | 35 | 26.33 | 4.06 | 268.50 | -0.25 | 0.802 | 0.04 |
| | Other | 16 | 25.28 | 4.13 | | | | |
| | Total | 51 | | | | | | |
| Q1_3 Simulation resources | Australia | 34 | 27.43 | 4.41 | 206.50 | -1.51 | 0.131 | 0.24 |
| | Other | 16 | 21.41 | 4.07 | | | | |
| | Total | 50 | | | | | | |
| Q1_5 Range of digital health technologies | Australia | 35 | 25.91 | 4.29 | 277.00 | -0.07 | 0.945 | -0.01 |
| | Other | 16 | 26.19 | 4.47 | | | | |
| | Total | 51 | | | | | | |
| Q1_6 Digital literacy development | Australia | 35 | 25.77 | 4.44 | 272.00 | -0.19 | 0.850 | -0.03 |
| | Other | 16 | 26.50 | 4.44 | | | | |
| | Total | 51 | | | | | | |
| Q1_7 NI embedded throughout curriculum | Australia | 35 | 24.19 | 4.18 | 216.50 | -1.57 | 0.116 | -0.23 |
| | Other | 16 | 29.97 | 4.80 | | | | |
| | Total | 51 | | | | | | |
| Q1_9 Curriculum linked with competency standards | Australia | 35 | 24.04 | 3.85 | 211.50 | -1.51 | 0.130 | -0.24 |
| | Other | 16 | 30.28 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q1_10 Linking NI with contemporary nursing practice | Australia | 35 | 25.96 | 4.26 | 278.50 | -0.04 | 0.971 | -0.01 |
| | Other | 16 | 26.09 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q1_12 Use of NI in clinical placements | Australia | 35 | 25.54 | 4.03 | 264.00 | -0.35 | 0.729 | -0.06 |
| | Other | 16 | 27.00 | 4.13 | | | | |
| | Total | 51 | | | | | | |
| Q1_13 Use of NI in simulation/ lab classes | Australia | 35 | 25.54 | 4.18 | 264.00 | -0.36 | 0.721 | -0.06 |
| | Other | 16 | 27.00 | 4.33 | | | | |
| | Total | 51 | | | | | | |
| Q1_14 Faculty who understand NI | Australia | 35 | 25.09 | 4.24 | 248.00 | -0.76 | 0.445 | -0.11 |
| | Other | 16 | 28.00 | 4.60 | | | | |
| | Total | 51 | | | | | | |
| Q1_15 Professional development of university faculty | Australia | 35 | 25.33 | 4.06 | 256.50 | -0.51 | 0.609 | -0.08 |
| | Other | 16 | 27.47 | 4.27 | | | | |
| | Total | 51 | | | | | | |
| Q1_16 Development of NI competencies | Australia | 35 | 24.16 | 3.94 | 215.50 | -1.41 | 0.158 | -0.23 |
| | Other | 16 | 30.03 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q1_18 Recognition of NI from peak Nursing bodies | Australia | 35 | 26.34 | 4.26 | 268.00 | -0.27 | 0.786 | 0.04 |
| | Other | 16 | 25.25 | 4.33 | | | | |
| | Total | 51 | | | | | | |

### *7.5.2.4 Stakeholder-group analysis – Gender and barriers to the integration of nursing informatics into undergraduate nursing education*

Comparison of the responses, according to gender, of the barriers for the integration of nursing informatics into undergraduate nursing education were analysed using stakeholder-group analysis. The Mann-Whitney U test was used in this analysis (refer to *Table 7.16*). The lack of understanding of nursing informatics by university faculty was scored higher by female participants ($M_{rank}$ = 28.41, $M$ = 4.45, n = 29), than by male participants ($M_{rank}$ = 20.05, $M$ = 3.89, n = 20), with a medium effect size $r_g$ = -0.34 and $p$-value = 0.029. This finding indicated that female participants viewed a lack of understanding of nursing informatics by university faculty as a more significant barrier to the integration of nursing informatics into nursing education (than the male participants). The disparities in gendered responses were not the specific purpose of this study; however, this could be addressed in future research, with a view to identifying whether this finding related to these participants only or is indicative of wider-spread disparities.

**Table 7-16 Gender and barriers to the integration of nursing informatics into undergraduate nursing education**

| Questions | Gender | | | | Statistical Tests of 2 variables: Mann-Whitney U | Standardised Test Statistic | Significance | Glass rank biserial correlation coefficient |
|---|---|---|---|---|---|---|---|---|
| | Groups | N | Mean Rank | Mean | $U$ | $z$ | $p$ | $r_g$ |
| Q3_1 Costs/ funding | Male | 19 | 23.79 | 4.21 | 262.00 | -0.31 | 0.759 | -0.05 |
| | Female | 29 | 24.97 | 4.71 | | | | |
| | Total | 48 | | | | | | |
| Q3_2 Lack of access to digital health technologies - placement | Male | 20 | 28.25 | 4.26 | 225.00 | -1.40 | 0.163 | 0.22 |
| | Female | 29 | 22.76 | 3.66 | | | | |
| | Total | 49 | | | | | | |
| Q3_3 Lack of access to current digital health technologies - university | Male | 20 | 23.58 | 4.37 | 261.50 | -0.65 | 0.514 | -0.10 |
| | Female | 29 | 25.98 | 4.41 | | | | |
| | Total | 49 | | | | | | |
| Q3_4 Lack of professional development - faculty | Male | 20 | 23.73 | 4.32 | 264.50 | -0.57 | 0.568 | -0.09 |
| | Female | 29 | 25.88 | 4.38 | | | | |
| | Total | 49 | | | | | | |
| Q3_6 Lack of incentive to include NI | Male | 20 | 26.48 | 4.26 | 260.50 | -0.65 | 0.517 | 0.10 |
| | Female | 29 | 23.98 | 3.93 | | | | |
| | Total | 49 | | | | | | |
| Q3_7 Lack of integration of NI throughout curriculum | Male | 20 | 21.20 | 4.32 | 214.00 | -1.78 | 0.076 | -0.26 |
| | Female | 29 | 27.62 | 4.62 | | | | |
| | Total | 49 | | | | | | |
| Q3_8 Overfull curriculum | Male | 20 | 24.15 | 3.89 | 273.00 | -0.37 | 0.715 | -0.06 |
| | Female | 29 | 25.59 | 3.97 | | | | |
| | Total | 49 | | | | | | |
| Q3_10 Varying levels of digital literacy - faculty | Male | 20 | 22.15 | 4.11 | 233.00 | -1.28 | 0.200 | -0.20 |
| | Female | 29 | 26.97 | 4.52 | | | | |
| | Total | 49 | | | | | | |
| Q3_13 Lack of understanding of NI - faculty | Male | 20 | 20.05 | 3.89 | 191.00 | -2.18 | 0.029 | 0.34 |
| | Female | 29 | 28.41 | 4.45 | | | | |
| | Total | 49 | | | | | | |
| Q3_14 Lack of understanding of NI - university hierarchy | Male | 20 | 21.08 | 3.89 | 211.50 | -1.72 | 0.086 | -0.27 |
| | Female | 29 | 27.71 | 4.38 | | | | |
| | Total | 49 | | | | | | |
| Q3_15 Lack of understanding of NI - nurses in the clinical setting | Male | 20 | 27.53 | 4.32 | 239.50 | -1.12 | 0.263 | 0.17 |
| | Female | 29 | 23.26 | 3.97 | | | | |
| | Total | 49 | | | | | | |

### *7.5.2.5 Stakeholder-group analysis – Professional role and barriers to the integration of nursing informatics into undergraduate nursing education*

Comparison of the responses, according to professional role, of the barriers for the integration of nursing informatics into undergraduate nursing education were analysed using stakeholder-group analysis. The Kruskal-Wallis test was used in this analysis (refer to *Table 7.17*). This analysis did not identify any results of significance with a small effect size also reported. However, a wide range of responses to a lack of the professional development of faculty were noted (nurse educator – $M_{rank}$ = *24.53,* $M$ = 4.26, n = 20; nurse informatician - $M_{rank}$ = 22.47, $M$ = 4.06, n = 16; expert in nursing informatics – $M_{rank}$ = 31.73, $M$ = 4.60, n = 15). This indicated that experts in nursing informatics identified a lack of faculty professional development as a more significant barrier to the integration of nursing informatics into nursing education (than nurse educators and nurse informaticians). This finding may reflect the priority placed on ongoing professional development by experts in nursing informatics aligned with a requirement of ongoing professional development for *all* nurses (in Australia), as outlined by the NMBA (2016c). However, as identified previously, nurses perceive ongoing education as not a priority for employers (Mlambo, Silén, & McGrath, 2021), with a lack of easily accessible and equitable education resources (Dagne & Beshah, 2021; McArthur et al., 2021; Rogers, 2019), and this may have influenced the nurse educators' attitudes to professional development. This aspect of the findings could be further explored in future research, particularly with a view of better preparing faculty to teach nursing informatics.

A wide range of responses to the lack of integration of nursing informatics in curriculum as a barrier were also noted (nurse educator – $M_{rank} = 23.50$, $M$ = 4.37, n = 20; nurse informatician - $M_{rank}$ = 24.38, $M$ = 4.44, n = 16; expert in nursing informatics – $M_{rank}$ = 31.07, $M$ = 4.67, n = 15). This finding indicated that nurse educators viewed the integration of nursing informatics throughout the curriculum as less of a priority than nurse informaticians or experts in nursing informatics and reflected a similar finding in *7.5.1.2 Stakeholder-group analysis – Professional role and enablers for the integration of nursing informatics into nursing education* where nurse educators scored embedding nursing informatics into the curriculum as a lower priority than nurse informaticians and experts in nursing informatics. These findings are unsurprising, as it is anticipated that nurse informaticians and experts in nursing informatics would perceive the integration of nursing informatics throughout undergraduate nursing education programs as a priority.

**Table 7-17 Professional role and barriers to the integration of nursing informatics into undergraduate nursing education**

| Questions | Professional description | | | | Statistical Tests of 3 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Kruskal-Wallis | Degrees of freedom | Significance | Cohen's *d* |
| | Groups | N | Mean Rank | Mean | *H* | *df* | *p* | *d* |
| Q3_1 Costs/ funding | Nurse educator | 19 | 27.84 | 4.37 | 1.00 | 2.00 | 0.605 | 0.29 |
| | Nurse Informatician | 16 | 24.75 | 4.19 | | | | |
| | Expert in NI | 15 | 23.33 | 3.93 | | | | |
| | Total | 50 | | | | | | |
| Q3_2 Lack of access to digital health technologies - placement | Nurse educator | 20 | 25.28 | 3.95 | 0.55 | 2.00 | 0.761 | 0.35 |
| | Nurse Informatician | 16 | 28.13 | 4.06 | | | | |
| | Expert in NI | 15 | 24.70 | 3.67 | | | | |
| | Total | 51 | | | | | | |
| Q3_3 Lack of access to current digital health technologies - university | Nurse educator | 20 | 26.25 | 4.42 | 1.31 | 2.00 | 0.519 | 0.24 |
| | Nurse Informatician | 16 | 23.19 | 4.19 | | | | |
| | Expert in NI | 15 | 28.67 | 4.47 | | | | |
| | Total | 51 | | | | | | |
| Q3_4 Lack of professional development - faculty | Nurse educator | 20 | 24.53 | 4.26 | 3.96 | 2.00 | 0.138 | 0.41 |
| | Nurse Informatician | 16 | 22.47 | 4.06 | | | | |
| | Expert in NI | 15 | 31.73 | 4.60 | | | | |
| | Total | 51 | | | | | | |
| Q3_6 Lack of incentive to include NI | Nurse educator | 20 | 24.95 | 4.00 | 0.46 | 2.00 | 0.796 | 0.37 |
| | Nurse Informatician | 16 | 25.44 | 4.06 | | | | |
| | Expert in NI | 15 | 28.00 | 4.07 | | | | |
| | Total | 51 | | | | | | |
| Q3_7 Lack of integration of NI throughout curriculum | Nurse educator | 20 | 23.50 | 4.37 | 3.27 | 2.00 | 0.195 | 0.33 |
| | Nurse Informatician | 16 | 24.38 | 4.44 | | | | |
| | Expert in NI | 15 | 31.07 | 4.67 | | | | |
| | Total | 51 | | | | | | |
| Q3_8 Overfull curriculum | Nurse educator | 20 | 26.88 | 4.11 | 0.13 | 2.00 | 0.937 | 0.40 |
| | Nurse Informatician | 16 | 25.31 | 3.94 | | | | |
| | Expert in NI | 15 | 25.57 | 3.80 | | | | |
| | Total | 51 | | | | | | |
| Q3_10 Varying levels of digital literacy - faculty | Nurse educator | 20 | 26.35 | 4.32 | 1.87 | 2.00 | 0.394 | 0.11 |
| | Nurse Informatician | 16 | 22.59 | 4.19 | | | | |
| | Expert in NI | 15 | 29.17 | 4.53 | | | | |
| | Total | 51 | | | | | | |
| Q3_13 Lack of understanding of NI - faculty | Nurse educator | 20 | 26.23 | 4.21 | 2.08 | 2.00 | 0.354 | 0.08 |
| | Nurse Informatician | 16 | 22.41 | 4.00 | | | | |
| | Expert in NI | 15 | 29.53 | 4.40 | | | | |
| | Total | 51 | | | | | | |
| Q3_14 Lack of understanding of NI - university hierarchy | Nurse educator | 20 | 27.43 | 4.26 | 0.58 | 2.00 | 0.750 | 0.35 |
| | Nurse Informatician | 16 | 23.94 | 4.06 | | | | |
| | Expert in NI | 15 | 26.30 | 4.20 | | | | |
| | Total | 51 | | | | | | |
| Q3_15 Lack of understanding of NI - nurses in the clinical setting | Nurse educator | 20 | 24.03 | 3.95 | 0.77 | 2.00 | 0.680 | 0.32 |
| | Nurse Informatician | 16 | 28.00 | 4.25 | | | | |
| | Expert in NI | 15 | 26.50 | 4.00 | | | | |
| | Total | 51 | | | | | | |

### *7.5.2.6 Stakeholder-group analysis – Country of practice and barriers to the integration of nursing informatics into undergraduate nursing education*

Comparison of the responses, according to country of practice, of the barriers for the integration of nursing informatics into undergraduate nursing education were analysed using stakeholder-group analysis. The Mann-Whitney U test was used in this analysis (refer to *Table 7.18*). This analysis did not identify any results of significance with a small effect size also noted. However, one result of interest was noted – a lack of understanding of nursing informatics by hierarchy, as a barrier to the integration of nursing informatics into undergraduate nursing education, was scored lower by Australian participants ($M_{rank}$ = 24.03, $M$ = 4.06, n = 35), than by participants from all other countries ($M_{rank}$ = 30.31, $M$ = 4.44, n = 16), with a small effect size $r_g$ = -0.25. This finding indicated that Australian participants viewed a lack of understanding of nursing informatics by university hierarchy as a less of a concern (than participants from all other countries). This disparity could indicate a difference in the hierarchical structure of universities in other countries and the role of hierarchy in determining curriculum.

**Table 7-18 Country of practice and barriers to the integration of nursing informatics into undergraduate nursing education**

| Questions | Country | | | | Statistical Tests of 2 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Mann-Whitney U | Standardised Test Statistic | Significance | Glass rank biserial correlation coefficient |
| | Groups | N | Mean Rank | Mean | *U* | *z* | *p* | $r_g$ |
| Q3_1 Costs/ funding | Australia | 34 | 26.21 | 4.21 | 248.00 | -0.54 | 0.590 | 0.09 |
| | Other | 16 | 24.00 | 4.13 | | | | |
| | Total | 50 | | | | | | |
| Q3_2 Lack of access to digital health technologies - placement | Australia | 35 | 25.49 | 3.88 | 262.00 | -0.39 | 0.699 | -0.06 |
| | Other | 16 | 27.13 | 3.95 | | | | |
| | Total | 51 | | | | | | |
| Q3_3 Lack of access to current digital health technologies - university | Australia | 35 | 27.71 | 4.47 | 220.00 | -1.36 | 0.175 | 0.21 |
| | Other | 16 | 22.25 | 4.13 | | | | |
| | Total | 51 | | | | | | |
| Q3_4 Lack of professional development - faculty | Australia | 35 | 25.81 | 4.32 | 273.50 | -0.14 | 0.886 | -0.02 |
| | Other | 16 | 26.41 | 4.25 | | | | |
| | Total | 51 | | | | | | |
| Q3_6 Lack of incentive to include NI | Australia | 35 | 27.20 | 4.12 | 238.00 | -0.92 | 0.359 | 0.15 |
| | Other | 16 | 23.38 | 3.88 | | | | |
| | Total | 51 | | | | | | |
| Q3_7 Lack of integration of NI throughout curriculum | Australia | 35 | 26.16 | 4.50 | 274.50 | -0.13 | 0.898 | 0.02 |
| | Other | 16 | 25.66 | 4.44 | | | | |
| | Total | 51 | | | | | | |
| Q3_8 Overfull curriculum | Australia | 35 | 26.96 | 4.06 | 246.50 | -0.72 | 0.472 | 0.12 |
| | Other | 16 | 23.91 | 3.75 | | | | |
| | Total | 51 | | | | | | |
| Q3_10 Varying levels of digital literacy - faculty | Australia | 35 | 25.56 | 4.29 | 264.50 | -0.35 | 0.728 | -0.06 |
| | Other | 16 | 26.97 | 4.44 | | | | |
| | Total | 51 | | | | | | |
| Q3_13 Lack of understanding of NI - faculty | Australia | 35 | 25.24 | 4.15 | 253.50 | -0.58 | 0.562 | -0.09 |
| | Other | 16 | 27.66 | 4.31 | | | | |
| | Total | 51 | | | | | | |
| Q3_14 Lack of understanding of NI - university hierarchy | Australia | 35 | 24.03 | 4.06 | 211.00 | -1.51 | 0.132 | -0.25 |
| | Other | 16 | 30.31 | 4.44 | | | | |
| | Total | 51 | | | | | | |
| Q3_15 Lack of understanding of NI - nurses in the clinical setting | Australia | 35 | 25.77 | 4.03 | 272.00 | -0.18 | 0.861 | -0.03 |
| | Other | 16 | 26.50 | 4.13 | | | | |
| | Total | 51 | | | | | | |

### *7.5.2.7 Stakeholder-group analysis – Gender and nursing informatics content recommendations for undergraduate nursing education*

Comparison of the responses, according to gender, of recommendations for nursing informatics content in undergraduate nursing education were analysed using stakeholder-group analysis. The Mann-Whitney U test was used in this analysis (refer to *Table 7.19*). This analysis did not identify any results of significance with a small effect size noted and with both males and females broadly in agreement regarding the priority of nursing informatics in the undergraduate nursing curriculum. The homogeneity of responses was reflected in the Mean values range of 4.30 – 4.95. This finding indicated that the recommendations for nursing informatics content identified by the participants in the Third Round Questionnaire reflected the opinions of the participants as a whole.

**Table 7-19 Gender and nursing informatics content recommendations for undergraduate nursing education**

| Questions | Gender | | | | Statistical Tests of 2 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Mann-Whitney U | Standardised Test Statistic | Significance | Glass rank biserial correlation coefficient |
| | Groups | N | Mean Rank | Mean | *U* | *z* | *p* | $r_g$ |
| Q5_1 Adopting new and emergent technologies | Male | 20 | 24.63 | 4.40 | 277.50 | -0.06 | 0.954 | 0.01 |
| | Female | 28 | 24.41 | 4.39 | | | | |
| | Total | 48 | | | | | | |
| Q5_2 Artificial Intelligence | Male | 20 | 27.43 | 4.50 | 241.50 | -1.09 | 0.274 | 0.17 |
| | Female | 29 | 23.33 | 4.32 | | | | |
| | Total | 49 | | | | | | |
| Q5_3 Digital literacy | Male | 20 | 25.30 | 4.95 | 284.00 | -0.29 | 0.769 | 0.02 |
| | Female | 29 | 24.79 | 4.89 | | | | |
| | Total | 49 | | | | | | |
| Q5_4 Data management | Male | 20 | 26.20 | 4.65 | 266.00 | -0.58 | 0.559 | 0.08 |
| | Female | 29 | 24.17 | 4.54 | | | | |
| | Total | 49 | | | | | | |
| Q5_5 Data security and privacy | Male | 20 | 23.63 | 4.60 | 262.50 | -0.80 | 0.425 | -0.09 |
| | Female | 29 | 25.95 | 4.82 | | | | |
| | Total | 49 | | | | | | |
| Q5_6 Digital devices | Male | 20 | 23.65 | 4.40 | 263.00 | -0.62 | 0.535 | -0.09 |
| | Female | 29 | 25.93 | 4.54 | | | | |
| | Total | 49 | | | | | | |
| Q5_7 Digital health | Male | 20 | 23.75 | 4.65 | 265.00 | -0.72 | 0.469 | -0.09 |
| | Female | 29 | 25.86 | 4.79 | | | | |
| | Total | 49 | | | | | | |
| Q5_8 EMR/ EHR - electronic health records | Male | 20 | 25.05 | 4.90 | 289.00 | -0.04 | 0.969 | 0.03 |
| | Female | 29 | 24.97 | 4.89 | | | | |
| | Total | 49 | | | | | | |
| Q5_9 EMM - electronic medication management systems | Male | 20 | 23.70 | 4.80 | 264.00 | -0.87 | 0.384 | -0.09 |
| | Female | 29 | 25.90 | 4.86 | | | | |
| | Total | 49 | | | | | | |
| Q5_10 Telehealth | Male | 20 | 21.68 | 4.30 | 223.50 | -1.54 | 0.123 | 0.23 |
| | Female | 29 | 27.29 | 4.57 | | | | |
| | Total | 49 | | | | | | |

#### *7.5.2.8 Stakeholder-group analysis – Professional role and nursing informatics content recommendations for undergraduate nursing education*

Comparison of the responses, according to professional role, of recommendations for nursing informatics content in undergraduate nursing education were analysed using stakeholder-group analysis. The Kruskal-Wallis test was used in this analysis (refer to *Table 7.20*). This analysis did not identify any results of significance with a small effect size also reported. The homogeneity of responses was reflected in the Mean values range of 4.30 – 4.95. This finding indicated that the recommendations for nursing informatics content identified by the participants in the Third Round Questionnaire reflected the opinions of the participants as a whole.

**Table 7-20 Professional role and nursing informatics content recommendations for undergraduate nursing education**

| Questions | Professional description | | | | Statistical Tests of 3 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Kruskal-Wallis | Degrees of freedom | Significance | Cohen's *d* |
| | Groups | N | Mean Rank | Mean | *H* | *df* | *p* | *d* |
| Adopting new and emergent technologies | Nurse educator | 20 | 24.53 | 4.36 | 0.29 | 2.00 | 0.867 | 0.39 |
| | Nurse Informatician | 16 | 25.44 | 4.40 | | | | |
| | Expert in NI | 14 | 26.96 | 4.50 | | | | |
| | Total | 50 | | | | | | |
| Artificial Intelligence | Nurse educator | 20 | 26.20 | 4.35 | 0.19 | 2.00 | 0.909 | 0.40 |
| | Nurse Informatician | 16 | 24.88 | 4.40 | | | | |
| | Expert in NI | 15 | 26.93 | 4.50 | | | | |
| | Total | 51 | | | | | | |
| Digital literacy | Nurse educator | 20 | 26.75 | 4.95 | 0.67 | 2.00 | 0.716 | 0.34 |
| | Nurse Informatician | 16 | 24.88 | 4.93 | | | | |
| | Expert in NI | 15 | 26.20 | 4.86 | | | | |
| | Total | 51 | | | | | | |
| Data management | Nurse educator | 20 | 26.83 | 4.60 | 0.14 | 2.00 | 0.933 | 0.40 |
| | Nurse Informatician | 16 | 25.44 | 4.53 | | | | |
| | Expert in NI | 15 | 25.50 | 4.57 | | | | |
| | Total | 51 | | | | | | |
| Data security and privacy | Nurse educator | 20 | 26.83 | 4.75 | 0.83 | 2.00 | 0.661 | 0.32 |
| | Nurse Informatician | 16 | 23.94 | 4.60 | | | | |
| | Expert in NI | 15 | 27.10 | 4.79 | | | | |
| | Total | 51 | | | | | | |
| Digital devices | Nurse educator | 20 | 26.83 | 4.50 | 0.55 | 2.00 | 0.758 | 0.35 |
| | Nurse Informatician | 16 | 26.97 | 4.53 | | | | |
| | Expert in NI | 15 | 23.87 | 4.36 | | | | |
| | Total | 51 | | | | | | |
| Digital health | Nurse educator | 20 | 26.43 | 4.75 | 1.30 | 2.00 | 0.522 | 0.24 |
| | Nurse Informatician | 16 | 23.66 | 4.67 | | | | |
| | Expert in NI | 15 | 27.93 | 4.79 | | | | |
| | Total | 51 | | | | | | |
| EMR/ EHR - electronic health records | Nurse educator | 20 | 25.95 | 4.90 | 0.29 | 2.00 | 0.864 | 0.38 |
| | Nurse Informatician | 16 | 25.31 | 4.87 | | | | |
| | Expert in NI | 15 | 26.80 | 4.93 | | | | |
| | Total | 51 | | | | | | |
| EMM - electronic medication management systems | Nurse educator | 20 | 27.00 | 4.90 | 0.54 | 2.00 | 0.763 | 0.35 |
| | Nurse Informatician | 16 | 24.81 | 4.80 | | | | |
| | Expert in NI | 15 | 25.93 | 4.79 | | | | |
| | Total | 51 | | | | | | |
| Telehealth | Nurse educator | 20 | 22.50 | 4.30 | 4.44 | 2.00 | 0.108 | 0.47 |
| | Nurse Informatician | 15 | 23.77 | 4.47 | | | | |
| | Expert in NI | 15 | 31.23 | 4.71 | | | | |
| | Total | 50 | | | | | | |

#### *7.5.2.9 Stakeholder-group analysis – Country of practice and nursing informatics content recommendations for undergraduate nursing education*

Comparison of the responses, according to country of practice, of nursing informatics content recommendations for undergraduate nursing education were analysed using stakeholder-group analysis. The Mann-Whitney U test was used in this analysis (refer to *Table 7.21*). This analysis identified digital health as having a significant difference in responses, with Australian participants ($M_{rank}$ = 29.29, $M$ = 4.89, n = 35) and participants from all other countries ($M_{rank}$ = 18.81, $M$ = 4.36, n = 16), with a $p$-value of 0.0001 and medium effect size $r_g$ = -0.41. This finding indicated that Australian participants viewed digital health, as nursing informatics content in undergraduate nursing education, as being a higher priority than participants from all other countries. The disparity between these responses may indicate the current level of understanding of digital health in Australia, with Australian participants feeling this should be prioritised above all other recommended content. This finding could inform future research with an exploration of nursing and nursing student understanding of digital health, both in Australia and globally.

**Table 7-21 Country of practice and nursing informatics content recommendations for undergraduate nursing education**

| Questions | Country | | | | Statistical Tests of 2 variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Mann-Whitney U | Standardised Test Statistic | Significance | Glass rank biserial correlation coefficient |
| | Groups | N | Mean Rank | Mean | *U* | *z* | *p* | $r_g$ |
| Q5_1 Adopting new and emergent technologies | Australia | 35 | 26.43 | 4.43 | 230.00 | -0.77 | 0.444 | 0.12 |
| | Other | 15 | 23.33 | 4.36 | | | | |
| | Total | 50 | | | | | | |
| Q5_2 Artificial Intelligence | Australia | 35 | 26.86 | 4.43 | 250.00 | -0.68 | 0.499 | 0.11 |
| | Other | 16 | 24.13 | 4.36 | | | | |
| | Total | 51 | | | | | | |
| Q5_3 Digital literacy | Australia | 35 | 27.29 | 4.97 | 235.00 | -1.96 | 0.050 | 0.16 |
| | Other | 16 | 23.19 | 4.79 | | | | |
| | Total | 51 | | | | | | |
| Q5_4 Data management | Australia | 35 | 27.86 | 4.66 | 215.00 | -1.55 | 0.122 | 0.23 |
| | Other | 16 | 21.94 | 4.36 | | | | |
| | Total | 51 | | | | | | |
| Q5_5 Data security and privacy | Australia | 35 | 26.06 | 4.69 | 278.00 | -0.05 | 0.956 | 0.01 |
| | Other | 16 | 25.88 | 4.79 | | | | |
| | Total | 51 | | | | | | |
| Q5_6 Digital devices | Australia | 35 | 28.26 | 4.57 | 201.00 | -1.80 | 0.071 | 0.28 |
| | Other | 16 | 21.06 | 4.21 | | | | |
| | Total | 51 | | | | | | |
| Q5_7 Digital health | Australia | 35 | 29.29 | 4.89 | 165.00 | -3.26 | 0.001 | 0.41 |
| | Other | 16 | 18.81 | 4.36 | | | | |
| | Total | 51 | | | | | | |
| Q5_8 EMR/ EHR - electronic health records | Australia | 35 | 27.04 | 4.94 | 243.50 | -1.44 | 0.150 | 0.13 |
| | Other | 16 | 23.72 | 4.79 | | | | |
| | Total | 51 | | | | | | |
| Q5_9 EMM - electronic medication management systems | Australia | 35 | 27.36 | 4.91 | 232.50 | -1.62 | 0.106 | 0.17 |
| | Other | 16 | 23.03 | 4.64 | | | | |
| | Total | 51 | | | | | | |
| Q5_10 Telehealth | Australia | 35 | 26.81 | 4.54 | 216.50 | -1.12 | 0.264 | 0.18 |
| | Other | 15 | 22.43 | 4.29 | | | | |
| | Total | 50 | | | | | | |

### 7.5.3 Reflexive thematic analysis

As part of the Fourth Round Questionnaire, the participants were asked four free-text questions:

- Q2 In your opinion, are there any other enablers that should be included?
- Q3 In your opinion, are there any other barriers that should be included?
- Q4 In your opinion, should any additional Nursing Informatics content be included in undergraduate nursing education

- Q5 Do you have any other information or comments you wish to provide?

The responses to these questions were uploaded to NVivo™ and analysed using a reflexive thematic analysis approach (as previously described). These four questions built on the third theme identified in the First and Second Round Questionnaires: *How can I learn about nursing informatics?* This theme included the potential enablers and barriers for the integration of nursing informatics education in undergraduate nursing education, and recommendations for nursing informatics content in undergraduate nursing education. The revisiting of these concepts allowed participants to identify any key concepts that they may have considered relevant to the discussion of enablers, barriers and recommended nursing informatics content.

#### *7.5.3.1 Further enablers for the integration of nursing informatics into undergraduate nursing education*

A number of participants (n=26) identified no further recommendations, with additional recommendations including mentorship programs (n=2), nursing informatics champions or super-users (n=2), interdisciplinary collaborations (n=2), digital health and health informatics experts to aid in integration of nursing informatics into curriculum (n=1), vendors of EMR to support university rollout (n=10), global informatics standards (n=1), professional pathways (n=1) and infrastructure to support the use of digital technologies (n=1). These enablers will be briefly addressed in *Chapter 8: Integration of findings.*

#### *7.5.3.2 Further barriers to the integration of nursing informatics into undergraduate nursing education*

A number of participants (n=28) identified no further recommendations, with additional recommendations including lack of nursing regulatory support for nursing informatics and lack of national standards (n=3), further research in nursing informatics (n=1), lack of agency by nursing in clinical and tertiary settings (n=1) and a lack of robust infrastructure (n=1).These barriers will be briefly addressed in *Chapter 8: Integration of findings.*

#### *7.5.3.3 Additional recommendations for specific nursing informatics content required in undergraduate nursing education*

Additional recommendations for specific nursing informatics content in undergraduate nursing education included ethical and legal use of digital health technologies and digital professionalism (n=5), data literacy (n=2), the importance of co-design with key stakeholders (n=1), consumer perspectives (n=1), virtual care as opposed to telehealth (n=1), interoperability between systems (n=1), infodemiology, digital ethics/cyberethics, machine learning, genomics, robotics, blockchain (n=1), smart technologies, RFID (radio-frequency distribution), nano technologies and information verification with a recommendation to be more explicit in descriptions of content (n=1). These recommendations will be briefly addressed in *Chapter 8: Integration findings.* A number of participants (n=17) identified no further recommendations.

#### *7.5.3.4 Additional comments*

Additional comments regarding the study results included recommendations to address the role of nursing in human-centred computing design principles (n=1), digital professionalism (n=1), importance of accurate data collection and entry (n=1) and facilitating patient engagement with digital health (n=1). The researcher also received notes of encouragement and congratulations. A number of participants (n=18) identified no further comments regarding the study results.

## 7.6 Conclusion

This chapter has provided a transparent and explicit discussion of the findings from each round of the Delphi study. Themes have been explored and described with the use of reflexive thematic analysis as developed by Braun and Clarke using NVivo™ - *What is nursing informatics and why is it important?*, *What do I need to know about nursing informatics*?, *How can I learn about nursing informatics*?, *Everyone knows how to use a computer!* and *Too many digital health terminologies*?. Descriptive statistics, in consultation with a statistical consultant and with the use of IBM SPSS™, have been used to summarise, organise and communicate characteristics of the data, establishing consensus regarding the enablers, barriers and content recommendations for the integration of nursing informatics into undergraduate nursing education. These results and the results from the scoping review will be integrated in *Chapter 8: Integration of findings* to provide a summary of the overall findings of this study, providing recommendations for the development of undergraduate nursing curricula and future research.

# Chapter 8 Integration Of Findings

## 8.1 Introduction

Chapter 7 addressed the findings from the Delphi study using reflexive thematic analysis and descriptive statistics. This chapter integrates the findings from Phase 1 – the Scoping review and Phase 2 – the Delphi study. The first part of this chapter restates the rationale for this study with the research questions to provide context for the discussion. The second section integrates the findings from Phases 1 and 2, with contemporary literature used to investigate and interrogate these findings. Joint displays are used to demonstrate how the data from the Phase 1 and Phase 2 were combined to support the study aims.

## 8.2 Study aim and research questions

The aim of this study was to address whether a distinct body of knowledge on nursing informatics could be further developed to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula. Underpinning this aim were the research questions:

1. Can a distinct body of knowledge of nursing informatics be developed?

2. Can operational definitions for nursing informatics be achieved through consensus?

3. Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?

## 8.3 Integration of scoping review and Delphi study findings

This study used a mixed-methods approach to explore nursing informatics in undergraduate nursing curricula. The decision to choose a mixed-methods approach was based on the premise that a mixed-methods research design draws upon the strengths of quantitative and qualitative research and triangulation (or convergence) of data sets, thereby providing a more in-depth understanding of the phenomenon of interest (Creswell & Creswell, 2018; Tashakkori & Newman, 2010). Methodological triangulation, with across methods and sequential triangulation was used. Across-method triangulation uses multiple methods in data collection (Joslin & Müller, 2016; Vivek, Nanthagopan, & Piriyatharshan, 2023); in this study, Phase 1 was a scoping review with analysis of the data using descriptive statistics and qualitative content analysis and Phase 2 was a Delphi study with analysis of data using reflexive thematic analysis and descriptive statistics. Sequential triangulation requires that the results of the first phase of the study inform the implementation of the second phase (Arias Valencia, 2022; Halcomb & Andrew, 2005); in this study, the findings from the scoping review informed the development of the First Round Questionnaire for the Delphi study.

As addressed in *Chapter 3: Study methodology*, a convergent design was used for this study; this approach typically involves the independent analysis of two data sets and convergence of findings (Creswell & Plano Clark, 2018; Dawadi, Shrestha, & Giri, 2021; Guetterman, Fetters, & Creswell, 2015). "The intent of integration in a convergent design is to develop results and interpretations that expand understanding, are comprehensive and are validated and confirmed" (Creswell & Plano Clark, 2018, p. 221). Data integration procedures include narrative discussion or joint displays (Creswell & Plano Clark, 2018; Guetterman, Fàbregues, & Sakakibara, 2021; McCrudden, Marchand, & Schutz, 2021), with Fetters and Tajima (2022, p. 11), in *Joint Displays of Integrated Data Collection in Mixed Methods Research*, recommending the use of joint displays to represent "how integration has been achieved across key study constructs of qualitative and quantitative data". The authors identified three types of joint displays – joint displays of integrated data collection, joint display analysis and joint displays of mixed-methods findings (Fetters & Tajima, 2022). This study used narrative descriptions and joint displays of the mixed-methods findings, from both phases of the study, and aligned this integration with the research questions. The integrated findings will now be discussed.

### 8.3.1 Nursing informatics and its role in contemporary nursing practice

Informed by the research questions - *Can operational definitions for nursing informatics be achieved through consensus?* and *Can a distinct body of knowledge of nursing informatics be developed?*, and informed by the literature review which identified a lack of consensus on terminology as a barrier to the integration of nursing informatics into undergraduate nursing education, the scoping review and the Delphi study sought to define and describe nursing informatics and identify its relevance to contemporary nursing practice.

#### *8.3.1.1 Defining nursing informatics*

The scoping review highlighted a lack of understanding of nursing and health informatics (Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Gonen et al., 2016; Lam et al., 2016; O'Connor & LaRue, 2021; Raghunathan, McKenna, & Peddle, 2022; Vottero, 2017), and a lack of consistent taxonomy and language related to nursing informatics (Asiri & Househ, 2017; O'Connor & Andrews, 2015; Risling, 2017), as barriers to the effective integration of nursing informatics into undergraduate nursing programs. The Delphi study participants were asked, in the First Round Questionnaire, how they would define or describe nursing informatics, and whilst an inherent understanding of the term was evident, there was considerable variation in the specific elements identified in the definitions. Participants referred to a range of definitions, including those developed by Staggers and Thompson (2002, p. 261) - “Nursing informatics is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice”; the Technology Informatics Guiding Education Reform Initiative (TIGER, 2009) - “the specialty that integrates nursing science with multiple information and analytical sciences to identify, define, manage and communicate data, information, knowledge and wisdom in nursing practice”; and the International Medical Informatics Association – Nursing Informatics Special Interest Group (2009), “Nursing informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families and communities worldwide”. These findings reflect previous studies which identified a range of definitions for nursing informatics, health informatics and associated terms (Hallberg & Salimi, 2020; Hussey & Kennedy, 2016; Morawski, Fanberg, & Pitts, 2021). The call for global consensus on informatics terminologies has been evident, with Morawski, Fanberg and Pitts (2021, p. 52), in *Responding to the need to curate global informatics definitions*, stating that definitions “are critical for illuminating the different health professions and their specialties, especially when it comes to how they relate to health informatics”. So to, Staggers and Thompson (2002), more than twenty years ago, identified the need for a clear definition of nursing informatics, stating:

> A definition is a fundamental element for shaping a specialty. A definition for nursing informatics guides role delineation for nurses interested in informatics and suggests directions for practice, education, training, and research…a definition for nursing informatics is needed to help others, within and outside nursing, understand the legitimacy of the practice and the general competencies of a nurse who specializes in informatics. (pp. 255-256)

However, since this time, continuing discussions regarding how to define nursing informatics have been evident in the literature (Asiri, 2016; Matney et al., 2011; Peltonen, Pruinelli, et al., 2019), with Reid, Maeder, Button, et al. (2021), in *Defining Nursing Informatics: A Narrative Review*, noting several key nursing informatics definitions currently in use, and stating:

> The differences, whilst nuanced, may be linked to the number of organisations in each country, which represent the interests of nursing informatics, thereby resulting in siloed bodies of knowledge. If the purpose of nursing informatics is to improve the safety and quality of patient care, then as a profession, nurses need to be provided with a clearer understanding of nursing informatics. This will only benefit nursing by leading to a consolidated body of knowledge, a clear education mandate and a digital ready workforce. (p.111)

The findings from the scoping review identified the ongoing confusion in the use of informatics-based terminologies, including nursing informatics, but the findings of the Delphi study indicated that understanding of the essence of nursing informatics is developing within nursing education. The question therefore remains, why is there still a lack of understanding of nursing informatics evident in the literature? The responses from the participants, in the Second Round Questionnaire, provide some answers to this conundrum. Participants were provided with the following definition of nursing informatics:

> *The use of nursing, computer and information science to better understand patient data for improved health outcomes and evidence-based care and managing and communicating data, information and knowledge to enhance nursing care, education, research and administration.*

Significant divergence of opinion was noted regarding supporting this definition, with recommendations to change key terms, shorten the definition, add additional information or use a different definition all together. This illustrates the inherent difficulty associated with developing a global taxonomy for nursing informatics (and associated fields), achieving the best way to define terms which are broad enough to capture the necessary information but concise enough to be practicable. A clear understanding of nursing informatics is necessary for the effective integration of nursing informatics and associated fields into education (Morawski, Fanberg, & Pitts, 2021; Reid et al., 2024; Staggers & Thompson, 2002); however, as the findings from this study have indicated, this goal is not without its challenges. Despite these issues, it is encouraging to note that all participants had a clear understanding of nursing informatics, something that was anticipated with nurse informaticians and experts in nursing informatics, but less so with nurse educators.

#### *8.3.1.2 Nursing informatics and its relevance to nursing practice*

The scoping review and Delphi study explored nursing informatics and its relevance to contemporary nursing practice, with the scoping review focusing on the barriers to the integration of nursing informatics content in undergraduate nursing education and the Delphi study extending this to include the relevance of nursing informatics to contemporary nursing practice. Participants linked nursing informatics with improving the safety and efficiency of health care, informing evidence-based practice and making nursing care more visible; importantly, most participants aligned nursing informatics with contemporary practice, rather than as a separate specialty area. This finding was anticipated from the nurse informaticians and the experts in nursing informatics, as this was their area of expertise; however, nurse educators also identified nursing informatics as being relevant to nursing practice. These findings reflect contemporary literature which has identified the growing need for nurses to develop digital proficiency, competency and capacity (Bichel-Findlay, Dixon, & Alexander, 2020; Booth, Strudwick, McMurray, et al., 2021; Brommeyer et al., 2023), with Kleib et al. (2022), in *Are Future Nurses Ready for Digital Health? Informatics Competency Baseline Assessment*, stating:

> Educating nurses about NI and DH is vitally important so they can safely use these tools when providing care, meaningfully participate in DH initiatives within their organizations, and critically examine benefits and impacts of current and new technologies on patient safety and nurses' professional responsibilities. (p.102)

As previously identified, the relevance of nursing informatics to contemporary nursing practice was highlighted by the Australian Nursing and Midwifery Accreditation Council (2014, p. 4), in *Health informatics and health technology - an explanatory note*, who stated “The guiding principle for all learning and teaching strategies related to informatics and technology in health is that being technically competent is a fundamental element of caring”. The use of nursing informatics was viewed as an integral aspect of nursing by many of the participants and linked with improving the safety and efficiency of health care, informing of evidence-based practice, and providing data to leverage change. The recognition of the value of nursing informatics to contemporary nursing practice is strongly supported in the literature, through clinical decision support (Jedwab et al., 2019; Yoshida et al., 2018), coordination of care (McKay & Vanaskie, 2018; Watterson et al., 2020), quality of care (Ayaad et al., 2019; Kutney-Lee et al., 2019) and access to real-time patient data (McCarthy et al., 2019; Rathert et al., 2019).

**Table 8-1 Nursing informatics and its role in contemporary nursing practice**

| **Defining nursing informatics** | | | | |
|---|---|---|---|---|
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can operational definitions for nursing informatics be achieved through consensus? | Limited understanding of nursing and health informatics, limited understanding of the role of nursing informatics in patient care outcomes, limited understanding of nursing informatics applications, including electronic health records and handheld devices, and a lack of consistent taxonomy and language related to nursing informatics. | Participants had a clear understanding of nursing informatics.<br><br>Divergence of opinion regarding how to define nursing informatics, with a range of definitions from nursing bodies and informatics organisations recommended.<br><br>In the Second Round Questionnaire, participants were provided with the definition (based on previous responses) - The use of nursing, computer and information science to better understand patient data for improved health outcomes and evidence based care and Managing and communicating data, information and knowledge to enhance nursing care, education, research and administration. | “NI manages and communicates data, information, and knowledge to enhance nursing care, education, research, and administration. (D09-1)<br><br>“Nursing informatics is the use of digital technology to better understand patient care, improve health outcomes and evidence-based care, and manage and communicate data, information, and knowledge to enhance nursing care, education, research, and administration”. (D40-2) | In 2024, there is still confusion regarding nursing informatics. Clear understanding of nursing informatics is essential for the effective integration of nursing informatics and associated fields into education. However, there is an inherent difficulty in developing a global taxonomy for nursing informatics and associated fields. |

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| | | Divergence of opinion noted with n=24 supporting the definition and n=27 recommending changes to the definition. | | |
| **Nursing informatics and its relevance to nursing practice** | | | | |
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a distinct body of knowledge of nursing informatics be developed? | The benefits of nursing informatics in clinical care included rapid access to crucial patient data, systematic patient assessment, improved time management, rapid patient assessment, secure use of information, patient self-monitoring, improved data collection, less clinical errors, evidence-based practice, cost-effectiveness, enhanced nursing practice at point of care, improved team communication and improved patient outcomes and safety. | Participants linked nursing informatics with improving the efficiency of health care (n=13), improving the safety of health care (n=8), aiding in evidence-based practice (n=7),making nursing care more visible (n=6), informing healthcare policy (n=2), informing education (n=1), improving health outcomes (n=1), with most participants aligning nursing informatics with contemporary practice (n=36), rather than as a separate specialty area. | "Nursing informatics is threaded throughout every aspect of nursing care. Nursing care and nursing informatics cannot be separated in my opinion". (D16-1)<br><br>"Data is the key to provide better patient care, stay within hospital budget, be current with state and local regulatory agencies. Knowing how to use informatics and how it can be useful can make one a better Nurse". (D51-1) | There is an urgent need for nurses to develop digital proficiency, competency and capacity, with recognition that nursing informatics is an inherent part of contemporary nursing practice. |

### 8.3.2 Understanding of nursing informatics by key stakeholders

Informed by the research question - *can a distinct body of knowledge of nursing informatics be developed?* and by the literature review, which identified a lack of understanding of nursing informatics by nurses, the scoping review and the Delphi study sought to determine the understanding of nursing informatics by key stakeholders – university faculty, university hierarchy, nursing students and nurses in the clinical setting. The scoping review highlighted a lack of understanding of nursing and health informatics (Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Gonen, Sharon, & Lev-Ari, 2016; Lam et al., 2016; O'Connor & LaRue, 2021; Raghunathan, McKenna, & Peddle, 2022; Vottero, 2017), with limited understanding of the role of nursing informatics in patient care outcomes (Gonen, Sharon, & Lev-Ari, 2016; Kleib & Olson, 2015; Peltonen, Pruinelli, et al., 2019), and limited understanding of nursing informatics applications (Booth, Sinclair, Strudwick, et al., 2017; Choi, Park, & Lee, 2016; Clever Together, 2015; Forman, Flores, & Miller, 2020; O'Connor et al., 2017; Raghunathan, McKenna, & Peddle, 2022). In the Second Round Questionnaire, participants were asked if educators, students, university hierarchy and nurses in the clinical setting adequately understood nursing informatics; this question was based on the scoping review findings regarding a lack of understanding of nursing and health informatics, limited understanding of the role of nursing informatics in patient care outcomes, limited understanding of nursing informatics applications and a lack of consistent taxonomy and language related to nursing informatics.

#### *8.3.2.1 Understanding of nursing informatics in university*

The majority of participants identified educators as having a limited understanding of nursing informatics; but there was an underlying belief that that understanding of nursing informatics was increasing amongst educators, with university hierarchy viewed as removed from the day-to-day teaching environment and therefore not expected to have an inherent understanding of nursing informatics. These findings are reflected in the literature with limited educator understanding of nursing informatics linked with a lack of integration of nursing informatics into undergraduate nursing education (Gonen, Sharon, & Lev-Ari, 2016; Hamilton, Iradukunda, & Aselton, 2021; Nagle, Kleib, & Furlong, 2020). As described by Procter (2021, p. 166), in *A Systematic Approach to Supporting Faculty Knowledge Development in Nursing and Health Informatics*, “it has long been recognized that there is a paucity of nurse educators who have the knowledge and skills to include informatics within their curriculum sessions”. However, there are indications that these barriers to effective nursing informatics education are being increasingly addressed through collaborations between universities and healthcare institutions to develop faculty competency (Freeman & Wilson, 2023), a focus on faculty buy-in for the use of nursing informatics tools (Brewer et al., 2024), and recognition of the need for the development of digital literacy and competency in nursing education programs (Tischendorf et al., 2024).

#### *8.3.2.2 Understanding of nursing informatics by undergraduate nursing students*

A number of participants identified undergraduate nursing students as having a limited understanding of nursing informatics, with this primarily linked to a lack of nursing informatics content in the curriculum, faculty with limited nursing informatics competency and a disconnect between digital health technologies and nursing informatics. As previously stated, undergraduate nursing students' lack of understanding of nursing informatics and its role in contemporary nursing practice has been highlighted in the literature (Harerimana et al., 2021; Kleib et al., 2022; O'Connor & LaRue, 2021; Stunden et al., 2024), with Martzoukou et al. (2024, p. 656) stating that "increasing awareness of existing digital gaps and offering tailored digital skills enhancement can empower students as future--proof evidence--based practitioners in an evolving digital healthcare landscape".

#### *8.3.2.3 Understanding of nursing informatics by nurses in the clinical setting*

Finally, participants were asked to consider whether nurses working in the clinical setting have an understanding of nursing informatics, with opinions divided on the degree of nursing informatics competence and understanding demonstrated. It was also noted that an understanding of nursing informatics was often limited to the use of EHRs and other digital tools within the clinical setting, rather than understanding the value and uses of big data, with *big data* "commonly used to describe a range of different concepts: from the collection and aggregation of vast amounts of data, to a plethora of advanced digital techniques designed to reveal patterns related to human behavior" (Favaretto et al., 2020, p. 1) These findings are reflected in contemporary literature regarding the workforce preparedness of nurses to effectively engaged with nursing informatics (Morris et al., 2023; Shin, Cummings, & Ford, 2018; Stunden et al., 2024), with Booth, Strudwick, McBride, et al. (2021, p. 1), warning that "nurses have generally not kept pace with rapid changes in digital technologies and their impact on society. This limits the potential benefits they bring to nursing practice and patient care".

**Table 8-2 Understanding of nursing informatics by key stakeholders**

| **Understanding of nursing informatics in university** | | | | |
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| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a distinct body of knowledge of nursing informatics be developed? | Limited understanding of nursing and health informatics, limited understanding of the role of nursing informatics in patient care outcomes, limited understanding of nursing informatics applications, including electronic health records and handheld devices, and a lack of consistent taxonomy and language related to nursing informatics. | In the Second Round Questionnaire, participants identified limited understanding of nursing informatics by university educators and hierarchy (n=43).<br><br>In the Third Round Questionnaire, barriers to the integration of nursing informatics into undergraduate nursing education, identified a lack of understanding of nursing informatics by university faculty (n=40) and by university hierarchy (n=39). | “Nursing Informatics, while gaining recognition, is still a relatively new field within healthcare. Educators may not fully understand its scope and significance due to: varied job descriptions, lack of standardization and limited exposure to the field.” (D14-2)<br><br>“I believe there is a gap in Educators' knowledge of Nursing Informatics. This may be related to educators' lack of exposure to rapid change in the field. Also, there is a need to increase expertise in nursing informatics for the Educators' workforce”. (D34-2)<br><br>“I believe Educators would at least be aware of this term, having worked for several years they are bound to have come across this and have some | University hierarchy have limited understanding of nursing informatics, and as such do not prioritise or support the integration of nursing informatics into undergraduate nursing curricula.<br><br>University faculty have varying levels of understanding and competency in nursing informatics; however, there are indications of increasing faculty understanding, associated with interprofessional collaborations, a focus on faculty buy-in and recognition of the importance of digital literacy and competency. |

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| | | | understanding of it but potentially may not have great depth of knowledge”. (D59-2) | |
| **Understanding of nursing informatics by undergraduate nursing students** | | | | |
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a distinct body of knowledge of nursing informatics be developed? | Limited understanding of nursing and health informatics, limited understanding of the role of nursing informatics in patient care outcomes, limited understanding of nursing informatics applications, including electronic health records and handheld devices, and a lack of consistent taxonomy and language related to nursing informatics. | In the Second Round Questionnaire, participants identified limited understanding of nursing informatics by undergraduate nursing students (n=28). | “I suspect students understand the use of digital technology to deliver and enhance care but have never really considered Nursing Informatics as the term for this”. (D25-2)<br><br>“Most BN programs only focus on basic nursing skills. This is then reinforced by nursing placement where nurses largely try to involve students only in patient care and not in aspects of nursing management, administration or research etc. where the data may have a wider professional impact”. (D50-2) | Undergraduate nursing students must enter the workforce, with a clear understanding of nursing informatics and its role in contemporary nursing practice, to be workforce ready.<br><br>Currently, undergraduate nursing students have a limited understanding of nursing informatics, which is linked with a lack of nursing informatics content in undergraduate curricula, faculty with limited nursing informatics competency and a disconnect between nursing informatics and digital health technologies. |

| Understanding of nursing informatics by nurses in the clinical setting | | | | |
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| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a distinct body of knowledge of nursing informatics be developed? | Limited understanding of nursing and health informatics, limited understanding of the role of nursing informatics in patient care outcomes, limited understanding of nursing informatics applications, including electronic health records and handheld devices, and a lack of consistent taxonomy and language related to nursing informatics. | In the Second Round Questionnaire, nurses in the clinical setting were viewed as having a degree of nursing informatics competence and understanding (n=22).<br><br>In the Third Round Questionnaire, barriers to the integration of nursing informatics into undergraduate nursing education, identified a lack of understanding of nursing informatics by nurses in the clinical setting (n=40).<br><br>Understanding of nursing informatics was identified as often being limited to EHRs and other digital tools, with limited understanding of big data. | "Yes, nurses in the clinical setting realize they cannot do their jobs adequately without the use of and understanding of the technology resources available to them". (D16-2)<br><br>"Nurses understand their daily practice—how they use their information systems and devices. What is mostly still lost is the use of data. All the possibilities for how they could follow processes and analyze outcomes based on data are still seldom carried out". (D40-2)<br><br>"I think nurses have a basic understanding of the role of nursing informatics but probably don't want or need to know the how or why; as long as it works!". (D46-2) | Nurses in the clinical setting have increasing nursing informatics competency; however, this is often limited to the tools used in clinical practice, rather than the uses of the associated data to inform and improve healthcare delivery. |

### 8.3.3 Knowledge requirements for the use of nursing informatics

Informed by the research question - *Can a distinct body of knowledge of nursing informatics be developed?*, and informed by the literature review which identified a lack of informatics-based competencies worldwide to inform undergraduate nursing education and a workforce who is not adequately prepared to work within the digital health care, the scoping review and the Delphi study sought to identify the types of digital technologies that may be encountered in both academic and clinical settings and relevant nursing informatics competency standards to inform nursing education.

#### *8.3.3.1 Digital health technologies in the clinical setting*

The scoping review identified interventions, tools and applications currently used to embed nursing informatics into undergraduate nursing programs. Interventions, tools and applications included barcode medication administration (Angel, Friedman, & Friedman, 2016; Booth, Sinclair, Brennan, & Strudwick, 2017; Booth, Sinclair, Strudwick, et al., 2017), electronic health records (Baxter & Andrew, 2018; Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Choi, Park, & Lee, 2016; Clever Together, 2015; Forman, Armor, & Miller, 2020b; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017; Gonen, Sharon, & Lev-Ari, 2016; Hern et al., 2015; Pobocik, 2015; Raghunathan, McKenna, & Peddle, 2021, 2022; Repsha et al., 2020; Risling, 2017; Sorensen & Campbell, 2016; Theron, Borycki, & Redmond, 2017; Wilbanks, Watts, & Epps, 2018), computer patient order entry (Gonen, Sharon, & Lev-Ari, 2016), and standardised electronic assessment forms (Bonnel, Vogel Smith, & Hober, 2018). Telehealth applications (Hamilton, Iradukunda, & Aselton, 2021; Royal College of Nursing (RCN), 2018), technology-enabled clinical simulation tools (Gambo et al., 2017; Harerimana et al., 2022; Hern et al., 2015), health informatics lectures (Hovenga & Grain, 2016), digital learning platforms (Mather & Cummings, 2015; McGregor et al., 2017; O'Connor et al., 2017), health informatics laboratories (Sapci & Sapci, 2017), and handheld and wearable health technologies, including smart watches and wearable sensors (Clever Together, 2015; O'Connor & Andrews, 2015; Risling, 2017; Royal College of Nursing (RCN), 2018) were also identified.

In the First Round Questionnaire, participants were asked to identify the digital health technologies used in their professional practice, with these technologies defined as information tools, communication tools and assessment tools. Information tools included databases, websites, online learning platforms, digital patient lists/ journey charts, clinical information systems and smart mobile applications. Communication tools included EHR/EMR, telehealth, radiology and pathology requests and results, electronic patient flow management, clinical handover tools, ChatGPT and smart mobile applications. And assessment tools included wearable technologies, simulation laboratories, monitoring technology, digital photography and decision-support tools. These tools were closely aligned with the interventions, tools and applications identified in the scoping review.

These findings are reflected in literature, with a broad range of digital health technologies now part of contemporary nursing practice (Reid, Button, et al., 2022), including EHRs or EMRs (Ellis et al., 2020; Jenkins et al., 2018; Mollart et al., 2021), BCMA (Creel, Carruth, & Taylor, 2020; Ledlow et al., 2022), telehealth and telenursing (Eckhoff, Guido-Sanz, & Anderson, 2022; Rutledge et al., 2021), Smart Mobile Applications (apps) (Callinici, 2017; O'Connor & Andrews, 2018), technology-enabled clinical simulation tools (Padilha et al., 2019; Plotzky et al., 2021) and decision support tools (McDonald, Boulton, & Davis, 2018).

#### *8.3.3.2 Nursing informatics competency standards to inform nursing education*

The lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies were identified in the scoping review as a barrier to nursing informatics education in undergraduate nursing programs. A lack of fit for purpose nursing informatics competencies was identified as a barrier to learning (Chauvette, Kleib, & Paul, 2022; Cummings, Borycki, & Madsen, 2015; Mather & Cummings, 2015; McGregor et al., 2017; O'Connor & Andrews, 2015), with digital competencies linked to the provision of effective and efficient healthcare within the digital healthcare environment (Booth, Sinclair, Strudwick, et al., 2017; Cummings, Whetton, & Mather, 2017). Underpinning the lack of competencies was a lack of recommendations, guidelines and evidence-based educational strategies for the integration of Informatics content into undergraduate programs (Asiri & Househ, 2017; Booth, Sinclair, Strudwick, et al., 2017; Brunner et al., 2018; Clever Together, 2015; Cummings et al., 2016; Egbert et al., 2019; Forman, Armor, & Miller, 2020b; Foster & Sethares, 2017; Harerimana et al., 2022; Mather & Cummings, 2015; O'Connor & Andrews, 2015; O'Connor & LaRue, 2021; Peltonen, Pruinelli, et al., 2019; Pobocik, 2015; Risling, 2017; Vottero, 2017). The importance of informatics competencies, recommendations, guidelines and evidence-based educational strategies was highlighted by Peltonen, Pruinelli, et al. (2019, p. 229) who noted that “International guidelines on NI education, competencies, certification, role definitions, job titles and descriptions, organisation and ethical aspects would support the development of NI”.

In the First Round Questionnaire, the participants were asked to identify the informatics competencies, recommendations, or guidelines that informed their use of nursing informatics. As previously stated, the NMBA (2021, p. 8) defined *competence* as “the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/ or superior performance in a profession/occupational area”, with competency frameworks serving to detail the desired characteristics of a competent workforce (Batt, Tavares, & Williams, 2020). More than half of the participants identified competency standards, recommendations of guidelines that informed their professional practice; however, a number of participants stated they did not use these resources to inform their practice. The identified competency standards or guidelines were separated into the specific country of origin, with Australian sources including the Nursing Informatics Position

Statement – Version 9 (Australian College of Nursing (ACN), Health Informatics Society of Australia (HISA), & Nursing Informatics Australia (NIA), 2017a, p. 7), the *Nursing Informatics Position Statement* (ACN, HISA & NIA, 2017b), and seminal documents developed by key professional bodies in Australia (ADHA, 2017; 2020, 2023c, 2023b; ADHA & AIDH, 2023b; ANMF, 2015; NMBA, 2016a; 2018). American frameworks included the American Association of Colleges of Nursing (AACN) - The Essentials of Baccalaureate Education for Professional Nursing Practice (2008) and Essentials Toolkit (2021), the American Nurses Association's Nursing Informatics: Scope and Standards of Practice (2008, 2015, 2022), and the American Nursing Informatics Association online resources (2024a). Canadian frameworks included the Canadian Association of Schools of Nursing (CASN) Nursing Informatics Entry-to-Practice Competencies for Registered Nurses (2012b), Canadian Nurses Association (CNA) and Canadian Nursing Informatics Association (CNIA), Nursing Informatics: Joint Position Statement (Canadian Nurses Association (CNA) & Canadian Nursing Informatics Association (CNIA), 2017), and Canada Health Infoway online resources (2024). Guidelines: Informatics for nurses entering practice (Honey, Collins, & Britnell, 2018) was identified as providing recommendations for Nurses in New Zealand, with the All-Ireland Nursing & Midwifery Digital Health Capability Framework (ONMSD & Northern Ireland Practice and Education Council for Nursing and Midwifery, 2023), Development of a core competency framework for clinical informatics (Davies et al., 2021), and the National Health Service publication (2023) Digital skills – health informatics competency standards, frameworks and tools for healthcare professionals identified as sources used in the United Kingdom. Finally, global sources included ICNP & SNOMED CT resources (ICN, 2021), TIGER resources (Hübner et al., 2018; O'Connor et al., 2017; Shaw et al., 2020; 2007, 2008, 2009, 2010), Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics: Second Revision (Bichel-Findlay et al., 2023), and the International Computer Driving License (ICDL, 2024).

Interestingly, despite these extensive resources, curriculum linked with competency standards was scored lower by Australian participants, in the Third Round Questionnaire, than participants from all other countries, which indicated that participants from all other countries prioritised the use of nursing informatics competency standards to inform the curriculum as a higher priority. This finding may have reflected the current lack of nursing informatics competency standards in use in Australia, with a lack of nursing informatics competencies embedded into education programs, particularly in Australia, identified as an ongoing priority (Borycki & Foster, 2014; Raghunathan, McKenna, & Peddle, 2023a; Reid, Button, et al., 2022) and resulting in inconsistent and *ad hoc* informatics competency in nursing graduates (Cummings et al., 2016).

These findings from this study indicated that despite a wide range of resources, including competency standards, there remains a lack of a cohesive approach to nursing informatics education, suggesting that these standards may not be fit for purpose in informing undergraduate nursing education. However, the recently released AACN Essentials (2021) which outlines "the necessary curriculum content and expected competencies" from undergraduate to doctoral programs and the Guidelines: Informatics for nurses entering practice (Honey, Collins, & Britnell, 2018, p. 5) which "identify the key knowledge, skills and behaviours toward nursing informatics for nurses as they enter practice as a Registered Nurse (RN)", are indicative of the resources being developed to inform the integration of nursing informatics into undergraduate nursing education. This suggests that the enablers and barriers for the integration of nursing informatics into undergraduate nursing education extend well beyond suitable educational resources and competency standards.

**Table 8-3 Knowledge requirements for the use of nursing informatics**

| **Digital health technologies in the clinical setting** | | | | |
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| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a distinct body of knowledge of nursing informatics be developed? | Interventions, tools and applications currently used in clinical settings included BCMA, EHR, computer patient order entry, standardised electronic assessment forms, telehealth applications, and wearable health technologies.<br><br>The scoping review focused on interventions, tools and applications currently used to embed nursing informatics into undergraduate nursing programs. In addition to tools in the clinical setting, technology-enabled clinical simulation tools, health informatics lectures, digital learning platforms and health informatics laboratories were identified. | Participants were asked to identify the digital health technologies used in their professional practice, these included EHR/ EMR (n=24), simulation laboratories (n=10), databases (n=7), monitoring technologies (n=5), smart applications (n=5), telehealth (n=4), decision support tools (n=3), wearable technologies (n=3), ChatGPT (n=2), electronic patient flow management (n=2), radiology and pathology (n=2), research tools (n=2), online learning platforms (n=2), patient lists (n=2), digital photography (n=1), clinical handover tools (n=1), dietary systems (n=1), learning management systems (n=1), MIMS online (n=1), podcasts (n=1), and websites (n=1). | "I use a range of technologies such as electronic medical records (EMRs), research databases to review the latest literature and research". (D25-1) | Nursing informatics competency is an essential requirement for nurses, due to use of a wide range of digital health technologies in clinical, research and education settings. |

| *Nursing informatics competency standards to inform nursing education* | | | | |
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| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a distinct body of knowledge of nursing informatics be developed? | The lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies were identified in the scoping review as a barrier to nursing informatics education in undergraduate nursing programs | A number of participants (n=42) identified a wide range of competency standards that informed their professional practice; however, some participants (n=19) did not align their practice with specific competency standards or guidelines. | "I don't really buy into competencies around abstract stuff like 'informatics' anymore…Competencies, while important to a specific degree, don't translate as well as competencies around say injections, or med admin, or, something else that is a bit more narrowly defined and operationalized". (D08-1).<br><br>"Lack of standardised informatics competencies for entry to practice at a national level– major barrier and subsequently leads to inconsistent preparation. Each institution is left to interpret what informatics involves and what should be taught". (D36-1) | The is a lack of a cohesive approach to nursing informatics education, despite a wide range of competency standards and resources, this suggests that many of these standards are not fit for purpose in informing undergraduate nursing education. |

### 8.3.4 Nursing informatics education

Informed by the research question - *Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?*, and informed by the literature review which identified limited undergraduate nursing education regarding nursing informatics, a lack of university faculty with nursing informatics' expertise, and a workforce who is not adequately prepared to work within the digital health care, the scoping review and the Delphi study sought to identify the barriers and enablers for nursing informatics in undergraduate nursing education, with the Delphi study including an exploration of the educational requirements of Registered Nurses and the understanding of nursing informatics by key stakeholders.

#### *8.3.4.1 Nursing informatics education for undergraduate nursing students*

Exploration of nursing informatics education for undergraduate nursing students was addressed in the scoping review and the Delphi study, and based on the literature review which identified a lack of nursing informatics education in undergraduate nursing programs (Cummings et al., 2016; Shin, Cummings, & Ford, 2018), with Australian undergraduate nursing students not adequately prepared for the effective use of nursing informatics technologies (Harerimana et al., 2022; Shin, Cummings, & Ford, 2018). This aspect of the study was addressed, in the Delphi study, as barriers for the integration of nursing informatics content in undergraduate nursing curricula, enablers for the integration of nursing informatics content in undergraduate nursing curricula, and recommended nursing informatics content in undergraduate nursing curricula.

##### *8.3.4.1.1 Barriers for the integration of nursing informatics content in undergraduate nursing curricula*

Barriers to nursing informatics education were identified in the scoping review and participants, in the Delphi study were also asked to consider barriers to the integration of nursing informatics into undergraduate nursing curricula in the Third Round Questionnaire, with these barriers first identified in the First and Second Round Questionnaires. Barriers identified and meeting the consensus threshold, in the Third Round Questionnaire, included: costs/funding, lack of access to digital health technologies on placement, lack of access to current digital health technologies in university, lack of professional development for university faculty, lack of incentive to include nursing informatics, lack of integration of nursing informatics throughout curriculum, overfull curriculum, varying levels of digital literacy in university faculty, lack of understanding of nursing informatics from university faculty, lack of understanding of nursing informatics from university hierarchy, and lack of understanding of nursing informatics from nurses in the clinical setting.

Stakeholder group analysis indicated that female participants viewed a lack of understanding of nursing informatics by university faculty as a more significant barrier to the integration of nursing informatics into nursing education (than the male participants); this could be addressed in future research, with a view to identifying whether this finding related to these participants only, or is indicative of wider-spread disparities. Nurse educators viewed the integration of nursing informatics throughout the curriculum as less of a priority than nurse informaticians or experts in nursing informatics and reflected a similar finding in *7.5.1.2 Stakeholder-group analysis – Professional role and enablers for the integration of nursing informatics into nursing education*, where nurse educators scored embedding nursing informatics into the curriculum as a lower priority than nurse informaticians and experts in nursing informatics. These findings are unsurprising, as it is anticipated that nurse informaticians and experts in nursing informatics would perceive the integration of nursing informatics throughout undergraduate nursing education programs as a priority. Australian participants viewed a lack of understanding of nursing informatics by university hierarchy as a less of a concern (than participants from all other countries); this disparity could indicate a difference in the hierarchical structure of universities in other countries and the role of hierarchy in determining curriculum.

Understanding of nursing informatics is addressed in *8.3.2 Understanding of nursing informatics by key stakeholders*; the other barriers will now be addressed.

***Costs, funding and infrastructure***, associated with the use of digital health technologies, were identified in the scoping review (Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Cummings, Borycki, & Madsen, 2015; Forman, Flores, & Miller, 2020; Honey et al., 2016; O'Connor & Andrews, 2015; Raghunathan, McKenna, & Peddle, 2022; Wilbanks, Watts, & Epps, 2018) and by the participants as barriers to the integration of nursing informatics into undergraduate nursing curricula. The scoping review also identified computer crashes, power outages, and hardware and software not working (Angel, Friedman, & Friedman, 2016; Booth, Sinclair, Strudwick, et al., 2017; Clever Together, 2015; Mather & Cummings, 2016; O'Connor & Andrews, 2015; Risling, 2017), coupled with a lack of technical support and poor infrastructure (Asiri, 2016; Hamilton, Iradukunda, & Aselton, 2021; Harerimana et al., 2022; Honey, Collins, & Britnell, 2021; Raghunathan, McKenna, & Peddle, 2022), poor internet connectivity (Baxter & Andrew, 2018; Gambo et al., 2017) and the development, cost and maintenance of hardware and software. These findings are reflected in contemporary literature with a lack of technical support (Al-Rawajfah & Tubaishat, 2019), a lack of adequate infrastructure (Irinoye et al., 2013), poor functionality and design of systems (Kaihlanen et al., 2021; Shin, Cummings, & Ford, 2018; Staggers et al., 2018), internet connectivity issues (Booth, Strudwick, McBride, et al., 2021; Irinoye et al., 2013) and the associated costs of development, purchase and maintenance of hardware and software (Al-Rawajfah & Tubaishat, 2019; Reid et al., 2024) as key barriers to the effective integration of nursing informatics into undergraduate nursing programs and clinical practice.

***Lack of access to digital health technologies on placement and in university*** were identified in the scoping review, with a lack of access to digital technologies in the clinical setting associated with a lack of access to devices and associated software (Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Chauvette, Kleib, & Paul, 2022; Choi, Park, & Lee, 2016; Hamilton, Iradukunda, & Aselton, 2021; Harerimana et al., 2022; Hern et al., 2015; Honey, Collins, & Britnell, 2021; Kleib & Olson, 2015), policies on student use of mobile devices in academic and clinical settings (Asiri & Househ, 2017; Chauvette, Kleib, & Paul, 2022; Mather & Cummings, 2016), policies regarding student use of digital technologies in the clinical setting (Baxter & Andrew, 2018; Bonnel, Vogel Smith, & Hober, 2018; Cummings, Whetton, & Mather, 2017; Harerimana et al., 2022; Honey, Collins, & Britnell, 2021; Pobocik, 2015), and the legal and ethical implications of undergraduate nursing students accessing patient information in the clinical setting (Bonnel, Vogel Smith, & Hober, 2018; Choi, Park, & Lee, 2016; Harerimana et al., 2022; Mather & Cummings, 2016). The participants also identified a student lack of access to digital health technologies as a barrier to the integration of nursing informatics in undergraduate nursing education. These findings are reflected in literature with lack of access to the required hardware (Arikan et al., 2021; Mollart et al., 2021), restrictions on undergraduate nursing student access to electronic health records (Hansbrough et al., 2020; Wynn, 2016) and concerns regarding maintaining the privacy and confidentiality of health records (Arikan et al., 2021; Wallace, 2015).

***Lack of professional development for university faculty*** was identified in the scoping review (Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017) and by the study participants as a barrier to the integration of nursing informatics into undergraduate nursing education. The scoping review also identified faculty resistance and technological stress (Asiri & Househ, 2017; Bonnel, Vogel Smith, & Hober, 2018; Booth, Sinclair, Strudwick, et al., 2017; Burke & Ellis, 2016; Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Hamilton, Iradukunda, & Aselton, 2021; Hern et al., 2015; Kleib & Olson, 2015), associated with changes to traditional modes and methods of teaching (Gonen et al., 2016), a lack of understanding and acceptance of digital technologies and informatics (Asiri & Househ, 2017; Bonnel, Vogel Smith, & Hober, 2018; Booth, Sinclair, Strudwick, et al., 2017; Burke & Ellis, 2016; Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Forman, Armor, & Miller, 2020a; Foster & Sethares, 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Hamilton, Iradukunda, & Aselton, 2021; Hern et al., 2015; Kleib & Olson, 2015), and a lack of digital competence (Foster & Sethares, 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016). These findings are reflected in the contemporary literature with increased demands on faculty to integrate nursing informatics into undergraduate nursing programs (Belchez, 2019; Bove & Sauer, 2023; Reid et al., 2024). Kinnunen et al. (2017, p. 41), in

*Curricula Challenges and Informatics Competencies for Nurse Educators*, noted that “activity relating to the development of nursing informatics competencies for beginning level nurses has exposed a paucity of understanding of the requirements for nursing informatics competencies for nurse educators”, with the need for nursing informatics competencies for faculty to guide development of these skills. Inherent within these competency requirements is the need to provide opportunities for faculty to develop a deeper understanding of nursing informatics and its role in patient care (Bove & Sauer, 2023; Ghonem, Ibrahim, & Abd elrahman, 2023).

***A lack of incentive to include nursing informatics*** was identified in the Delphi study as a barrier to the integration of nursing informatics into undergraduate nursing education, due to a lack of leadership from professional nursing bodies and a lack of governance. These findings were evident in the scoping review which found a lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies (refer to *8.3.3.2 Nursing informatics competency standards to inform nursing education*). These findings are reflected in contemporary literature which found that the minimum standards for registration in Australia did not address the need for Registered Nurses to have basic informatics skills on completion of undergraduate education (Australian Nursing and Midwifery Federation (ANMF), 2015; Stunden et al., 2024), despite the release of the Registered Nurse standards for practice in 2016 (NMBA, 2016a). Globally, the issue was also evident with a call for nursing informatics to be included in the undergraduate nursing curricula (Chipps et al., 2022; Chung & Cho, 2017; Honey & Procter, 2017), reflecting the current lack of a coherent approach to nursing informatics education for undergraduate nursing students.

***A lack of integration of nursing informatics throughout curriculum*** was identified in the Delphi study as a barrier to the integration of nursing informatics into undergraduate nursing education, due to a lack of entry to practice nursing informatics competencies resulting in inconsistent preparation and the prioritisation of other content, with this issue also being linked to the view of nursing informatics as separate from contemporary nursing practice. Participants were asked to consider whether nursing informatics should be embedded throughout the curriculum or presented as a standalone course or topic; however, nursing informatics as a standalone course or topic failed to meet the consensus threshold in the Third Round Questionnaire. This finding is evident in the contemporary literature, with studies exploring nursing informatics, as a standalone or discrete topic (Kazawa et al., 2022; Luo & Kalman, 2018; O'Connor & LaRue, 2021) or embedded throughout the curriculum (Bonnel, Vogel Smith, & Hober, 2018; Cummings et al., 2020; Harerimana et al., 2021, 2022). The majority of studies have supported integrating nursing informatics content throughout the curriculum, rather than being viewed as “additional or separate from the core unit content or context” (Cummings et al., 2016, p. 321); this reflects the beliefs of the participants.

***Overfull curriculum*** was identified in the Delphi study as a barrier to the integration of nursing informatics into undergraduate nursing education, due to time constraints with questions of how to include nursing informatics content. This finding was reflected in contemporary literature, with a lack of available time identified as a key barrier to not including nursing informatics content in undergraduate nursing education (Chauvette, Kleib, & Paul, 2022; Cummings, Borycki, & Madsen, 2015; Forman, Flores, & Miller, 2020; O'Connor & LaRue, 2021), and reliance on clinical placements to provide this education identified as leading to discrepancies in nursing education and posing risks to patient health outcomes (Jenkins et al., 2018; Raghunathan, McKenna, & Peddle, 2021).

***Varying levels of digital literacy in university faculty*** was identified as another barrier to the integration of nursing informatics into undergraduate nursing education in the Delphi study. Interestingly, although identified initially, the varying levels of digital literacy in the undergraduate student population did not meet the consensus threshold. Further discussion of digital literacy is included in *8.3.5 Computer and digital literacy*.

##### *8.3.4.1.2 Enablers for the integration of nursing informatics content in undergraduate nursing curricula*

Enablers to nursing informatics education were identified in the scoping review and participants, in the Delphi study were also asked to consider enablers to the integration of nursing informatics into undergraduate nursing curricula in the Third Round Questionnaire, with these enablers first identified in the First and Second Round Questionnaires. Enablers identified and meeting the consensus threshold, in the Third Round Questionnaire, included: access to digital health technologies, technical support for students and university faculty, modern simulation resources, education regarding a broad range of digital health technologies, development of digital literacy, nursing informatics embedded throughout curriculum, curriculum informed by competency standards, linking nursing informatics with contemporary nursing practice, use of nursing informatics in clinical placement, use of nursing informatics in simulation/ lab classes, faculty who understand nursing informatics, professional development of university faculty, development of nursing informatics competencies and recognition of nursing informatics from peak Nursing bodies. Understandably, many of the enablers for the integration of nursing informatics content in undergraduate nursing curricula, were also addressed as barriers, when they were not part of undergraduate nursing education.

*Stakeholder group analysis* revealed that the female participants viewed the use of nursing informatics in clinical placement and professional development of university faculty as higher priorities (than the male participants); this could be addressed in future research, with a view to identifying whether this finding related to these participants only, or is indicative of wider-spread disparities. Nurse educators viewed the integration of nursing informatics throughout the curriculum as less of a priority than nurse informaticians or experts in nursing informatics, which was unsurprising, as it reasonable that nurses who specialise in nursing informatics would view it as a priority in undergraduate nursing curriculum; whereas nurse educators would be aware of all of the other content required in the curriculum. Comparison of the responses, according to country of practice, indicated that Australian participants viewed simulation resources as a higher priority (than participants from all other countries); this could be addressed in future research, with a view to identifying whether Australian undergraduate nursing students receive the same access to nursing informatics simulation resources, as the students in other countries and whether this impacts learning outcomes. In contrast, participants from all other countries prioritised the use of nursing informatics competency standards to inform the curriculum as a higher priority (than Australian participants), which could be indicative of the lack of nursing informatics competencies in use in Australia.

Faculty who understand nursing informatics and professional development of faculty are addressed in *8.3.2.1 Understanding of nursing informatics in university*, understanding of nursing informatics is addressed in *8.3.2 Understanding of nursing informatics by key stakeholders*, curriculum informed by competency standards and development of nursing informatics competencies are addressed in *8.3.3.2 Nursing informatics competency standards to inform nursing education*, nursing informatics embedded throughout curriculum is addressed in 8*.3.4.1.1 Barriers for the integration of nursing informatics content in undergraduate nursing curricula - A lack of integration of NI throughout curriculum*, access to digital health technologies, use of nursing informatics in clinical placement, use of nursing informatics in simulation/ lab classes are addressed in *8.3.4.1.1 Barriers for the integration of nursing informatics content in undergraduate nursing curricula - Lack of access to digital health technologies on placement and in* university, recognition of nursing informatics from peak nursing bodies is addressed in 8*.3.4.1.1 Barriers for the integration of nursing informatics content in undergraduate nursing curricula - A lack of incentive to include NI*, and development of digital literacy is addressed in *8.3.5.3 Development of computer and digital literacy.* Technical support for students and university faculty, modern simulation resources, education regarding a broad range of digital health technologies and linking nursing informatics with contemporary nursing practice will now be addressed.

***Technical support for students and university faculty*** – interestingly, whilst technical support for students and university faculty was identified as an enabler, a lack of technical support for students and university faculty, as a barrier, did not meet the consensus threshold in the Delphi study and was seen by a number of participants as being of less importance than other key barriers (refer to *7.4.1.3 Barriers to the integration of nursing informatics into undergraduate nursing education – lack of technical support for students and faculty*). As previously noted, a lack of technical support, associated with inadequate infrastructure, poor functionality of systems, poor internet connectivity, and limited development, purchase and maintenance of hardware and software, has been identified as a barrier to integrating nursing informatics into undergraduate nursing curriculum (Baxter & Andrew, 2018; Forman, Flores, & Miller, 2020; Oh et al., 2019). In contrast, the participants identified technical support, within the university setting, as an enabler in the use of digital health technologies, with the importance of information technology support in educational settings evident in the literature (Dogan, Dogan, & Celik, 2021; Scalabrin Bianchi, Dinis Sousa, & Pereira, 2021), and Pursan, Adeliyi and Joseph (2023, p. 270), in *Information Technology Technical Support Success Factors in Higher Education: Principal Component Analysis*, noting that "Support from technical staff is not limited to infrastructure, hardware, and software issues", with support from technical staff enhancing the likelihood of academics using multi-modal technologies.

***Modern simulation resources*** were identified by the Delphi participants as an enabler for the integration of nursing informatics into undergraduate nursing curricula, with contemporary literature identifying the importance of simulation in undergraduate nursing education (Mollart et al., 2021; Padilha et al., 2019; Repsha et al., 2020), and Coffey, McTier and Phillips (2022, p. 355) noting that "within a Bachelor of Nursing program, high-fidelity simulation optimises student preparation for the clinical environment and promotes the consolidation of clinical skills". Repsha et al. (2020, p. 59), in *Use of a Simulated Electronic Health Record to Support Nursing Student Informatics Knowledge and Skills*, stated that "to work effectively in the modern healthcare environment, student nurses will need to have knowledge and skills surrounding meaningful use of healthcare technologies", with recommendations to incorporate simulation for the development of nursing informatics competency.

***Education regarding a broad range of digital health technologies*** - As addressed in *8.3.3 Knowledge requirements for the use of nursing informatics*, the participants identified a broad range of digital health technologies used in their professional practice. So too, participants provided a range of nursing informatics content that they believed should be included in undergraduate nursing curricula to inform the development of nursing informatics competency (refer to *8.3.4.1.3 Recommended nursing informatics content in undergraduate nursing curricula*). The participants also identified education regarding a broad range of digital health technologies as an enabler for the integration of nursing informatics into undergraduate nursing curricula. The scoping review included the use of barcode medication administration (Angel, Friedman, & Friedman, 2016; Bonnel, Vogel Smith, & Hober, 2018; Booth, Sinclair, Brennan, & Strudwick, 2017), electronic health records (Baxter & Andrew, 2018; Bonnel, Vogel Smith, & Hober, 2018; Burke & Ellis, 2016; Choi, Park, & Lee, 2016; Clever Together, 2015; Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020; Foster & Sethares, 2017; Gonen, Sharon, & Lev-Ari, 2016; Hern et al., 2015; Pobocik, 2015; Raghunathan, McKenna, & Peddle, 2021, 2022; Repsha et al., 2020; Risling, 2017; Sorensen & Campbell, 2016; Theron, Borycki, & Redmond, 2017; Wilbanks, Watts, & Epps, 2018), computer patient order entry (Gonen, Sharon, & Lev-Ari, 2016), standardised electronic assessment forms (Bonnel, Vogel Smith, & Hober, 2018), telehealth applications (Hamilton, Iradukunda, & Aselton, 2021; Royal College of Nursing (RCN), 2018), and handheld and wearable health technologies, including smart watches and wearable sensors (Clever Together, 2015; O'Connor & Andrews, 2015; Risling, 2017; Royal College of Nursing (RCN), 2018), used in undergraduate nursing education. Contemporary literature has recommended the inclusion of electronic health records (Ellis et al., 2020; Jenkins et al., 2018; Mollart et al., 2021), barcode medication administration (Creel, Carruth, & Taylor, 2020; Ledlow et al., 2022), telehealth (Eckhoff, Guido-Sanz, & Anderson, 2022; Rutledge et al., 2021), Smart Mobile Applications (apps) (Callinici, 2017; O'Connor & Andrews, 2018), technology-enabled clinical simulation tools (Padilha et al., 2019; Plotzky et al., 2021), and decision support tools (McDonald, Boulton, & Davis, 2018), with Mollart et al. (2021, p. 49) recommending that undergraduate nursing programs provide a “supportive scaffolded educational environment”, rather place the burden of this education on nurses in the clinical setting.

***Linking nursing informatics with contemporary nursing practice*** - The Delphi participants identified the importance of linking nursing informatics with contemporary nursing practice and making this link explicit to undergraduate nursing students. The relevance of nursing informatics to contemporary nursing practice was addressed in *8.3.1.2 Nursing informatics and its relevance to nursing practice*. Contemporary literature also links nursing informatics with workforce readiness of undergraduate nursing students and new graduate nurses (Bichel-Findlay, Dixon, & Alexander, 2020; Chipps et al., 2022; Stunden et al., 2024), with Booth, Strudwick, McBride, et al. (2021) recommending that an urgent reform of nursing education is needed to provide “educational opportunities at undergraduate and graduate levels in informatics, digital health, co-design, implementation science, and data science”.

##### *8.3.4.1.3 Recommended nursing informatics content in undergraduate nursing curricula*

In the Third Round Questionnaire, participants were asked to consider which specific nursing informatics content should be included in undergraduate nursing education, with recommendations for this content identified in the First Round Questionnaire. The recommended content included artificial intelligence, adopting new and emergent technologies, digital devices, telehealth, data management, data security and privacy, digital health, electronic medication management systems, digital literacy and electronic health records, with all recommendations reaching or exceeding the 75% consensus threshold.

Stakeholder group analysis indicated that, regardless of the identified professional role or gender, there was a high degree of agreement in the recommendations for nursing informatics content.

However, Australian participants viewed digital health as being a higher priority than participants from all other countries. The disparity between these responses may indicate the current level of understanding of digital health in Australia, with Australian participants feeling this should be prioritised above all other recommended content and could inform future research with an exploration of nursing and nursing student understanding of digital health, both in Australia and globally.

Subsequent recommendations for nursing informatics content, identified in the Fourth Round Questionnaire included ethical and legal use of digital health technologies and digital professionalism, data literacy, the importance of co-design with key stakeholders, consumer perspectives, virtual care as opposed to telehealth, interoperability between systems, infodemiology, digital ethics/cyberethics, machine learning, genomics, robotics, blockchain, smart technologies, RFID (radio-frequency distribution), nano technologies and information verification with a recommendation to be more explicit in descriptions of content. This extensive list again reflects the complex nature of integrating content into undergraduate nursing education, with Kleib et al. (2024, p. 10) noting the continuously evolving nature of digital health technologies and recommending that "nursing students have opportunities to develop a baseline knowledge and competency in digital health and to cultivate this knowledge through continuing education upon becoming independent practitioners". The need for preparing undergraduate nursing students for digital health technologies of the future is encapsulated by Booth, Strudwick, McMurray, et al. (2021):

> Since the future of nursing informatics is constantly evolving, nurse educators will need to understand and be comfortable teaching concepts that supersede individual technologies, and that can be applied to a variety of novel technologies that nursing students may interact with in their clinical practicum environments. (p. 408).

**Table 8-4 Nursing informatics education for undergraduate nursing students**

| **Barriers for the integration of nursing informatics content in undergraduate nursing curricula** | | | | |
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| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? | Barriers identified included belief in the digital native, the constantly evolving nature of nursing informatics and digital technologies, lack of student access to digital technologies and associated resources, faculty resistance and technological stress, lack of nursing informatics competencies, recommendations, guidelines and evidence-based educational strategies, the lack of understanding of nursing informatics and its role in the profession, and limited infrastructure and resources. | Barriers, identified in the Third Round Questionnaire, included lack of integration of nursing informatics throughout curriculum (n=46), varying levels of digital literacy in university faculty (n=45), lack of access to current digital health technologies in university (n=43), lack of professional development for university faculty (n=42), costs/ funding (n=41), lack of incentive to include nursing informatics (n=41), lack of understanding of nursing informatics from university faculty (n=40), lack of understanding of nursing informatics from nurses in the clinical setting (n=40), lack of understanding of nursing informatics from university hierarchy (n=39), lack of access to digital health technologies on | "An additional barrier is the expense associated with the purchase, implementation, and technology support necessary for students to use an academic electronic medical record in coursework". (D16-1)<br><br>"The biggest barrier is the lack of understanding and relevance of nursing informatics by universities…Undergraduate nursing education is often delivered based on the 'way it was always done'". (D25-1)<br><br>"Barriers also include the lack of support from placement providers enabling students to use online and digital tools in placement".(D39-1) | Significant barriers remain to the effective integration of nursing informatics into undergraduate nursing curricula, including limited access to digital health technologies, a lack of digitally competent university faculty, and curricula which does not effectively present nursing informatics as an essential element of contemporary nursing practice. |

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| | | placement (n=38), and overfull curriculum (n=38). | | |
| **Enablers for the integration of nursing informatics content in undergraduate nursing curricula** | | | | |
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? | The scoping review focused on barriers to the integration of nursing informatics content into undergraduate nursing curricula. | Enablers, identified in the Third Round Questionnaire, included access to digital health technologies (n=45), simulation resources (n=45), use of nursing informatics in simulation/ laboratory classes (n=45), digital literacy development (n=45), range of digital health technologies (n=44), and recognition of nursing informatics from peak nursing bodies (n=44), nursing informatics embedded throughout curriculum (n=43), faculty who understand nursing informatics (n=42), curriculum linked with competency standards (n=42), linking NI with contemporary nursing practice (n=42), technical support (n=41), development of nursing | "Well educated and suitably prepared nurse educators. They need to be familiar with technical jargon, have a conceptual understanding of technologies in use and their limitations" (D20-1)<br><br>"Governance through AHPRA, NMBA, ANMAC, ACN, ANMF, AIDH all have roles in ensuring the next generation of health professionals understand digital health (including nursing informatics) needs to be included across and within disciplines for the DH ecosystem to operate efficiently, safely and with efficacy" (D26-1).<br><br>"Leadership support from the institution, thereby ensuring sustained efforts in | It is essential that undergraduate nursing students graduate with the necessary competencies to be part of the current and future healthcare workforce.<br><br>Undergraduate nursing students require up-to-date education in nursing informatics provided by digitally competent university faculty, supported by access to digital health resources and informed by fit-for-purpose nursing informatics competency standards. |

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| | | informatics competencies (n=41), use of nursing informatics in clinical placements (n=40), and professional development of university faculty (n=39). | integrating informatics" (D61-1)/ | |
| **Recommended nursing informatics content in undergraduate nursing curricula** | | | | |
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? | Interventions, tools and applications used to embed nursing informatics into undergraduate nursing programs, included BCMA, EMR, standardised electronic assessment forms, telehealth applications, technology-enabled clinical simulation tools, health informatics lectures, digital learning platforms, health informatics laboratories, and handheld and wearable health technologies | Recommended nursing informatics content, identified in the Third Round Questionnaire, included digital literacy (n=50), EMM (n=50), data security and privacy (n=49), digital health (n=48), data management (n=47), digital devices (n=47), artificial intelligence (n=44), telehealth (n-44), adopting new and emergent technologies (n=43). | "Principally, nursing informatics is part of nursing. Therefore, providing foundational curriculum in undergraduate education to prepare nurses for this reality is critical". (D07-1)<br><br>"Not so much about specific technologies or systems but focus on principles which will they take them further in their careers". (D19-1)<br><br>"DH/NI is not an add-on it is integral to safe, effective and efficacious health care". (D26-1) | Nursing informatics content in undergraduate nursing education needs to reflect the contemporary healthcare workplace and should not be limited to EHR or BCMA. A broader understanding of data management, security and privacy must be embedded in education, with a focus on competency to use new and emergent technologies. |

#### *8.3.4.2 Nursing informatics education for Registered Nurses*

Exploration of nursing informatics education for Registered Nurses was addressed in the scoping review and the Delphi study, and based on the literature review which found that nurses are still not being adequately prepared to use digital health technology due to a lack of consensus on Informatics terminology, a lack of informatics-based competencies worldwide, limited undergraduate nursing education regarding nursing informatics, a lack of university faculty with nursing informatics' expertise, resulting in a workforce who is not adequately prepared to work within the digital health setting. This aspect of the study was addressed, in the Delphi study, as development of nursing informatics competency and further professional development.

##### *8.3.4.2.1 Development of nursing informatics competency*

Participants were asked in the First Round Questionnaire how they developed their nursing informatics competency with formal education, participation in relevant professional groups and self-learning identified as the key means of developing nursing informatics competency. Formal education in nursing informatics included credentialling by nursing informatics and nursing organisations, the International Computer Driving License (ICDL), CHIA (Certified Health Informatician Australasia), certificates and graduate certificates in information technology, nursing informatics, digital health and ehealth, Masters in nursing, health services management, information technology and health informatics, and PhD in nursing informatics and health administration. Participation in relevant professional groups included nursing informatics groups, multidisciplinary health informatics groups, digital health groups and government organisations. Self-learning included conducting research studies, attending workshops and conferences, on the job experience, online learning modules including MOOCs (massive open online courses), reading, vendor training, teaching nursing informatics and working with experts. As identified by Booth, Strudwick, McMurray, et al. (2021, p. 401), in *The Future of Nursing Informatics in a Digitally-Enabled World*, the nursing of the future will require "receptivity toward various virtual and digital care models that may look significantly different than approaches used in the past" and the acknowledgement that nursing practice will be increasingly conceptualised with the integration of digital health technologies.

##### *8.3.4.2.2 Further professional development*

When asked what further professional development would inform their nursing informatics competency, the participants identified artificial intelligence, chatbots, clinical devices, cybersecurity, data analytics, data governance, emerging digital technologies, machine learning and telehealth. This demonstrated the broad range and complexity of digital health technologies currently in use in nursing practice, as addressed in *8.3.3.1 Digital health technologies in the clinical setting*.

**Table 8-5 Nursing informatics education for Registered Nurses**

| **Development of nursing informatics competency** | | | | |
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| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? | The scoping review focused on undergraduate nursing education; however, the literature review identified that barriers in the use of digital technologies include insufficient nursing education, inadequate relevant competencies, and a lack of computer and digital literacy. | The participants identified that nursing informatics improved the safety and efficiency of health care, informing evidence-based practice and making nursing care more visible, with competency developed through both formal and informal education pathways. | "I worked for 10 years in a telecommunication company where I was able to develop skills in general computer applications as required in my employment". (D33-1)<br><br>Most of my training was done on the job. Technical training, data analytics, system design and build, project Management, organizational change management". (D43-1) | It is essential that nursing informatics be recognises as an integral part of contemporary nursing practice.<br><br>Development of nursing informatics competency is not a one-size-fits-all approach, with a wide range of career and learning pathways available. |
| **Further professional development** | | | | |
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for | The scoping review focused on undergraduate nursing education; however, the literature review identified adult learning principles, continual professional development, and | Formal education pathways included PhD (n=12), CHIA (n=6), Graduate Certificate (n=6), Masters (n=6), Bachelor (n=30, Graduate Diploma (n=2), Post graduate Certificate (n=2), Certificate | "I feel like my biggest informatics deficiency right now is related to artificial intelligence and machine learning and I am actively pursuing professional development in these areas | Registered Nurses need to have nursing informatics competency, in recognition that digital technologies extend beyond EHR or BCMA, and include artificial intelligence, chatbots, clinical devices, |

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| nurses regarding nursing informatics? | knowledge sharing practices within nursing. | (n=1), credentialling (n=1), ICDL (n=1) and other (n=1).<br><br>Informal pathways included reading (n=9), vendor training (n=5), conferences and workshops (n=5), short courses (n=4), participation in professional groups (n=4), online learning (n=4), working with experts (n=3), teaching nursing informatics (n=1), with some participants identifying on the job experience (n=5).<br><br>Participants identified future educational goals to learn about artificial intelligence (n=6), data analytics (n=4), cybersecurity (n=2), emerging digital technologies (n=2), machine learning (n=1), and data governance (n=1), but noted that support for professional development required sufficient time allocations. | to improve my knowledge". (D16-1)<br><br>"Updates on new technologies, better education when platforms change and you need to use them immediately. The best education seems to be the self directed information packages if you have been made aware that they are there". (D21-1)<br><br>"I would like to attend formal training for nursing specific informatics as it differs to health informatics. I would like to know that what I am doing in in line with industry trends and what more could / should I be doing" (D38-1) | cybersecurity, data analytics, data governance, emerging digital technologies, machine learning and telehealth. |

### 8.3.5 Computer and digital literacy

Informed by the research question - *Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?* and informed by the literature review which identified digital literacy as a key component of nursing informatics competency, the scoping review and the Delphi study sought to define and describe computer and digital literacy, address the development of computer and digital literacy, and address belief in the digital native.

As described in the literature review, computer and digital literacy is a crucial requirement for safe and effective nursing care in today's digital healthcare environment (ADHA, 2020; Callinici, 2017; van Houwelingen et al., 2017; Vitvitskaya et al., 2022). The scoping review identified the need for computer and digital literacy for both students and faculty (Baxter & Andrew, 2018; Chauvette, Kleib, & Paul, 2022; Clever Together, 2015; Cummings, Borycki, & Madsen, 2015; Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Gambo et al., 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Harerimana et al., 2022; Hovenga & Grain, 2016; Lam et al., 2016; Luo & Kalman, 2018; Mather & Cummings, 2015; McGregor et al., 2017; O'Connor et al., 2017; O'Connor & LaRue, 2021; Theron, Borycki, & Redmond, 2017; Theron et al., 2019; Topol, 2019; Vottero, 2017) with Harerimana et al. (2022, p. 535) noting that "nursing graduates are expected to be digitally literate" and defining digital literacy as combining computer and information literacies.

In the First Round Questionnaire, participants predominantly identified computer literacy as the ability to navigate and perform functions on a computer, with some participants extending this definition to include a continuum from novice to expert, as described by Benner (1982), with most participants identifying digital literacy as deeper level thinking than computer literacy and with the ability to find evaluate and communicate data. In the Second Round Questionnaire the concepts of computer and digital literacy were revisited with significant divergence of opinion noted regarding the definition of computer literacy and the relevance of the term computer literacy, in the contemporary digital environment questioned. These findings reflect contemporary literature with the rapidly evolving nature of digital technologies identified as being problematic in establishing a coherent definition of computer literacy (Jacob & Warschauer, 2018; Tsai, Liang, & Hsu, 2021). Less divergence of opinion was noted regarding the definition of digital literacy but with questions raised regarding the relevance of the dichotomy between computer and digital literacy was also identified. These findings are reflected in contemporary literature with the term computer literacy used primarily in the 1980s (Bawden, 2008; Park, Kim, & Park, 2021), and with digital literacy encompassing more than the use of a computer (Koltay, 2011; Park, Kim, & Park, 2021).

#### *8.3.5.1 Development of computer and digital literacy*

The scoping review identified the need to assess the computer and digital literacy of undergraduate nursing students and faculty, with recommendations including the use of pre-existing nursing informatics competency frameworks (Egbert et al., 2019; Forman, Armor, & Miller, 2020a; Gonen, Sharon, & Lev-Ari, 2016); nursing informatics assessment tools (Chauvette, Kleib, & Paul, 2022; Forman, Armor, & Miller, 2020a; Honey, Collins, & Britnell, 2021; Repsha et al., 2020), basic computer proficiency assessments (Gambo et al., 2017; Gonen, Sharon, & Lev-Ari, 2016; Kleib & Olson, 2015), student engagement with digital technologies surveys (Lam et al., 2016; Theron, Redmond, & Borycki, 2017), and other assessment tools (Hern et al., 2015; Kleib & Olson, 2015). Assessment of computer and digital literacies were recommended as a baseline, on completion of the education program and one year post-clinical entry (Chauvette, Kleib, & Paul, 2022), as pre-education or baseline surveys (Gambo et al., 2017; Gonen et al., 2016; Hern et al., 2015; Honey, Collins, & Britnell, 2021; Kleib & Olson, 2015; Repsha et al., 2020), and as a process of continual self-reflection and assessment (Brunner et al., 2018; Luo & Kalman, 2018). In the First Round Questionnaire, the participants identified embedding computer and digital literacy into assessments, evaluation at set times in the curriculum, the use of self-assessment tools, developing a plan for remediation where needed, and teaching a foundational topic to enhance computer and digital literacy. These findings are reflected in contemporary literature with recommendations to evaluate the computer and digital literacy of students and faculty, as a means of identifying gaps in knowledge and embedding digital literacy through nursing programs (Kleib et al., 2022; Reid, Button, & Brommeyer, 2023; Sipes et al., 2017).

The scoping review identified the importance of the development of basic computer skills, including the ability to perform database searches (Cummings, Borycki, & Madsen, 2015; Vottero, 2017), accessing online courses and resources (Chauvette, Kleib, & Paul, 2022; Gonen, Sharon, & Lev-Ari, 2016), the ability to perform web searches (Cummings, Borycki, & Madsen, 2015), use of social media (Chauvette, Kleib, & Paul, 2022; Gambo et al., 2017; Hay et al., 2017; Vottero, 2017), use of learning management systems (Chauvette, Kleib, & Paul, 2022; Gonen, Sharon, & Lev-Ari, 2016), using word processing, spreadsheets and presentation software (Chauvette, Kleib, & Paul, 2022; Foster & Sethares, 2017; Gonen, Sharon, & Lev-Ari, 2016), developing understanding of the concepts and components of information and computer technology, such as hardware, software and electronic networks (O'Connor & LaRue, 2021), with recommendations for the pursuit of basic computer literacy by students prior to commencement of undergraduate studies (Foster & Sethares, 2017).

Digital literacy development recommendations included participation in educational workshops (Chauvette, Kleib, & Paul, 2022; Gambo et al., 2017; Gonen et al., 2016; Gonen, Sharon, & Lev-Ari, 2016; Lam et al., 2016; Theron, Borycki, & Redmond, 2017; Theron et al., 2019), development of digital professionalism through class activities (Cummings, Whetton, & Mather, 2017), peer-learning (Clever Together, 2015; Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Lam et al., 2016; Theron, Borycki, & Redmond, 2017; Theron, Redmond, & Borycki, 2017; Theron et al., 2019; Vottero, 2017), faculty guidance of students in sourcing credible sources of information (Clever Together, 2015; Mather & Cummings, 2015; Theron, Borycki, & Redmond, 2017) and applying digital technologies to models of care (McGregor et al., 2017).

These findings are reflected in contemporary literature, with recommendations to develop the computer and digital literacy of undergraduate students identified in a number of studies (Brown, Pope, et al., 2020; Hallam, Thomas, & Beach, 2018), through embedding the development of digital literacy into education programs (Athreya & Mouza, 2017; Brown, Morgan, et al., 2020; Brown, Pope, et al., 2020), the use of peer-to-peer collaboration (Brown, Morgan, et al., 2020), modelling of digital literacy behaviours by faculty (Latorre-Cosculluela et al., 2024), the use of digital literacy mentors within the student population (Brown, Morgan, et al., 2020), the development of guidelines and frameworks for embedding digital literacy into education programs (Hallam, Thomas, & Beach, 2018), the development of core digital literacy competencies for nursing faculty, and the development of digital literacy competencies for entry to practice Registered Nurses (Reid, Button, & Brommeyer, 2023).

#### *8.3.5.2 Belief in the digital native*

First addressed in the literature review, the term *the digital native*, was identified in the scoping review and the Delphi study. The term Digital Native has been used to describe young people born after 1980 who have been surrounded by digital technologies their entire lives (Prensky, 2001a),. The scoping review identified the concept of the digital native as being a barrier to nursing informatics education in undergraduate nursing programs (Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Lam et al., 2016), with faulty assumptions linking exposure to social media and other digital technologies with competency in health informatics, has resulting in a lack of proficiency in using digital health technologies (Cummings, Whetton, & Mather, 2017; Foster & Sethares, 2017; Lam et al., 2016). The participants were asked about their understanding of the concept in the First Round Questionnaire, with reactions to the concept of the digital native demonstrating an understanding of the term; however, many of the participants identified the concept of the digital native as a myth and not reflecting reality. Subsequently, in the Second Round Questionnaire, participants were asked if growing up with technology was linked with computer and digital literacy; in response to this, a number of participants did identify an inherent link; however, a similar number of participants did not equate lifelong exposure to digital technologies with computer and digital literacy, with some participants cautioning that the presumption of exposure to digital technologies was flawed, as not all individuals would have access to the required digital technologies. Despite these reservations, most participants identified the need for nursing education to reflect the current cohort of students' exposure to digital technologies.

These findings are evident in the contemporary literature, with discussion of the digital native described "as an academic form of a moral panic" (Reid, Button, & Brommeyer, 2023, p. 579), that is not adequately supported by the literature (Hills, Levett-Jones, & Lapkin, 2017), and Evans and Robertson (2020, p. 274) noting that the term digital natives had been used in 15,800 articles in Google Scholar with findings that "are anything but consistent. The belief, that specific generations have differing engagement with digital technologies, has been an ongoing narrative in discussions on digital literacy and tertiary education (Prensky, 2001b, 2001a, 2006; Sorrentino, 2018; Vitvitskaya et al., 2022), including in nursing education (Chicca & Shellenbarger, 2018; Reid, Button, & Brommeyer, 2023). However, the myth of the digital native and the inherent belief in the internet as "a panacea for the issues of increasing costs of higher education and increasing demand by students for authentic and interactive learning opportunities", has overlooked the complex needs of students (Burton et al., 2015, p. 151). Furthermore, the perpetuation of these assumptions "negates the reality that exposure to digital technologies does not equate (with) digital literacy and has resulted in deficits in nursing education programs" (Reid, Button, & Brommeyer, 2023, p. 573).

**Table 8-6 Computer and digital literacy**

| **Development of computer and digital literacy** | | | | |
|---|---|---|---|---|
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? | Computer and digital literacy are crucial requirements for safe and effective nursing care, including the ability to perform database searches, access credible online resources, use basic digital tools, with recommendations that computer literacy should be evaluated prior to the commencement of undergraduate studies. | A range of definitions were provided for computer and digital literacy, with digital literacy identified as deeper level thinking requiring engagement with a range of digital technologies (n=32). Recommendations for the development of student computer and digital literacy, included embedding computer and digital literacy into all assessments (n=24), evaluation at set times throughout the curriculum (n=12), computer and digital literacy taught as a foundational subject (n=11), the development of a remediation plan as required (n=6), assessing beyond basic computer and digital literacy (n=5), expectation of computer and digital literacy prior to commencing undergraduate nursing | "Embed digital literacy competencies across subjects and use technology-rich assignments to foster skill development". (D23-1).<br><br>"This should be assessed throughout the whole nursing curriculum since these dynamic competencies take time to acquire and should be understood as a continuous development program for student to continue developing along their career". (D24-1)<br><br>"I think the computer and digital literacy assessment should be done in high school before entering university. It is not a skill that only applies to university students, in fact, it is a skill everyone should have". (D44-1) | Computer and digital literacy are mandatory requirements for the nursing profession, and need to be developed throughout the undergraduate nursing curriculum, with the development of digital literacy competencies for entry to practice Registered Nurses. |

| | | | | |
|---|---|---|---|---|
| | | programs (n=3), and self-assessment (n=1). | | |
| **Belief in the digital native** | | | | |
| **Research question** | **Scoping review** | **Delphi study** | **Narrative examples** | **Integrated findings** |
| Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics? | The concept of the digital native was identified as a barrier to nursing informatics education in undergraduate nursing programs, due to faulty assumptions about the student cohort and their proficiency with digital technologies. | In the First Round Questionnaire, a number of participants demonstrated an understanding of the term – digital native (n=); however, many participants identified the concept as a myth (n=).<br><br>In the Second Round Questionnaire, some participants linked the concept with computer and digital literacy (n=); however, a similar number did not equate lifelong exposure to digital technologies with computer and digital literacy (n=), with concerns expressed regarding the impacts of stereotyping student cohorts. | "Digital native assumes that a child born today understands technology and is computer literate. I find students often don't know how to use many computer/tech functions and systems when they come to university". (D18-1).<br><br>"A digital native is someone who has grown up with technology from when they were young. It's a little misleading to some extent though. Just because you are a digital native, does not necessarily mean you are digitally literate. You might just use technology but not understand the frameworks or legislation for example that underpin this". (D25-1)<br><br>"Potential stereotyping may occur if an assumption is made that because an | Undergraduate nursing students may be efficient in the use of handheld digital devices; however, exposure to technology does not equate with digital literacy or the ability to apply and understand nursing informatics principles. |

| | | | | |
|---|---|---|---|---|
| | | | individual is a ‘digital native’ they do not have to study/learn nursing informatics in nursing education. Or that nursing education do not need to consider nursing informatics in undergraduate nursing education since students in this generation are assumed to be ‘digital native’”. (D33-1) | |

## 8.4 Study limitations

### 8.4.1 Limitations of the scoping review

As previously identified, Item 25 of the PRISMA ScR (Tricco et al., 2018) identifies the limitations of the scoping review. (Arksey & O'Malley, 2005, p. 24) identified non-appraisal of the quality of evidence and synthesis, large data sets, and the requirement for “high degrees of analytic skill in order to develop frameworks through which large numbers of studies can be described” as limitations of the approach, with (Peters et al., 2021, p. 2123) stating that “any limitations in terms of the breadth and comprehensiveness of the search strategy should be detailed and justified”.

*Chapter 4: Research Methods - Phase 1 – Scoping Review* addressed the data collection, data extraction and data analysis in this study, with the acknowledgement that the screened sources of information were all published or translated into English, with acknowledgement that seminal sources published in languages other than English may have been omitted. A further limitation was, that as a single novice researcher, the researcher needed to learn to use new software including Endnote™ and Covidence™.

### 8.4.2 Limitations of the Delphi study

Limitations of the Delphi technique can include a lack of standard guidelines for the method, sample size, the use of experts, non-responders and identifying when questioning should end (Chalmers & Armour, 2019). Other weakness identified include difficulty generalising findings to larger populations and limited views of participants, with Fink-Hafner et al. (2019) recommending methodological triangulation and the use of an eDelphi approach and establishing rigour in Delphi studies, with recommendations to address this issue through the integration of data sets with other forms of evidence and “acceptance that Delphi results do not offer indisputable fact and that instead they offer a snapshot of expert opinion, for that group, at a particular time, which can be used to inform thinking, practice or theory” (Hasson & Keeney, 2011, p. 1701).

*Chapter 6: Research Methods - Phase 2 – Delphi Study* addressed the data collection, data extraction and data analysis in this study and limitations associated with the Delphi study phase included non-response of pilot study and Delphi participants; however, a low attrition rate in the Delphi study was noted of 16.4%. In addition, Delphi findings provide “a snapshot of expert opinion” at one moment in time; however, methodological triangulation, through the use of the scoping review and other contemporary sources of information, was used to enhance the trustworthiness of the study findings. Additional challenges with the Delphi study included non-response, which was addressed through the researcher maintaining individual contact (via email) with each participant and is reflected in the attrition of only 12 participants throughout this study.

### 8.4.3 Response bias

Due to the nature of recruitment for the Delphi phase of this study, only participants with an interest in nursing informatics may have responded; this is an inherent limitation in purposive sampling, where participants are recruited based on characteristics relevant to the phenomenon of interest (Andrade, 2021); which limits generalisability to the larger population from which the sample was obtained (Onwuegbuzie & Collins, 2017). It has been acknowledged that Delphi studies provide a snapshot of expert opinion in a moment in time; so too, the researcher acknowledges that this study provides findings based on a moment in time and as such the use of purposive sampling was appropriate for this study. It is also important to note that other educators, without an interest in nursing informatics may provide different responses and that this could be used in future research of nursing informatics education.

### 8.4.4 Other limitations

Other limitations associated with this study included technical difficulties with Qualtrics and learning statistical analysis. *Qualtrics* was used for the Delphi study data collection with personal links sent to each participant; however, some participants reported that the links either did not work or stated they had completed the questionnaire. Therefore, the researcher individually contacted each participant, identifying the problem and asking them to request another link if this occurred. In future, the researcher would examine alternative methods of disseminating Delphi questionnaires, as this process was time consuming, and no doubt added to the frustration of the participants.

## 8.5 Conclusion

This chapter has addressed the integrated findings from the study, placed them within the landscape of contemporary literature and acknowledged the limitations of the study. Discussion of *Nursing informatics and its role in contemporary practice* has defined nursing informatics and addressed its relevance to nursing practice; *Understanding of nursing informatics by key stakeholders* has addressed the understanding of nursing informatics in university, by undergraduate nursing students and nurses in the clinical setting; *Knowledge requirements for the use of nursing informatics* has identified digital health technologies currently in use in clinical settings and nursing informatics competency standards; *Nursing Informatics education* has addressed the barriers and enablers for the integration of nursing informatics content in undergraduate nursing curricula, recommendations for nursing informatics content to be included in undergraduate nursing education and the development of nursing informatics competency for Registered Nurses; and *Computer and digital literacy* has discussed definitions for computer and digital literacy, development of computer and digital literacy and belief in the digital native. *Chapter 9: Conclusions and recommendations*, summarises the current issues in workforce readiness of Registered Nurses and integration of nursing informatics content into undergraduate nursing curricula. Recommendations for integration of nursing informatics content into undergraduate nursing curricula, for professional nursing bodies and future research are addressed. The final section discusses the significant original contribution of this study.

# Chapter 9 Conclusions And Recommendations

## 9.1 Introduction

Chapter 8 provided the integrated findings from the scoping review and the Delphi study supported by contemporary literature. This final chapter summarises the current issues in workforce readiness of Registered Nurses and integration of nursing informatics content into undergraduate nursing curricula. Recommendations for integration of nursing informatics content into undergraduate nursing curricula, for professional nursing bodies and future research are addressed. The final section discusses the significant original contribution of this study.

## 9.2 Revisiting the study's aims

The aim of this study was to address whether a distinct body of knowledge on nursing informatics could be further developed to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula. Underpinning this aim were the research questions:

1. Can a distinct body of knowledge of nursing informatics be developed?
2. Can operational definitions for nursing informatics be achieved through consensus?
3. Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics?

Each of these research questions were linked with the integrated findings from the scoping review and the Delphi study in the previous chapter.

The research was underpinned by a pragmatic theoretical framework in which singular and multiple realities were explored to provide a real-world perspective of the current understanding of nursing informatics, with the understanding that pragmatism does not seek to find an absolute truth or reality (Powell, 2001) but focuses on the problem to be researched and practical outcomes, and offers the potential to effectively integrate research, practice and policy (Glasgow, 2013). In particular, this study applied Dewey's philosophy which is aligned with the philosophical underpinnings of mixed-methods research (Hall, 2013; Johnson et al., 2016), moving pragmatism beyond what works and "treating research as a human experience that is based on the beliefs and actions of actual researchers" (Morgan, 2014, p. 1051).

This study integrated findings from a scoping review of 3227 articles with 53 selected sources of evidence and a Delphi study with 61 participants, including nurse educators, nurse informaticians and experts in nursing informatics. Methodological triangulation was used to gain a deeper understanding of nursing informatics education, with the data collected, analysed and addressed using contemporary literature. Emerging from these integrated findings were key issues and recommendations for consideration; these will now be addressed.

## 9.3 Current issues in workforce readiness of Registered Nurses

Computers were first introduced to nursing care in the 1950s (Blažun Vošner et al., 2020; Ozbolt & Saba, 2008; Saba, 2001), with the first global conference on medical informatics held in 1974 and five papers presented on nursing informatics at this time (Marin & Marques, 2005; Saba, 2001). Hovenga (1997, n.p.) noted that nursing informatics in Australia first began around 1984 and had a "torturous history". This history is evident in contemporary literature, more than 35 years later, with nurses still not being adequately prepared to use digital health technologies (Kinnunen et al., 2023; Kleib et al., 2022; Morris et al., 2023), due to a lack of consensus on informatics terminologies, including standardised terminologies reflecting nursing practice (Fennelly et al., 2021; Hovenga, 2023; Monsen, Heermann, & Dunn-Lopez, 2023), a lack of consensus on nursing informatics competencies evidenced by the wide range of current competency standards (Batt, Tavares, & Williams, 2020; Kleib, Chauvette, et al., 2021; Lozada-Perezmitre, Ali, & Peltonen, 2022), and limited undergraduate nursing education regarding nursing informatics (Bove, 2020; Cummings et al., 2020; Freeman & Wilson, 2023). Concerns regarding the workplace readiness of Registered Nurses continue to be evident, with Kleib et al. (2022, p. 98) noting that new graduates are "exiting undergraduate programs with deficient knowledge in core informatics competencies needed in the workplace and have limited confidence in using DH tools such as electronic health records" and Kavanagh and Sharpnack (2021, p. 3) stating "As educators, we must address the brutal facts of failing to prepare graduates as residency-ready and confront the issue that the academic, or preparation-to practice gap, is increasing despite current efforts". These issues are evident in the scoping review and the Delphi findings from this study, with the selected sources of evidence and the expert opinion identifying deficits in the workforce preparedness of Registered Nurses and advocating for a cohesive approach to nursing informatics competencies supported by professional nursing bodies, with opportunities for ongoing professional development in digital health.

## 9.4 Current issues in integration of nursing informatics content into undergraduate nursing curricula

The lack of integration of nursing informatics in undergraduate nursing curricula has been identified in contemporary literature (Booth, Strudwick, McBride, et al., 2021; Kaihlanen et al., 2021; Mollart et al., 2021), with barriers including the associated costs of implementing and maintaining digital health technologies (Brewer et al., 2024; Ge et al., 2022; Raghunathan, McKenna, & Peddle, 2021), a lack of access to digital health technologies on placement (Chauvette, Kleib, & Paul, 2022; Harerimana et al., 2022; Honey, Collins, & Britnell, 2021), and a lack of access to current digital health technologies in university (Arikan et al., 2021; Mollart et al., 2021; Raghunathan, McKenna, & Peddle, 2023b). University faculty understanding of nursing informatics is another significant barrier to the integration of nursing informatics content into undergraduate education (Hamilton, Iradukunda, & Aselton, 2021; Nagle, Kleib, & Furlong, 2020; Procter, 2021), and is aligned with limited professional development for university faculty (Forman, Armor, & Miller, 2020a; Forman, Flores, & Miller, 2020). Varying levels of digital literacy in faculty have been identified in contemporary literature (Jobst et al., 2022; Nabolsi et al., 2021; Ryhtä et al., 2020), with Matthews (2021) identifying the potential link between the digital literacy of health educators and inclusion of digital curricular content and Wells-Beede et al. (2023, p. 1) noting that despite expectations that educators must be digitally competent and willing to adapt to a rapidly changing environment, “evidence regarding requisite competencies of nurse educators is limited”. Other barriers include a lack of incentive to include nursing informatics due to minimum standards for registration not addressing the requirement for Registered Nurses to have basic informatics skills (Cummings et al., 2020; Honey, Collins, & Britnell, 2020; Raghunathan, McKenna, & Peddle, 2023a; Woods et al., 2023) and the lack of integration of nursing informatics throughout curriculum (Hamilton, Iradukunda, & Aselton, 2021; Kleib et al., 2024; Nagle, Kleib, & Furlong, 2020), often attributed to an overfull curriculum (Chauvette, Kleib, & Paul, 2022; Forman, Flores, & Miller, 2020; O'Connor & LaRue, 2021). Kleib et al. (2024, p. 10) warn that “digital health education should not be a side topic in the nursing curriculum or be taught on a need-to-know basis, but rather it should be comprehensively embedded throughout all levels of nursing education and nursing career trajectories”. These issues are evident in the scoping review and the Delphi findings from this study, with the selected sources of evidence and the expert opinion identifying barriers to the integration of nursing informatics into undergraduate nursing curricula, including costs/ funding, lack of access to digital health technologies on placement and in university, a lack of nursing informatics competency and digital literacy in faculty, a lack of incentive to include nursing informatics, and a lack of integration of nursing informatics throughout curriculum.

## 9.5 Recommendations for integration of nursing informatics content into undergraduate nursing curricula

Emerging from the integrated findings of this study are recommendations for the integration of nursing informatics content into undergraduate nursing curricula which will now be addressed.

### 9.5.1 Definition of nursing informatics and associated fields

A clear understanding of nursing informatics is necessary for the effective integration of nursing informatics and associated fields into education; however, defining nursing informatics and associated terminologies has been historically problematic with multiple definitions evident in the literature. Despite these issues, it is encouraging to note a growing understanding of nursing informatics evident in contemporary literature and in this study. It is recommended that consensus be sought regarding key terminologies to inform nursing education and workforce readiness of nurses; this could be through the adoption of a global taxonomy, with additional comments made to align these definitions with the local context. Examples of definition resources include the *HIMSS TIGER Committee Informatics Definitions* (HIMSS, 2018), the *HiNZ Acronym Dictionary* (Health Informatics New Zealand (HiNZ), n.d.), *A Taxonomy for Health Information Systems* (Janssen, Donnelly, & Shaw, 2024), and the *ADHA Glossary* (Australian Digital Health Agency (ADHA), 2024a). However, a global resource would provide educators and nurses with an invaluable information to inform nursing informatics education and ongoing professional development.

### 9.5.2 Development of university faculty digital competency

Nurse educators working in tertiary institutions require both digital literacy and nursing informatics competencies as evidenced by the scoping review, the Delphi study and contemporary literature; however, there remains a lack of specific competency requirements for the employment of nursing faculty. It is therefore a recommendation of this study that competency standards be developed to inform the professional development of nurse educators regarding digital literacy and nursing informatics competency requirements. It is no longer acceptable for faculty to omit informatics content or to revert traditional practices, as this impacts the workforce readiness of new graduate nurses. Competency standards for nurse educators have been developed, including *A VISION FOR The Changing Faculty Role: Preparing Students for the Technological World of Health Care* (National League for Nursing (NLN), 2015), *Global Pillars for Nursing Education* (Global Education for Leadership in Nursing Education and Science (GANES), 2019) and *Australian Nursing Educator Professional Practice Standards* (Australian Nurse Teachers Society (ANTS), 2024); however, these standards need to be prioritised by the relevant professional nursing bodies and embedded as a requirement for employment. In addition, the professional development of faculty needs to be prioritised with a view to developing the existing skills of current faculty; this requires sufficient funding and time allocation by university hierarchy. Development of an open access repository for nursing informatics education would be a useful means of limiting siloed information and providing nurse educators with the opportunity to engage in self-directed professional development.

### 9.5.3 Access to digital health technologies

Access to digital health technologies, in university and on clinical placement, have been identified as a key barrier to the development of nursing informatics competency in undergraduate nursing students; therefore, it is essential that student have access to a range of digital health technologies. Whilst it is noted that the associated costs of these resources can be prohibitive, it is insufficient to solely rely on clinical settings to provide students with access to digital health technologies, including electronic health records, bar code medication administration and clinical decision support tools. Therefore, it is recommended that relationships be established between vendors, healthcare facilities and universities to provide fit-for-purpose digital health technologies, with a view to the sharing of resources and providing access to students within the safety of a simulation environment, with examples of this collaboration evident in the literature (Eardley, Matthews, & DeBlieck, 2021; Ellis et al., 2020; Raghunathan, McKenna, & Peddle, 2023b). The issue of student access to available digital health technologies is further complicated by concerns regarding privacy and confidentiality. It is recommended that digital professionalism, including adhering to the legal and ethical requirements of access to patient records, should be embedded in preparation for clinical placement to address these concerns.

### 9.5.4 Competency standards

A lack of fit for purpose nursing informatics competencies has been identified as a barrier to learning (Chauvette, Kleib, & Paul, 2022); underpinning these lack of competencies is a lack of recommendations, guidelines and evidence-based educational strategies for the integration of Informatics content into undergraduate programs (Forman, Flores, & Miller, 2020; Harerimana et al., 2022; O'Connor & LaRue, 2021). In the Delphi study, participants identified a broad range of informatics competencies, recommendations, or guidelines that inform their use of nursing informatics; in addition there are recent guidelines which have been developed to support the integration of nursing informatics into undergraduate nursing curriculum (American Association of Colleges of Nursing (AACN), 2021; Honey, Collins, & Britnell, 2018); however, despite these resources, there remains a lack of a cohesive approach to nursing informatics education, suggesting that relevant competency standards may not be informing undergraduate nursing education. Therefore, it is recommended that the development of undergraduate nursing curricula be explicitly linked with relevant competency standards, against which educators and universities can measure their own competence and delivery of appropriate information. In the Australian context, this requires the ANMAC (Australian Nursing and Midwifery Accreditation Council) to develop nursing informatics competency standards to inform the development of undergraduate nursing programs in Australia. In this way, the theoretical underpinnings of nursing informatics education can be more appropriately evaluated.

### 9.5.5 Digital literacy

As address in the integration of the study findings, the term computer literacy no longer adequately described the requirements for the use of digital health technologies, with the term digital literacy increasingly evident in contemporary literature. Concerns regarding the digital literacy of undergraduate nursing students and faculty identified in contemporary literature, the scoping review and the Delphi study must be addressed to ensure that effective use of digital health technologies and associated data is realised. The belief in the digital native remans pervasive; however, as identified, the ability to use digital devices in daily life cannot be correlated with nursing informatics competency. Therefore, a baseline assessment of digital literacy is recommended for undergraduate nursing students, as part of foundational studies at the commencement of the degree, with appropriate remediation provided as required. Ongoing evaluation of digital literacy should be embedded throughout assessments, with further opportunities to develop these skills, with examples of this process evident in the literature and recommendations to embed a digital literacy framework into undergraduate nursing education (Harerimana et al., 2022; Stunden et al., 2024). Examples of digital literacy frameworks include *Foundation Skills for Your Future Program - Digital Literacy Skills Framework APRIL 2020* (DESE, 2020), *All Aboard - Digital Skills in Higher Education* (NUI Galway et al., n.d.), and *Building digital capabilities framework: The six elements defined* (Jisc (formerly Joint Information Systems Committee), 2024).

## 9.6 Recommendations for nursing bodies and nursing leadership

A lack of incentive to include nursing informatics in undergraduate nursing curricula has been linked with a lack of leadership from professional nursing bodies (Booth, Strudwick, McBride, et al., 2021; Raghunathan, McKenna, & Peddle, 2023a), with O'Connor and LaRue (2021, p. 1) noting "a dearth of leadership to support the required changes, and the absence of specific informatics criteria in education standards set by professional regulatory bodies among others". Similarly, informatics understanding in nursing leadership have been identified as a determinant in the effective adoption and use of nursing informatics (Laukka et al., 2020; Laukka, Pölkki, & Kanste, 2022; Lo et al., 2021), with Morse and Warshawsky (2021, p. 67), in *Nurse leader competencies: Today and tomorrow,* stating that "at minimum, nurse leaders need to understand the technology to remove barriers and support the adoption of innovations that have the potential to improve practice and patient care while balancing quality and resources". Therefore, it is recommended that nursing informatics competency standards for nursing leadership, including those nurses working in professional nursing bodies, be implemented as a priority. As identified by Strudwick et al. (2019), in *Informatics Competencies for Nurse Leaders: A Scoping Review*, nurse leaders may be unaware of their limited knowledge and competency in nursing informatics but there are available resources which may help in identifying gaps in knowledge, including the *Nursing Informatics*

*Competency Assessment for the Nurse Leader* (Yen et al., 2017), and *Informatics competencies for nursing and healthcare leaders* (Westra & Delaney, 2008). It is therefore imperative that the requirements for nursing informatics competency be recognised as an essential requirement for nurse leaders with appropriate professional development provided to address gaps in understanding.

## 9.7 Recommendations for future research

In addressing the integrated findings of the scoping review and the Delphi study, several recommendations for future research were identified. Stakeholder group analysis was performed using gendered responses to the enablers, barriers and recommended content for nursing informatics into undergraduate nursing education. Enablers for the integration of nursing informatics into undergraduate nursing education indicated a disparity in responses with female participants viewing the use of nursing informatics in clinical placement and professional development of university faculty as higher priorities (than the male participants). Barriers for the integration of nursing informatics into undergraduate nursing education indicated that female participants viewed a lack of understanding of nursing informatics by university faculty as a more significant barrier to the integration of nursing informatics into nursing education (than the male participants). These findings could be addressed in future research, with a view to identifying whether these findings related to these participants only or is indicative of wider-spread disparities.

Stakeholder group analysis was performed using country of practice responses to the enablers, barriers and recommended content for nursing informatics into undergraduate nursing education. Enablers for the integration of nursing informatics into undergraduate nursing education indicated that Australian participants viewed simulation resources as a higher priority (than participants from all other countries). The differences in access to nursing informatics simulation resources could be addressed in future research, with a view to identifying whether Australian undergraduate nursing students receive the same access to nursing informatics simulation resources, as the students in other countries and whether this impacts learning outcomes. In contrast, participants from all other countries prioritised the use of nursing informatics competency standards to inform the curriculum as a higher priority (than Australian participants). This could be addressed in future research with a focus on whether nursing informatics competency standards are used to inform undergraduate nursing curricula in Australia and which particular competency standards are used. Nursing informatics content recommendations for undergraduate nursing education indicated that Australian participants viewed digital health, as being a higher priority than participants from all other countries. The disparity between these responses may indicate the current level of understanding of digital health in Australia, with Australian participants feeling this should be prioritised above all other recommended content. This finding could inform future research with an exploration of nursing and nursing student understanding of digital health, both in Australia and globally.

Stakeholder group analysis was performed using professional responses to the enablers, barriers and recommended content for nursing informatics into undergraduate nursing education. Comparison of the responses, according to professional role, of the barriers for the integration of nursing informatics into undergraduate nursing education indicated that experts in nursing informatics identified a lack of faculty professional development as a more significant barrier to the integration of nursing informatics into nursing education (than nurse educators and nurse informaticians). However, as identified previously, nurses perceive ongoing education as not a priority for employers, with a lack of easily accessible and equitable education resources and this may have influenced the nurse educators' attitudes to professional development; therefore, this aspect of the findings could be further explored in future research, particularly with a view of better preparing faculty to teach nursing informatics.

## 9.8 Significant original contribution of knowledge

This study has included a significant contribution to knowledge through integrating contemporary literature and the voices of nursing experts to provide findings that can support the integration of nursing informatics content into undergraduate nursing education. These findings have provided a snapshot of the nursing profession's progress in adopting nursing informatics into contemporary practice. As identified, nurses, despite being the largest workforce within health care, are still not being adequately prepared to use nursing informatics. The benefits of nursing informatics to patient care through rapid access to crucial patient data, systematic patient assessment. less clinical errors, evidence-based practice, cost-effectiveness and improved patient outcomes and safety are also not being effectively realised. In response, this research identified the current gaps in the understanding of nursing informatics and its relevance for contemporary practice, it provided a discussion of enablers, barriers and recommended content for nursing informatics education and addressed the gaps in the digital literacy of all key stakeholders, and it provided recommendations for how these gaps could be addressed to develop workforce readiness and digital competency in both undergraduate nursing students and Registered Nurses.

## 9.9 Final thoughts

When this study began, more than six years ago, the aim was to address whether a distinct body of knowledge on nursing informatics could be further developed to structure education for university faculty and nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula, with a focus on developing a distinct body of knowledge of nursing informatics, identifying operational definitions through consensus and providing a knowledge map to address current deficits in undergraduate nurse education and continual professional development education for nurses regarding nursing informatics. However, the journey from conception to realisation, has resulted in more than addressing these research questions. Throughout this time, I have been fortunate to experience the collegiality of others with a passion and vision for nursing education and informatics, I have developed my research skills, including my understanding of mixed-methods research, scoping reviews and Delphi studies, and most importantly, I have stood on the foundations built by those pioneering nurses more than fifty years ago, who realised the potential of integrating nursing with information and computer technologies. It is my hope that my research will provide additional foundations on which to build nursing as a profession, with the understanding that as the largest healthcare workforce we must embrace digital healthcare and be active participants in creating our futures.

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# Appendix A1: Scoping Review Protocol

## Nursing Informatics and undergraduate nursing curricula: a scoping review protocol


### Abstract

#### Introduction

Nursing is the largest workforce in health care and nurses are increasingly required to work with digital information systems. The need for nurses to understand and embrace information technology is closely linked with the ability to function in the contemporary healthcare workplace. However, despite the early adoption of Nursing Informatics in Australia in the 1980s, there remain barriers to Nursing Informatics engagement and proficiency, including poor computer literacy, limited professional development and a lack of undergraduate informatics education. Therefore, this scoping review aims to review contemporary published literature on Nursing Informatics education in undergraduate nursing education.

#### Methods and analysis

This scoping review will be developed in adherence with the JBI Manual for Evidence Synthesis: Scoping Reviews and the PRISMA-ScR Checklist. To be included in this scoping review, papers need to include nursing informatics' education for undergraduate nursing students in a Bachelor of Nursing program. Undergraduate nursing students are defined by the Australian Nursing and Midwifery Federation (ANMF, 2020), as individuals enrolled within a recognised nursing program leading to registration as a Nurse. To meet the requirements for registration as a Registered Nurse, in Australia, individuals are required to complete a Bachelor of Nursing program at a university as defined by the Australian Qualifications Framework Council (2013). For the purpose of this scoping review, undergraduate nursing students are defined as those individuals undertaking a three-year Bachelor of Nursing program at a university. Equivalent international definitions will be also used in the scoping review procedure. Sources of information will be included if they were published between 2015-2022 and describe curriculum recommendations (including barriers to implementing nursing informatics education). The purpose of the identified timespan is to reflect the rapidly evolving nature of health informatics and digital technologies. The requirement for curriculum recommendations is to reflect the purpose of the scoping review as the basis for a Delphi study, in which Nursing Informatics and its integration into Bachelor of Nursing curricula will be explored and described in collaboration with domain experts.

Ethics and dissemination Ethics approval has been obtained for this scoping review (Project ID: 2156) from the Flinders University's Human Research Ethics Committee and has been determined to be low risk.



***Keywords:*** Nursing, Informatics, Undergraduate, Education, Curriculum


### Introduction

As the largest workforce within healthcare (Australian Institute of Health and Welfare (Australian Institute of Health and Welfare (AIHW), 2016), nurses play a pivotal role in digital health through the use of digital health information systems (Australian Nursing and Midwifery Federation (ANMF), 2018). The need for nurses to embrace information technology, particularly within the clinical setting, has been strongly linked with an ability to effectively function within the contemporary healthcare environment (Chang et al., 2011). In 2014, the Australian Nursing and Midwifery Accreditation Council (ANMAC, 2014, p. 4) stated that “the guiding principle for all learning and teaching strategies related to informatics and technology in health is that being technically competent is a fundamental element of caring.” These technologies include electronic health records, telehealth and mobile smart applications.

### Electronic Health Records (EHRs)

The adoption of electronic health records (EHR) has aimed to reduce costs, enable new models of healthcare delivery and increase the efficiency and quality of health care (Australian Digital Health Agency (ADHA), 2017). In Australia in 2012, the Personally Controlled Electronic Health Record (PCEHR) was launched with the purpose of allowing patients to become more involved in their digital health record (Hambleton & Aloizos, 2019). Subsequently, in 2016, the PCEHR was renamed My Health Record (Hambleton & Aloizos, 2019). Internationally, different digital health records have been implemented (ADHA, 2019). The introduction of EHRs have changed the ways in which Nurses practice. Nurses now use EHRs for documentation, medication management, clinical decision-making, and care coordination (Kutney-Lee et al., 2019).

### Telenursing

Applications for telenursing have included home monitoring, video consultations, sharing of clinical information between the multidisciplinary team and the provision of support to the primary care provider (Hegney et al., 2007). More recently, telenursing applications have included the use of drones to deliver emergency supplies such as first aid and automated external defibrillators, the use of camera glasses which allow the patient to communicate the information they are seeing to emergency care Nurses and portable mobile healthcare devices which allow patients to have ongoing nursing assessment and monitoring (Balenton & Chiappelli, 2017).

### Smart Mobile Applications

Mobile applications (apps) are now a mainstay of digital technologies, and consumer and clinical health applications are easily accessible on multiple platforms. These mobile technologies are being used to support clinical practice, clinical education and patient safety (Bauman, 2016); but Nurses must be able to critically evaluate the quality of these applications, therefore “computer literacy is a survival skill for the profession” (Callinici, 2017, p. 1). The development of knowledge and skills in the use of information systems, communication technologies and the use of mobile applications, is strongly aligned with safe clinical practice (American Association of Colleges of Nursing (AACN), 2008). Therefore, the development of new knowledge and skills to assist Nurses in better supporting patients to evaluate and use mobile applications is essential (Ferguson & Jackson, 2017).

### Barriers to the use of information technology

Barriers to the use of digital technologies continue to be an issue within the clinical setting, including poor computer literacy (Moule, Ward, & Lockyer, 2010), limited workplace education and support (Kleib & Nagle, 2018), a lack of health informatics education within the undergraduate nursing sector (Borycki et al., 2013; Cummings et al., 2016), and confusion and uncertainty about what constitutes nursing informatics (Larson, 2017). Kleib and Nagle (2018, p.413), in exploring the factors associated with Canadian Nurses' informatics competency, concluded that “comprehensive integration of informatics in undergraduate nursing education, especially exposure to informatics applications used in clinical practice, is the key to ensuring Nurses’ readiness for informatics prior to joining the workplace”. Borycki and Foster (2014) noted that the deficits in undergraduate nursing informatics’ education are further complicated by a lack of nursing informatics competencies for graduate nurses, a coherent strategy for the integration of informatics competencies into the undergraduate curricula and investment in informatics technologies which simulate systems used in clinical settings. These findings continue to be relevant, with a recent study, *Are Future Nurses Ready for Digital Health: Informatics Competency Baseline Assessment* (Kleib et al., 2022), identifying key barriers to digital readiness and competence with information technologies including: limited use of EHRs prior to clinical placement, varied access and permissions to use EHRs whilst on clinical placement, limited exposure to more specialised nursing informatics applications, such as telehealth, and a lack of understanding regarding the need for technology usage by senior undergraduate nursing students. Uncertainty about nursing informatics as a discipline and the significance of nursing informatics on patient outcomes continue to be ongoing concerns identified in the literature (Cummings, Whetton, & Mather, 2017; Peltonen et al., 2019).

## Rationale for the scoping review

Historically, there has been a lack of consensus on health informatics and digital health terminologies (Boogerd et al., 2015; Fatehi, Samadbeik, & Kazemi, 2020; Friedman, 2012; Rowlands, Digital Health Workforce Academy (DHWA), & Health Informatics Society of Australia (HISA), 2019), a lack of consistent nursing informatics competencies worldwide (Cummings et al., 2016; Honey et al., 2016), disparate undergraduate nursing education regarding Nursing Informatics (Honey et al., 2016), a lack of university faculty with Nursing Informatics' competence and expertise (Kinnunen et al., 2017), and a healthcare workforce not adequately prepared to work within the digital health sphere (Rowlands & Health Informatics Society of Australia (HISA), 2019). Therefore, this scoping review will address whether a distinct body of knowledge on Nursing Informatics can be further developed to be used to structure education for university faculty and Nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula.

The scoping review questions are:

- Can a distinct body of knowledge of nursing informatics be developed?
- Can operational definitions for nursing informatics be achieved through consensus?
- Can a knowledge map be used to address current deficits in undergraduate nurse education and continual professional development education for nurses in regard to nursing informatics?

The overarching question is: Can a distinct body of knowledge on nursing informatics be further developed to be used to structure education for university faculty and nurses in the clinical setting, to inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula?

## Methods

This scoping review protocol has been developed in adherence with Chapter 11 of the JBI Manual for Evidence Synthesis: Scoping Reviews (Peters et al., 2020) and the PRISMA-ScR Checklist (Tricco et al., 2018) for the purpose of undertaking a scoping review of Nursing Informatics and undergraduate nursing curricula. A description of the planned search of protocols and registrations, inclusion criteria, search strategy, source of evidence selection, data extraction, analysis of the evidence and presentation of the results are detailed below.

### Protocols and registrations

In adherence with Chapter 11 of the JBI Manual for Evidence Synthesis: Scoping Reviews (Peters et al., 2020) and the PRISMA-ScR Checklist (Tricco et al., 2018), a search of existing review protocols should be performed. A search of both Cochrane and the JBI databases was performed in December 2020 and no existing review protocols were identified.

Registration of an a priori scoping review protocol is recommended, particularly if publication of the completed scoping review is intended (Pollock et al., 2021). This scoping review protocol was uploaded to OSF (Open Science Frameworks) on 10 August 2022 (https://osf.io/7qe39/) but at the time of publication remains private.

### Inclusion criteria

A scoping review protocol needs to clearly identify the eligibility or inclusion criteria and the types of sources of information to be included (Peters et al., 2020; Tricco et al., 2018). Peters et al. (2020) recommend the use of the PCC mnemonic (population, concept and context) to identify the focus and context of the review. The population of this scoping review is undergraduate nursing students, the concept is nursing informatics and the context is education. To be included in this scoping review, papers need to include nursing informatics' education for undergraduate nursing students at any time during a Bachelor of Nursing program (or equivalent). Undergraduate nursing students are defined by the Australian Nursing and Midwifery Federation (ANMF, 2020) as individuals enrolled within a recognised nursing program leading to registration as a Nurse. To meet the requirements for registration as a Registered Nurse, in Australia, individuals are required to complete a Bachelor of Nursing program at a university (Australian Qualifications Framework Level 7) as defined by the Australian Qualifications Framework Council (2013). For the purpose of this scoping review, undergraduate nursing students are defined as those individuals undertaking a three-year Bachelor of Nursing program at a university. Equivalent international definitions will be also used in the scoping review procedure.

Sources of information will be included if they were published between 2015-2022 and described curriculum recommendations (including barriers to implementing nursing informatics education). The purpose of the identified timespan is to reflect the rapidly evolving nature of health informatics and digital technologies. The requirement for curriculum recommendations is to reflect the purpose of the scoping review as the basis for a Delphi study, in which Nursing Informatics and its integration into undergraduate nursing curricula will be explored and described in collaboration with domain experts.

**Information sources**

The description of the databases used to search for sources of information and the date of the most recent search should be identified (Peters et al., 2020; Tricco et al., 2018). "For the purposes of a scoping review, the "source" of information can include any existing literature, e.g. primary research studies, systematic reviews, meta-analyses, letters, guidelines, websites, blogs, etc." (Peters et al., 2020, p. 417). To identify potentially relevant sources, the following databases will be searched - CINAHL, Ovid, ProQuest, PubMed and Scopus, and will include scholarly journals, books, reports, conference papers and proceedings. A search of the grey literature and a search of bibliography sources will be performed following the review of databases.

**Search strategy**

"The search strategy for a scoping review should ideally aim to be as comprehensive as possible within the constraints of time and resources in order to identify both published and unpublished (grey or difficult to locate literature) primary sources of evidence, as well as reviews" (Peters et al., 2020, p. 418). A three-step strategy should be utilised (Peters et al., 2020) – the first step requires an initial limited search of two databases and analysis of text words in the title and abstract. The second step requires that all identified keywords be used across all included databases. The final step requires that the reference lists of selected full-text sources should be examined and included in the review (if relevant to the phenomenon of interest). In addition, the search strategy for at least one database should be described, so that it could be repeated if required (Peters et al., 2021). These requirements as described by Peters et al. (Peters et al., 2020; Peters et al., 2021) will be adhered to and described in the scoping review.

**Selection of sources of evidence**

Following searches of the database using the a priori protocol and the removal of duplicate sources, the results will be screened using Covidence. Covidence is "a web-based collaboration software platform that streamlines the production of systematic and other literature reviews" and aids in the uploading of search results, the screening of abstracts and full text, completing data collection, review by two or more reviewers and exporting of data (Veritas Health Innovation, 2022).

**First Pass – Title and Abstract Screening**

The screening process will determine whether each article meets the inclusion criteria and will be included in the scoping review. This process will involve two specific stages: First Pass or Title and Abstract Screening and Second Pass or Full-Text Screening. The numbers of sources screened and assessed for inclusion and exclusion criteria and the reasons sources have been excluded at each stage, should ideally presented in a flow diagram (Peters et al., 2021; Tricco et al., 2018). The procedure of selecting sources of evidence and resolving disagreements between reviewers must also be included in the scoping review (Peters et al., 2020; Tricco et al., 2018). This requires a narrative description of the source of evidence selection process, including how disagreements between reviewers were resolved (Duffett et al., 2013; Tricco et al., 2018). During Title and Abstract Screening, the PhD candidate will screen sources using the Covidence program in consultation with the PhD supervisors in weekly meetings and each source will be reviewed and discussed. To enhance trustworthiness of the screening process, an Excel spreadsheet will be developed, and each excluded source will be categorised.

**Inclusion of additional sources**

The scoping review search can "be quite iterative as reviewers become more familiar with the evidence base, additional keywords and sources, and potentially useful search terms may be discovered and incorporated into the search strategy" (Peters et al., 2020, p. 418). Therefore, other sources, from both grey literature and scanning reference lists of included sources, should be considered to ensure a comprehensive literature search is performed (Tricco et al., 2018).

Following the First Pass – Title and Abstract Screening, every reference list from the included sources of information will be reviewed for inclusion of additional relevant sources of information. The identified additional sources will then be added to Covidence for screening and possible inclusion.

Tricco et al. (2018) advises that a detailed account of the search for grey literature should be documented. Grey Matters: a practical tool for searching health-related grey literature (Canadian Agency for Drugs and Technologies in Health (CADTH), 2019) is identified in the PRISMA-SCR as providing an approach to search for grey literature. A search of grey literature will be conducted using this tool. Identified additional sources will then be added to Covidence for screening and possible inclusion.

**Second pass– Full-Text Screening**

This stage involves examining the full text of each source to determine if it meets the inclusion criteria and providing coherent reasons for exclusion of sources. During the second screening process, two reviewers will read the full text of articles for potentially relevant sources. Disagreements on study selection will be discussed in weekly PhD meetings with the PhD supervisors to arrive at a consensus.

**Data extraction**

Data extraction for a scoping review "should include extraction of all data relevant to inform the scoping review objective/s and question/s" (Peters et al., 2020, p. 435). The first requirement is to develop a standardised data extraction template and then pilot testing the use of this template with two or more reviewers extracting data from two to three papers (Pollock et al., 2021). The development of the template occurs during the scoping review protocol stage and is tested to ensure consistency and trustworthiness of the data extraction process; however, the template may be refined as the scoping review progresses. (Peters et al., 2021; Pollock et al., 2021). The process of data extraction requires two reviewers to limit the risk of errors and researcher bias and "can be an iterative process, often requiring multiple refinements to be able to best meet the objectives and research question(s) of the scoping review" (Peters et al., 2021, p. 8).

Prior to importing the sources to the Covidence platform, an excel spreadsheet will be developed in consultation with the PhD supervisors. The data extraction spreadsheet will record key information including authors, the reference, year of publication, country of origin, the aim and purpose of the study, the population and undergraduate curricula recommendations. This process will be used, in conjunction with the development of the search strategy, to ensure that the population (undergraduate nurses) concept (nursing informatics) and context (education) are reflected in the retrieved articles.

Once the sources of information have been imported to the Covidence platform, the data extraction template will be developed online (in consultation with the PhD supervisors). The data extraction template will replicate the data extraction spreadsheet by recording key information including authors, the reference, year of publication, country of origin, the aim and purpose of the study, the population and undergraduate curricula recommendations. Other information which will be added to the template include the sampling procedure, study design, possible conflicts of interest for authors and inclusion and exclusion criteria. It is recognised that this is an iterative process, and additional categories may be identified at this time.

**Analysis of the evidence**

Methods of data analysis in a scoping review may include descriptive qualitative content analysis, frequency counts of the population, concepts and context or basic coding (Peters et al., 2020; Peters et al., 2021; Pollock et al., 2021) with results presented "in a logical, diagrammatic or tabular form, or in a descriptive format that aligns to the objectives and scope of the review" (Khalil et al., 2016, p. 121). Peters et al. (2020, p. 421) caution that "qualitative content analysis in scoping reviews is generally descriptive in nature and reviewers should not undertake thematic analysis/synthesis…as this would be beyond the scope of a scoping review". The way in which data is analysed and presented, predominantly depends on the purpose of the scoping review and the authors' judgment and it is therefore essential that the authors use a transparent and explicit approach which justifies the methodological decisions made (Peters et al., 2020).

The data analysis process aims to provide the reader with a logical, descriptive summary of the data which will be aligned with the previously established objectives and questions of the scoping review. Qualitative content analysis seeks to elicit meaning from the data by using the stages of decontextualisation, recontextualisation, categorisation and compilations to code and categorise data (Bengtsson, 2016). Content analysis can be used to quantify data by objectively identifying specific data within the text. Content analysis can be undertaken manually or by research software; at this time, it is anticipated that manual coding will be used for this study with a qualitative content analysis framework.

**Presentation of results**

Collation and presentation of the results aims to identify the implications for policy, practice and research, with the conclusion reflecting the objective of the scoping review (Khalil et al., 2016). The method of data presentation should be described in the scoping review protocol Peters et al. (2021) suggest the use of two sections; the first section provides a description of the search strategy results (with the inclusion of the PRISMA flow diagram); and the second section details the key information relevant to the scoping review questions.

Results will be presented with a description of the search strategy including the PRISMA flow diagram. Findings will be synthesised in narrative and tabular formats with recommendations for policy, practice and research reflecting the objective of the scoping review. Each source's summary will include key information including the authors, the reference, the year of publication, the country of origin, the aim and purpose of the study, the population and any undergraduate curricula recommendations. The findings will be classified as conceptual groups, for example: basic computer literacy, implementation strategies, barriers to implementation and benefits of implementation. A narrative summary will be provided which reflects the three scoping review questions and the overarching question.

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## Conflict of interest

The authors declare no conflict of interest.

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# Appendix A2: PRISMA – ScR Checklist

## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a scoping review. | 2 |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | 2 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | 3 |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | 3 |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | 4 |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | 5 |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | 6 |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | 6 |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | 7 |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | 8 |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | 8 |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | n/a |

| | | | |
|---|---|---|---|
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | 9 |

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **RESULTS** | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | 9 |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | 10 |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | n/a |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | 10 |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | 10 |
| **DISCUSSION** | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | 11 |
| Limitations | 20 | Discuss the limitations of the scoping review process. | 11 |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | 11 |
| **FUNDING** | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | 12 |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: *Annals of Internal Medicine*, Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. *Ann Intern Med. 2018*;*169*:467–473. doi: 10.7326/M18-0850

# Appendix A3: Data Extraction (Modified) Spreadsheet

Please note: for the purpose of clarity this spreadsheet has been modified. The full spreadsheet is available on request.

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Angel, Friedman & Friedman<br>(2016)<br>USA | "the integration of bar-code medication administration technology competencies in the nursing curriculum through interprofessional collaboration among nursing, pharmacy, and computer science disciplines" (p.239) | Not described | •Described program of BCMA use through 3 semesters using simulation | •EMR & MARs cost prohibitive<br>•Technical difficulties (computer crashes, power outages, bar codes not readable) caused delayed medication administration & possibility of errors<br>•Staff training<br>•Over-reliance on BCMA system to identify errors instead of thinking critically | •Less risk & reduction of errors<br>•Cost-effectiveness<br>•Improved patient identification<br>•Improved organisation of data & medication administration, •Changes or stat orders updated in real time<br>•eMAR easier to read than handwriting.<br>•Fewer steps lead to reduced medication errors & ability for multiple health care providers to view the eMAR at the same time | Not described |
| Asiri & Househ<br>(2017)<br>Saudi Arabia | "to introduce the reader to the rise of mobile technology used in nursing education and practice. Subsequently, we conclude with a brief review of future trends in the use of mobile technologies in nursing education and practice" (p.422) | Not described | •Standardised definition of mobile technology & its use in education<br>•Incorporating mHealth into patients' daily preventive care strategies<br>•Nurses need to understand the potential & limitations of health technologies | •Lack of IT support & infrastructure<br>•Lack of qualified staff<br>•Cost<br>•Lack of acceptance & role modelling by faculty<br>•Lack of structured activities or assignments encouraging use of mobile devices<br>•Constraints on use of mobile technology in clinical settings<br>•Absence of clear definition of mobile technology & its boundaries & where they lie in clinical nursing education<br>•Constantly evolving new mobile technologies | •Instant access to evidence-based materials that improve students' knowledge as well as their skills<br>•Enhanced nursing practice at point of care<br>•Supporting individual-centered care in the form of self-monitoring of peoples' health-related behaviors and receiving a feedback of such behaviors via mHealth technologies | Not described |
| Baxter & Andrew<br>(2018)<br>USA | "reports the challenges involved in the successful addition of an academic EHR into an existing curriculum" (p.250) | Not described | •Staggered implementation of academic EHR<br>•End of semester surveys<br>•Modification of academic EHR following discussions with vendor | •Internet connectivity<br>•Some faculty did not feel learning electronic documentation was a priority<br>•Students did not buy into need to learn electronic documentation; many were so inundated with a learning nursing that they became overwhelmed with learning a documentation system they would not use after graduation<br>•Barriers to EHR use in clinical setting | •Students need exposure to electronic documentation & data management for successful employment after graduation | •Faculty super-users |

| Author Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Bonnel, Vogel Smith & Hober (2018) USA | "gain teaching and learning strategies to help students think critically and work responsibly with data and information systems" (p.181) | •HIMSS (n.d.) the electronic health record<br>•NLN (2008) Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda<br>•AACN (2008) The Essentials of Baccalaureate Education for Professional Nursing Practice<br>•QSEN (2013) Competencies<br>•TIGER (2016) Initiative | •Faculty engagement<br>•Integrating user-friendly EHRs into non-clinical topics<br>•Clinical EHRs on placement & EHRs in lab sessions<br>•Described assignments linked with NI | •Variation of EHRs across schools of nursing<br>•Curricular integration<br>•Faculty acceptance/ approval<br>•Evolving nature of EHRs<br>•Development, cost & maintenance of academic EHRs<br>•Clinical practice access<br>•Student computer competencies<br>•Access to EHRs<br>•Patient confidentiality & information security | •Documentation for safe practice & quality improvement<br>•Team communication<br>•Decision support for clinical decision-making<br>•Monitoring patient data and trends<br>•Enhance clinical outcomes<br>•Students learn to think critically<br>•Students assess, record & review patient data<br>•Students gain understanding of how separate pieces of data from assessments combine for problem clarification and decision making<br>•Healthcare providers identify problems efficiently for individual patients (as well as larger populations) | •Professional development<br>•Faculty super-users<br>•Faculty discussion on what type of assignments count, opportunities to engage students with EHR data, use of technologies in healthcare systems and populations, leadership and policy issues<br>•Introduction to big data & specific national competencies that are addressed in curriculum |
| Booth, Sinclair, Brennan et al. (2017) Canada | "describes the development of a simulated electronic medication administration system, including the use of sociotechnical systems theory to inform elements of the design, implementation, and testing of the system" (p.131) | Not described | •SMART eMAR developed<br>•Decision support commonly found in eMAR technology added to the system, including color-coded (ie, green or red) prompts for correct or incorrect barcode scans | •Little development or research toward EBP to implement eMAR technology into curricula<br>•eMAR & related systems have potential to facilitate unintended consequences throughout the medication administration process, including the generation of new types of medication errors, human-technical interface difficulties & redefining of workflow & administration processes<br>•Note: Project yet to be tested empirically | •Development & implementation of educational eMAR system provided an opportunity for faculty & students to work together n to address an immediate learning requirement of modern nursing practice | •Training materials for clinical staff<br>•Academic literature |
| Booth, Sinclair, Strudwick et al. (2017) Canada | "the importance of teaching medication administration practices using BCMA and eMAR within nursing education; and...to outline a range of suggestions toward developing, implementing, testing, and designing curricula for simulation incorporating BCMA and eMAR" (p.246) | Not described | •Real & simulated BCMA/ eMar system<br>•Homegrown or Open Source BCMA/eMAR Platform<br>•Purposeful & carefully attenuated use for new learners to avoid cognitive overload<br>•Embedding clinical reasoning into use of technology<br>•Consider cost and sustainability of the system | •Lack of knowledge regarding implementing BCMA & eMAR into curricula<br>•BCMA/eMAR administration can give rise to new types of medication errors that are highly unlikely within a paper-based administration process<br>•Students confident using technology to support medication administration but were fearful of committing a serious errors<br>•Prohibitive costs of BCMA/ eMAR<br>•Technical difficulties<br>•Lack of knowledge by faculty<br>•Lack of knowledge on medication rights | •Clinical BCMA/ eMar platform provides opportunity to learn with a real life platform<br>•Simulated BCMA/ eMar platform provides scaffolded learning | •Safe practices seminar<br>•Professional development |

| **Author**<br>**Year** | **Aim/ purpose of study** | **Competency frameworks** | **Enablers** | **Barriers** | **Benefits** | **Faculty development** |
|---|---|---|---|---|---|---|
| Brunner et al.<br>(2018)<br>Australia | "to develop a framework that could be used to guide health curriculum design based on current evidence, and stakeholder perceptions of eHealth capabilities expected of tertiary health graduates" (p.1) | •Capability NOT competency<br>•Capability framework developed by authors | Not empirically tested | •More research needed<br>•Further research exploring the implications for the existing health care workforce is also warranted, with focus on identifying the relevance & impact of capability statements on policy & practice, including recruitment, professional development, performance management & systems improvement activities | •Framework has direct implications for curriculum redevelopment in health education & professional development opportunities for the current health workforce | Not described |
| Burke & Ellis<br>(2016)<br>USA | "The purpose of this study was to describe the technological stressors that nurse educators experienced when using electronic health records while teaching clinical courses" (p.46) | •NLN (2008) Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda<br>•AACN (2008) The Essentials of Baccalaureate Education for Professional Nursing Practice | •Nurse educators experienced moderate stress when teaching the use of EHRs | •Technological stress.<br>•Lack of student access to EHR training materials.<br>•Need for educators to learn new EHRs<br>•Student knowledge of EHRs<br>•Availability of EHR support<br>•Access to EHR during clinical placement<br>•Cost prohibitive commercial EHRs<br>•Different EHR systems makes preparing students difficult | •Improved patient outcomes & quality of care | •Partnerships with clinical facilities to support access to EHRs<br>•Professional development |
| Chauvette, Kleib & Paul.<br>(2022)<br>Canada | “to explore nursing faculty experiences in integrating digital tools to support undergraduate students’ learning and development of nursing informatics competencies” (p.1) | •CASN (2012)Nursing informatics entry-to-practice competencies for Registered Nurses<br>•CASN (2013) Nursing informatics teaching toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula<br>•NLN (2008) Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda | •Development of NI competency including working with digital tools, digging a little deeper & weeding through it, using Allies, & creating awareness | •Learning in a digital-paper environment & limited & timely access were barriers that encountered in the clinical environment<br>•Students do not have access to digital tools due to the limited number of computers, lack of log-in credentials to access computers, or even access to WiFi in clinical settings<br>•Some clinical environments continue to ban use of mobile devices which limits experiential learning opportunities<br>•Evolving complexity of NI tools | •Faculty reported using a health science librarian to assist students in developing NIC<br>•Librarians are an important resource in the development of students' information literacy skills - support students in searching & critically appraising the literature, ensuring that the information is reliable & high quality as well as relevant to nursing practice | •Minimum NI competencies for faculty |

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
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| Choi, Park & Lee<br>(2016)<br>South Korea | "to explore how students, new nurses, clinical instructors, and faculty perceive the integration of academic electronic medical records into the undergraduate clinical practicum" (p.259) | •TIGER (2009) Competencies Collaborative<br>•NLN (2008) Preparing the next generation of nurses to practice in a technology-rich environment: an informatics agenda | •Adapting EMRs as learning tool for clinical practicum | •Physical barriers - lack of space & EMR workstations for students on placement<br>•Practical and liability issues - means students don't experience filling out the EMR<br>•Difficulty understanding contents of EMRs<br>•Study possibly not generalisable to large population | •Understanding patient's condition<br>•Understanding nursing processes<br>•Understanding of nurses' clinical activities<br>•Assistance with clinical case report assessments<br>•Practicing nursing documentation<br>•Means of recording & evaluating student activities in clinical practicum<br>•Enhancing NI competency<br>•Enhancing nursing documentation capacity<br>•Integrating theory and practice | •Partnerships with hospitals to develop EHRs |
| Clancy<br>(2015)<br>USA | "discuss how nursing informatics content builds across BSN, MSN and DNP curricula; Demonstrate how nursing informatics content can be threaded into existing didactic and clinical courses; Provide exemplars of resources, assignments and other tools used to teach nursing informatics" (n.p.) | •AACN (2008) The Essentials of Baccalaureate Education for Professional Nursing Practice<br>•QSEN (2013) Competencies<br>•TIGER (2010) Informatics Competencies for Every Practicing Nurse: Recommendations from the TIGER Collaborative | •Integrated across curriculum & existing courses & programs<br>•Detailed description of BSN HI Course<br>•Care documentation<br>•Academic EHRs<br>•Integration of technologies to document patient care | •No barriers noted<br>•Note: PowerPoint needed a voice over to follow the slides | •Safe, quality patient care<br>•Cost effective & secure use of information | |
| Clever Together<br>(2015)<br>USA | "promote excellence in nursing education to build a strong and diverse nursing workforce to advance the health of our nation and the global community" (p.1) | •QSEN (2013) Competencies | • Instructional designers & informatics specialists to facilitate course design<br>•Incentive-based programs for faculty<br>•Institutional and financial support for faculty development<br>•Learning opportunities to develop technological skills & knowledge<br>•Collaboration to increase opportunities for contextual learning by designing clinical encounters using technology & simulation across the continuum of care<br>•Develop learning activities that incorporate the shift to public & community health resources<br>•Create clinical experiences for students to assess consumer eHealth literacy & assist patients to translate data for meaningful use | •Faculty not experienced with technology<br>•Scant quality educational resources<br>•Nursing education has not kept up with evolving practice requirements, including the focus on innovative technologies. | •New patterns of patient-care responses & health information emerge that further inform nursing interventions<br>•Telecommunications technologies can enable nursing and medical teams provide health management on a continuum from chronic illness to acute injuries, using telemedicine to support primary care providers with limited access to these services | •Incorporate health promotion & health maintenance<br>•Professional development<br>•Identify ways to work efficiently with ICT<br>•Collaborate with practice partners to increase opportunities for contextual learning by designing clinical encounters using technology & simulation across the continuum of care |

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| Cummings, Borycki & Madsen (2015) Canada, Australia & Denmark | "provides a brief historical description of the uptake of nursing informatics in each of the three countries and discusses the required future directions and strategies towards incorporating nursing informatics into the undergraduate curriculum" (p. 39) | •ANMAC (2012) Registered Nurse Accreditation Standards •CASN (2014) -Nursing Informatics Competencies Entry-to-practice for Registered Nurses (NB - document published in 2012) | •Peer to peer network •Select, access, search & evaluate appropriate databases and the Web; relate information technology, information literacy & evidence-based practice •Define, describe & discuss basics about standardised languages and their impact •Describe the transformation of data & information into knowledge (knowledge management) •Introduction to electronic health & medical records •Understand how to handle patient information ethically, data security, social media use & communication | •Lack of time •Developmental or technical assistance •Faculty knowledge & commitment •Funding •Training opportunities •Appropriate software •Lack of basic informatics content in curriculum •Limited NI education •Lack of NI competencies in current Australian nursing codes | •Increased recognition of the importance of NI education •Denmark more developed then Canada & Australia. •In Denmark, NI is uniformly present in nursing curricula and there are nurses who are prepared in the field of NI who teach these courses | •Peer-to-peer network providing mentorship & support •Professional development |
| Cummings, Whetton & Mather (2017) Australia | "health informatics as an increasingly integral element of the higher education sector for health professions in Australia" within political, economic, legal, and cultural factors, "as mandated by Government legislation, policies, and strategies, that shape the emerging Australian digital health environment" (p.323) | •ANMAC (2012) Registered Nurse Accreditation Standards | •Mobile computing, networking & digital professionalism training •Classroom & simulation-based activities can augment learning •Capability to be digitally professional needs to be demonstrated prior to work integrated learning to ensure high quality & safe patient-care •Integrated Programs Linking HI Research & Teaching Program •HI education and culture across health professional education courses •HI technologies as normal element in education •Discuss legal, political & cultural issues around use of health informaticss. •Virtual community of practice using Twitter | •Historical ad hoc approach & view of informatics as not part of clinical knowledge •Education sporadic & uncoordinated •Lack of systematic approach to teach, assess, evaluate, or audit HI in professional education •Overloaded curricula •Complex, changing digital environment •Assumptions about digital natives •Barriers using technology on placement •Limited understanding of HI & specialisation of HI more specifically •Poor understanding of HI amongst many of the health professional education staff | •E-health, HI & health should be viewed as synonymous in contemporary healthcare •There is a need to incorporate e-health & HI skills in higher education programs globally | •Educators must be prepared to teach students how to become digitally literate & prepare them for their healthcare experiences |

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| Egbert et al. (2019) Austria, Germany & Switzerland | "to show how such recommendations can be developed, what competency areas are most relevant in the three countries and how the recommendations can be implemented in practice" (p.351) | •AMIA (2012) Board White Paper: definition of biomedical informatics and specification of core competencies for graduate education in the discipline<br>•GHWC (2015) Global academic curricula competencies for health information professionals<br>•AHIEC (2011) Health Informatics Scope, Careers and Competencies Version 1.9<br>•COACH (2012) Informatics Professional Core Competencies v3.0<br>•TIGER (2010) Informatics Competencies for Every Practicing Nurse: Recommendations from the TIGER Collaborative<br>•IMIA (2010) Recommendations on Education in Biomedical and Health Informatics First Revision | •Model for developing national recommendations<br>•Online study program - principles of nursing informatics, applied computer science/informatics, information & communication systems for nursing, eHealth, telematics & telehealth, information management & knowledge management in patient care, nursing documentation (including terminologies), data protection & security, ethics and IT, process, project, change & stakeholder management | •Lack of existing recommendations for NI | Useful in curricula development | |
| Forman, Armor & Miller (2020) USA | "to determine the state of the science related to clinical informatics competencies of registered nurses and to determine best practices in educational strategies for both nursing students and faculty" (p.3) | •TIGER ( 2007) The TIGER initiative: Evidence and informatics transforming nursing: 3-Year action steps toward a 10-year vision.<br>•CASN (2013) Nursing informatics teaching toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula<br>•QSEN (2018) QSEN Competencies | •No consensus on how competency education is best implemented | •Lack of effective educational strategies<br>•Faculty not appropriately engaged with technology<br>•Ongoing lack of integration of CI education in nursing curricula | •Present & future professional nurses must be able to use informatics & technology to facilitate critical decision-making for optimal patient outcomes | •Organised comprehensive faculty training programs<br>•Use of resources through professional organisations |
| Forman, Flores & Miller (2020) USA | "the review process targeted the following question: 'How are EHRs being used to teach clinical informatics in nursing education courses?" (p.28) | | | •Cost of EHR<br>•Cost of support personnel, technology upgrades & faculty time<br>•Faculty stress<br>•Lack of technology support<br>•Lack of faculty experience with EHRs<br>•Lack of opportunity for EHR training for students & staff<br>•Lack of time | •EHR training can provide the nursing student a comprehensive understanding of the value technology brings to a patient's quality of care.<br>•Increased use of EHR training to alleviate training issues related to EHR system navigation & documentation<br>•Improved attitude & comfort level of students when using EHR<br>•Improved student informatics skills<br>•Improved patient safety<br>•Improved nursing documentation skills | •Cultivating a positive attitude among faculty needed to improve perception of EHRs in education<br>•TIGER training |

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| Foster & Sethares (2017) USA | "the most current strategies used to implement informatics into the nursing curricula...Describe facilitators and barriers to implementation of informatics into nursing curricula" (p.1) | •TIGER ( 2009) TIGER Informatics Competencies Collaborative (TICC) Final Report<br>•IOM (2003) Core Competencies<br>•QSEN (2012) Project overview | •Baseline informatics competencies of students upon entry into program by computer- generated, computer-graded assessment tools that allow for immediate feedback upon completion of the assessment, using the results to prioritise what informatics strategies should be included in the curriculum<br>•Four major content areas - professional responsibility, care delivery, community nursing and care of populations & leadership/ management faculty<br>•Introduce case scenarios that increase in difficulty over the course of the student's education | •Lack of faculty competence<br>•Lack of faculty awareness of NI curricular guidelines<br>•Lack of consensus on how to integrate NI into nursing curriculum<br>•Inconsistent infusion of NI knowledge and skills into nursing education<br>•Belief in the Digital Native | •Nurses who are experienced with using technology and databases are able to retrieve information to make sound decisions based on current research rather than opinion | •Support from outside personnel and peers •Professional development<br>•Inventory of informatics resources and tools |
| Gambo et al. (2017) USA | "provides a framework for incorporating technology-driven strategies for developing new and revising existing simulation experiences and is guided by Rogers' Diffusion of Innovation (DoI) framework" (p.375). | •QSEN (2007) Project<br>•NLN (2008) Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda<br>•INACSL (2016) Standards of Best Practice: Simulation | •Real life simulation scenarios<br>•QR code on "patient" wristband with health information<br>•Integration of simulation into all stages<br>•Presimulation preparation<br>•Prebriefing<br>•Simulation scenario<br>•Debriefing | •Technology support<br>•Internet speed<br>•Cost of software & hardware<br>•Availability of devices<br>•Second career learners<br>•Generational resistance<br>•Changing role of educator<br>•Infection control<br>•Patient privacy | •Integration of high-fidelity simulation into nursing curricula gives students the opportunity to practice newly learned skills & reinforces prior knowledge in a safe patient care learning environment | •Baseline assessment of educator technology proficiency<br>•Professional development |
| Gonen, Dganit & Lev-Ari (2016) Israel | "to promote the knowledge of Information Competencies Technology among nurses' educators and student" (p.1). | •NLN (2008) Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda<br>•QSEN (2013) Competencies<br>•TIGER (2008) The TIGER initiative: Collaborating to integrate evidence and informatics into nursing practice and education: An executive summary | •NI plan developed for all aspects of learning throughout 4-year degree<br>•Technology Acceptance Model (TAM) used as educational platform<br>•Curriculum change planned according to student's stage of learning, from beginner to expert<br>•New courses covering different aspects of NI: introduction to NI, basic computer competencies with expert lecturers | •Limited knowledge by faculties about appropriate integration of NI into curriculum<br>•Overcoming faculty resistance & receiving academic support<br>•Lack of understanding of how NI can contribute to the quality of nurses' work<br>•Lack of faculty computer skills & discomfort with technology<br>•Limited funding & high costs of NI education<br>•Variation in nursing curriculum<br>•Variety of informatics that need to be accommodated within the curriculum | •Updating & developing academic courses & adopting pedagogic tools for nurses educators<br>•Rapid access & easy navigation to crucial data such as patient current vital signs, medication history & alerts to drug allergies<br>•Systematic patient assessment<br>•Access to decision-making support tools | •Professional development<br>. |

| Author Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
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| Gonen et al. (2016) Israel | "to evaluate the feasibility of a situated learning approach for Information Technology course by assessing students' perceptions at the end of the course" (p.1) | | •Situated learning exercises & simulations designed for students based on examples from practice: taking a patient's medical history case studies, lists of medications and instructions for patient discharge | •Hard to implement in classtroom<br>•Nursing faculty who lacked IT teaching skills or understanding of NI | •Genuine, authentic real-life context<br>•Promotion of profound learning<br>•Critical reflection<br>•Increased student engagement<br>•Perceived value for learners | •Collaboration with other key stakeholders<br>•Faculty meetings where project was presented & goals of studying method explained<br>•Examples from the course were presented & demonstrated<br>•Team invited to experience this kind of teaching & learning first-hand |
| Hamilton, Iradukunda & Aselton (2021) USA | "to explore the integration of telehealth into undergraduate nursing curricula and to describe the experience one university has had in piloting its use in both undergraduate and graduate education" (p.18) | | •Described telehealth program using telehealth equipment with simulated telehealth experience | •Lack of funding<br>•Lack of knowledge among faculty<br>•Lack of laboratory support staff<br>•Lack of laboratory space<br>•Lack of time for faculty to develop simulated telehealth case studies to enhance student learning<br>•Not adequate time for all students in the graduate & undergraduate program to have hands-on experience<br>•Older technology<br>•Lack of funding to maintain the equipment, hire additional staff &provide training for faculty<br>•Lack of telehealth clinical sites | •Some nursing students reported using telehealth improved their clinical experience & patient care<br>•On graduation, students will have telehealth skills that enhance their job performance<br>•Level of familiarity adds to comfort in using telehealth<br>•Simulation can increase students' engagement & stimulate their interest in telehealth<br>•Use of simulation is one of the most effective methods to enhance telehealth integration in nursing curricula | |
| Harerimana et al. (2022) Australia | "to provide an overview of the published literature on how nursing informatics was embedded and integrated into the undergraduate nursing curriculum in Australia before coronavirus disease (COVID-19)" (p.537) | •TIGER (2018) An International Recommendation Framework of Core Competencies in Health Informatics for Nurses<br>•CASN (2014) -Nursing Informatics Competencies Entry-to-practice for Registered Nurses<br>•AMIA ( 2012) Board White Paper: definition of biomedical informatics and specification of core competencies for graduate education in the discipline<br>•ANMF (2015) Nursing informatics standards for nurses and midwives | •Baseline perspective of how NI was embedded & integrated into nursing education in Australia before COVID-19<br>•NI in undergraduate nursing education recommended by the ANMAC but differs across institutions<br>•Mode of delivery of instructions included online, virtual & blended learning<br>•Technology-supported teaching strategies essential | •Lack of NI guidelines & non-adherence to standards & criteria for teaching NI<br>•Ambiguity of NI definition impacts informatics practice and education<br>•Clinical simulations - lack of time, technical & academic support, equipment & access to dedicated simulation environment<br>•Lack of guidelines/ frameworks to develop NI & guide integration of technology in curriculum<br>•Students' poor ICT literacy & limited access to ICT tools & applications<br>•Limited exposure to NI due to lack of interaction with NI in clinical placement, caused by ethical issues to access patient data in health systems in hospitals | •Increasing demands for universities to produce digitally-competent graduates who can use ICT to deliver quality healthcare<br>•Use of technology in nursing education prepares nursing students to provide quality care in a technology-mediated environment & better understand their roles as RNs<br>•Enhanced students' digital health literacy & increased confidence to use technology to support their studies & later in nursing practice | •Multidisciplinary collaboration & partnership with academic learning support facilitators, unit coordinators, team coordinators & librarians<br>•Presence of specialists in NI & experts in online course development helped the faculty develop course content<br>•Training packages to improve digital literacy & competencies to teach NI to the students |

| Author Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
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| Hay et al. (2017) Australia | "to identify in what way social media and mobile technology assist with learning and education of the undergraduate nurse" (p.8) | | •Twitter hashtag for networking, learning & content consolidation •On-campus conferences relating to mobile technology & social media use in nursing | •Costs of devices, wireless access, infection control & adherance to hospital guidelines •The challenge for undergraduate nursing course designers will be to build on these findings to use social media & mobile technology in nursing research & education | •On basis of results of the research & as guided by the conceptual framework, several new initiatives have been developed within the nursing program at the University of Notre Dame •2 on-campus conferences relating to mobile technology & social media use in nursing were productively co-organized with both students & staff representative | •Committee formed to assist both staff & students to support greater integration of digital technologies within curriculum |
| Hern et al. (2015) USA | "to increase knowledge, skills, and attitudes (KSA) of nursing faculty about informatics and EHRs; and to increase student use of EHRs in on-campus labs. The secondary goal was to enhance faculty adoption and pedagogical incorporation of informatics into the nursing curriculum" (p.118) | •TIGER (2013) Initiative •QSEN (2013) Graduate competency KSAs •AACN (2008) Essentials of Baccalaureate Education for Professional Nursing Practice | •Pilot with seminars & national consultants' presentations to faculty regarding their knowledge, skills & attitudes about informatics & use of EHRs •Participant faculty members received an iPad as incentive to participate & kept the iPad while employed in the school | •Restriced use of EHRs in clinical practicums •Older faculty & clinical nurses tend to be slower to adopt technology •Note: Survey not validated (yet they still got published in the USA!!!) refer to end of section 2.1 •Very USA centric! •Small sample size •Implementation not clearly described | •Improved student attitudes to EHRs •Improved student confidence in clinical settings •Student anticipation that education on EHRs would help ease transition to clinical setting •Faculty felt students were better prepared for clinical setting | •Professional development •Training sessions on new equipment •Information technology staff specialist met one-on-one with faculty •Faculty received an incentive of an iPad |
| Honey, Collins & Britnell (2021) New Zealand | "asked nurse educators from around New Zealand (n=40) what they perceived as the concerns, barriers and facilitators to implementing nursing informatics within their curricula" (p.124) | | •Motivated staff were engaged with this aspect of nursing education •A health system that supported the informatics growth of nursing students •An organisation that dedicated time & resources to nursing informatics •National resources | •Cost, policy, training, staffing & support •Constantly evolving nature of ICT •Lack of access to devices for students | | •Professional development for nurse lecturers •Nationally available resources would be helpful |
| Hovenga & Grain (2016) Australia | "explains the need for such a structured body of knowledge from an educational and workforce capacity building perspective" (p.336) | •IMIA (2010) recommendations on Education in Biomedical and Health Informatics •AMIA ( 2012) white paper •COACH (2012) HIP competency framework •GHWC (2014) Global Academic Curricula Competencies for Health Information Professionals •TIGER (2008) The TIGER initiative: Collaborating to integrate evidence and informatics into nursing practice and education: An executive summary •CASN (2014) Nursing Informatics: Entry-to-Practice Competencies for Registered Nurses | | •Often a gulf between ICT research & teaching staff & health research & health professional education •Health workforce generally appears to have little or no appreciation of the need to improve their understanding of HI discipline as evidenced by a common reluctance to address this need •Many stakeholders unable to differentiate between ICT skills & HI skills & knowledge | •Collectively frameworks could be used to develop an inventory of possible job roles to assist health informatics educators with the identification of knowledge, professional, technical & behavioural competency needs along with required experience and qualification levels | |

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
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| Kleib & Olson<br>(2015)<br>Canada | "to develop an informatics educational intervention for baccalaureate nursing students and compare outcomes associated with vodcasting and face-to-face methods for delivering this material" (p.395) | •AACN (2008) The essentials of baccalaureate education for professional nursing practice<br>•QSEN (2013) Competencies<br>•TIGER (2007) Evidence and informatics transforming nursing: 3-year action steps toward a 10-year vision<br>•CASN (2013) Nursing informatics teaching toolkit: Supporting the integration of the CASN nursing informatics competencies into nursing curricula | •Development & pilot test of informatics educational intervention<br>•Content - basic HI and NI principles and some tools available through HI applications<br>•Evaluation of efficacy of intervention in increasing knowledge, confidence & attitude outcomes towards the EHR | •Student's competing commitments<br>•Lack of interest about NI and perception that NI is not relevant to nursing practice<br>•Limited access to technology applications<br>•Lack of faculty knowledge & skills<br>•Use of conventional approaches<br>•Faculty members equated being involved in distance learning, online learning & web-based instruction with being prepared in informatics<br>•Limited integration of handheld devices<br>•Informatics education in curriculum sufficient for clinical practice<br>•Note: Results have limited generalisability due to low response rate and small sample | •Patient safety due to enhanced clinical decision-making<br>•Build on existing student knowledge of ICT | |
| Lam et al.<br>(2016)<br>Australia | "explored health sciences students' preparedness for working, and leading change, in eHealth-enabled environments" (p.305) | | •Online questionnaire student use of ICT<br>•Faculty-wide initiative to increase access to eHealth with electives including interviews with health professionals using eHealth<br>•Focus on how & why technology is used for health, including practical role-play sessions to support students' eHealth confidence & skill development | •Limited understanding of unclear understanding of eHealth as it relates to professional practice<br>•Assumption of student eHealth readiness due to being "digital natives"<br>•Limited exposure to eHealth within professional practice<br>•Difficulty transferring existing ICT skills to higher education learning context<br>•Females less confident than male counterparts | •Results suggest eHealth education for health sciences students should provide students with sufficient time to work through new ICT problems and/or involve guided support by an individual familiar with the ICT system or its application in health contexts | •Faculty wide initiative to increase eHealth experiences |
| Luo & Kalman<br>(2018)<br>USA | "to describe and discuss how we designed and developed a 12-step technology training protocol" (p.20) | •QSEN (2013) Competencies | •Describes procedure to connect students' prior knowledge with use of new softwareVideo on a new type of software | •Nurses who did not grow up in computer age may not have sufficient computer knowledge<br>•End users of technology unable to see "big picture" of how technologies help in collecting, recording, protecting, storing, utilising, analysing & reporting information & data related to patient safety & improved outcomes<br>•Integration of technologies hampered by nurses' workarounds<br>•Real-workflow culture does not fit design purposes of EHRs<br>•One size fits all training fails to take into account prior learning | •Nurses' technological knowledge of skills in & attitudes toward new technologies in the health care setting are critical to improving healthcare outcomes<br>•Meaningful learning - connecting new knowledge to prior knowledge | |

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| Mather & Cummings<br>(2016)<br>Australia | "exploring the use of mobile learning by undergraduate student nurses revealed barriers, challenges, risks, and benefits to using mobile learning at the workplace" (p.277) | •NMBA (2015) 2nd draft registered nurse standards for practice | | •Resistance by non-technology users<br>•Inappropriate use of technology<br>•Reduced eye contact & barrier with patient interaction<br>•Negative response of other nurses and patients - looks unprofessional<br>•Technical issues - battery life, screen size, availability of charging ports, speed of internet or resources not regularly updated<br>•Risks to patient privacy<br>•Potential theft of device<br>•University & organisational policy not to use mobile devices during placement | •Enabling access to resources for clinical or educational purposes<br>•Facilitation of learning in the clinical environment<br>•Learning in real time | •Nurse supervisors need to support legitimate use of mobile devices in clinical settings |
| Mather & Cummings<br>(2015)<br>Australia | "describes the complex matrix of knowledge, skills, attitudes and behaviour employed by the triad model of patient, student, and nurse supervisor (human context) at point of care to enable a supportive (physical and social) environment promoting eHealth literacy assessment and development" (p. 631) | •ANMC (2006) Australian nursing and midwifery competency standards for nurses and midwives<br>•ANMC, now known as ANMAC | •Use of a triad model using a case scenario - nurse/ patient/ health information | •Few nursing courses overtly describe HI competency level expected by graduates, nor have they developed clear strategies for integrating competencies into curricula<br>•Lack of investment in tools representative of real world settings<br>•Students lack competencies for finding & evaluating health information<br>•Students have difficulty discriminating between primary & secondary sources & credible sites for health information | •Cost containment through time-saving, error reduction & real-time access to information at point of care can advance eHealth literacy & transform the nurse-patient relationship<br>•Future-proofing health of patients by improving eHealth literacy in situ is an innovation that can no longer be ignored | •Need for understanding about eHealth literacy concept.<br>•Nursing supervisors must be aware of digital reading habits |
| Mather, Cummings & Nichols<br>(2016)<br>Australia | "reports on a study that aimed to explore student nurses use of social media and their media preferences for sourcing information" (p.345) | •ANMAC (2012) Registered Nurse Accreditation standards<br>•NMBA (2015) Framework for assessing standards for practice for registered nurses, enrolled nurses and midwives - does not address informatics | | •There is currently a gap in the curriculum to ensure appropriate guidance & support in the use of newer platforms<br>•Lack of scaffolded learning about professionalism<br>•Lack of consistency in curriculum topics is confusing for educators, clinicians & students | •Connects students with peers, colleagues, experts & organisations to assist them to keep up to date with important professional changes<br>•Opportunities for employment<br>•Making professional connections | •Need to integrate & model appropriate social media use in the classroom & during placement |
| McGregor et al.<br>(2017)<br>Australia | "to explore stakeholders' perceptions of e-health knowledge and skills anticipated of workforce-ready tertiary graduates from clinical health degree programs" (p.91) | | •Focus on technical skills required to practice within digital contexts should be expanded<br>•Reinforce existing competencies<br>•Acknowledge & adapt individual's existing competencies to make them transferable to eHealth contexts<br>•Introduce new learning & provide opportunities for interactions with e-health within education & practice encounters | • Limited understanding of core competencies for eHealth<br>•Need to move focus beyond technical skills & to broader professional competencies | •Participants asserted that helping students to understand overarching principles, purposes, and benefits of systems & technologies would best foster individual intrinsic motivation to adopt existing systems, while positioning them well to be adaptive to future evolutions and emerging innovations | |

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
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| O'Connor & LaRue<br>(2021)<br>United Kingdom (UK) | "describes how health informatics is being integrated into a Bachelor of Nursing programme in the United Kingdom" (p.1) | •TIGER (2009) TIGER informatics competency collaborative (TICC) final report<br>•IMIA (2010) Recommendations on Education in Biomedical and Health Informatics<br>•ANA (2015) Nursing informatics: Scope and Standards of practice<br>•CASN (2012) Nursing informatics entry to practice competencies for registered nurses<br>•ANMF (2015) National informatics standards for nurses and midwives<br>•UKCHIP (2017) The UKCHIP code of Conduct | •Individual learning units corresponding to the six competency domains & learning descriptors are being designed by faculty & integrated into Bachelor of Nursing program. | •Lack of faculty expertise on HI<br>•Lack of consensus on which HI concepts should be taught.<br>•Rapidly evolving technology | •Understanding of digital professionalism<br>•Understanding use of social media<br>•Development of foundational knowledge | •Professional development |
| O'Connor et al.<br>(2017)<br>UK, USA & Germany | Overview of TIGER (Technology Informatics Guiding Education Reform) and the European Union (EU) - United States (US) Collaboration on eHealth | •TIGER (2009) TIGER Informatics Competency Collaborative (TICC) final report<br>•Health Information Technologies COMPetencies (HITComp, 2017) Empowering a digitally skilled workforce. | •Sharing of ideas & solutions<br>•TIGER Initiative to guide creation of solutions to suit the needs of ocal health workforce & population of people they care for | •Clinical staff resistant due to limited technical knowledge and capability<br>•Poor digital literacy<br>•Lack of training in clinical setting<br>•Some educators & researchers have been slower to develop technological knowledge & abilities, which means they cannot make the best use of electronic tools & applications in their respective roles | •Technology underpins all three legs of the proverbial stool i.e. education, research & practice, it is critical that nurses are adequately trained in informatics | |
| O'Connor & Andrews<br>(2015)<br>*UK & Ireland* | "comprehensively summarizes and critically reviews the available literature on mobile technology used in undergraduate clinical nursing education" (p.137) | | | •Lack of definition & clarity on what mobile technology is, the range of devices & applications it refers to & rationales for selection<br>•Technical issues - freezing, crashing etc., lack of Wi-Fi connection, difficulties with small screen<br>•Cost of equipment<br>•Poor computer literacy & technical support.<br>•Lack of tailored resources<br>•Negative attitudes of nursing students & staff | •Drug reference guide the most used software program<br>•Improved students' pharmacological knowledge & patient education<br>•Medical calculators to improve drug calculations/ reduce errors<br>•Laboratory & diagnostic manuals to check physiological indicators of disease<br>•Clinical portfolio software<br>•Clinical decision-making<br>•Communication with student peers, patients and families<br>•Enhanced clinical knowledge & knowledge retention - a "learning scaffold"<br>•Flexible form of education that matches individual's needs<br>•Increased student productivity & organisation | •Nurse educators & students should consider adopting handheld devices to augment nursing education & practice |

| Author Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Oh et al. (2019) South Korea | "To develop flipped learning classes by using film clips for undergraduate nursing students in an online nursing informatics course, based on the Analysis, Design, Development, Implementation, and Evaluation model, and to evaluate the effectiveness and students' responses to this method of teaching" (p.385). | •ANA (2014) Nursing informatics: Scope and standards of practice<br>•QSEN (2016) Quality and Safety Competencies | •Flipped classroom using C-REVERSE design with educational intervention | •Technical difficulties with equipment & software<br>Only preliminary evidence at this stage & limited sample size | •Improved understanding of NI concepts<br>•Strong intention to recommend the learning method to other students | |
| Peltonen et al. (2019) Finland, USA, Canada, Mexico, Kuwait, Brazil, Sweden, Australia, Republic of Korea, Argentina & Philippines | "explores responses to questions about: what should be done to further develop NI as an independent discipline; existing policies and standards influencing NI; perceived support towards NI as a discipline; and advice from NI specialists to students and emerging professionals" (p.220) | | •Increase NI teaching in undergraduate programs<br>•Establish & standardise NI competencies<br>•Ensure educational content meets practice demands<br>•Take advantage & learn from international NI education | •NI education needs development to better meet practice demands<br>•Education in NI-related competencies are often inadequate for the newly graduated nurse<br>•General lack of understanding regarding the potential of NI to change and improve health care | •National policies & international white papers in NI are needed to guide resource distribution to better support practice | •Increase faculty in NI |
| Pobocik (2015) USA | "reviewed how an educational electronic documentation system helped nursing students to identify the accurate "related to" statement of the nursing diagnosis for the patient in the case study" (p.26) | | •Development & integration of educational EHR | •In some clinical settings students cannot use the EHR<br>•Nurses in practice have negative attitudes about using an EDS<br>•Poor documentation potentially negatively affects patient care, professional accountability & organisational risk/ nurses who have poor computer skills may inaccurately report patient data | •Allows educators to track student progress throughout education & serve as indicator for bench-marking standards on this technology<br>•When student nurses received education & training on nursing process, they had higher accuracy than those who did not have the training<br>•Knowledgeable use of EHR can lead to successful transition into professional practice<br>•An online activity using a case study increased nursing students' clinical decision-making skills, helped them recognise the importance of a patients' assessment<br>•Students able to identify critical cues in patients' data<br>•Increased clinical reasoning | |

| Author Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Raghunathan, McKenna & Peddle (2021) Australia | "sought to explore how academic electronic medical records are used in entry-to-practice nursing curricula" (p.1) | | •Assignments & learning activities developed to mimic clinical systems •AEMRs in skills & simulation laboratories, or classrooms or other settings •Introduction to AEMRs within programs varied & AEMRs were usually embedded within initial fundamentals courses •Essential foundational nursing skills were also embedded into AEMR activities •Range of activities & resources to engage learners with AEMRs •Integrating case scenarios with AEMRs was highlighted as an effective way to assist students to develop skills to confidently use clinical EMRs | •Nurse education has delegated proficiency with digital records to clinical settings with students exposed to EMRs during clinical placements. •Nursing graduates are inadequately prepared to use digital systems in practice •Lack of curriculum interventions to address health technology capabilities poses risks as inadequate knowledge to operate EMR systems in the healthcare environment can compromise clinical decision-making, patient safety & quality of healthcare outcomes •Individual challenges including issues with product features, software functionality & lack of faculty expertise | •Because nurses are at the frontline of care, with key roles in collecting, recording & managing health data, proficiency with ICT & informatics skills is essential | |
| Raghunathan, McKenna & Peddle (2022) Australia | "To explore how academic electronic medical records are currently used in pre-registration nurse education in Australia and New Zealand to prepare students for the clinical environment" (p.645) | | | •Healthcare is rapidly digitising but application of AEHRs in nurse education not extensive across Australia & New Zealand •Gaps identified in academic-healthcare partnerships and sharing of resources •Cost, lack of funds, lack of technology support & inadequate faculty knowledge •Faculty - lack of NI & technology knowledge, lack of time to develop and teach AEMR content within an expanding nursing curriculum •Lack of data about student preparedness for digital health practice | •Incorporating AEMRs offers practical & meaningful learning experiences •AEMRs incorporated into curricula for documentation, health assessment & care planning, nursing notes & reading medical orders, medication charting & interprofessional practice when used for teaching nursing competencies •Improves educational experiences & safety & quality of care •Students less likely to make cognitive errors •AEMRs in skills & simulation settings replicates clinical environment & heightens realism | •Professional development |
| Repsha et al. (2020) USA | "to determine informatics competencies for prelicensure nursing students using a simulated EHR" (p.55) | | •Pre-intervention use of the SANICS •4 hours of high-fidelity simulation weekly. Three of the simulation hours are completed in the simulation laboratory, while 1 hour is provided for preparation •Simulated patient cases involve complex, acute situations presented as one or two patient assignments •Post-intervention of the SANICS | •Nursing education programs are not uniform in the integration of NI into the curriculum •Limited formal EHR training in curriculum. | •Through collection of pre-intervention & post-intervention surveys, study demonstrated an increase in perceived informatics competency among nursing students | |

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Risling<br>(2017)<br>Canada | "several technology trends are explored that are likely to influence the healthcare transformation of the next decade. A critical reflection on what nursing educators should consider now in order to better support the clinicians of the future is also included with a particular focus on existing informatics curricular supports" (p.89) | •CASN (2015) Entry to Practice Competencies for Registered Nurses NB - document was published in 2012<br>•TIGER (2008) The TIGER initiative: Collaborating to integrate evidence and informatics into nursing practice and education: An executive summary | •Nursing curriculums should include detailed digital best practice content covering legal & ethical concerns<br>•Comprehensive increase to informatics competencies throughout nursing curricular content supported by well-developed frameworks such as those provided by TIGER or CASN | •Integration of EHRs remain a challenge due to technical issues such as access speeds, content lag & interruptions related to malfunction<br>•A lack of consensus & specificity in managing digital best practice content in a digitised healthcare environment creates ongoing curricular challenges<br>•Challenges with EHRs include underutilisation, language standardisation & lack of flexibility in design<br>•Resistance from nurses | •Improved care plan data quality<br>•Improved connectivity between MDT members<br>•Improved patient outcomes | •Educators should engage in future-casting about the potential evolution of nursing & not be limited by current practice paradigms |
| Royal College of Nursing<br>(2018)<br>UK | "presents the analysis of what we heard from the nurses and midwives who took part" in a consultation on the digital future of nursing (p.4) | | •Provides a number of case study examples | •Inadequacy of IT systems<br>•Lack of centralised procurement<br>•Chronic understaffing in clinical areas<br>•Lack of confidence about nursing & midwifery staff regarding digital competencies<br>•A degree of negativity about impact of digital technologies<br>•Lack of digital skills amongst nurses & midwives | •Improved safety & quality<br>•The vision that emerges from this consultation is one that any nurse or midwife would be able to support: digitally enabled health and social care that creates better outcomes for patients, enables better experiences for staff & offers opportunities to make working practices more efficient | |
| Sapci & Sapci<br>(2017)<br>USA | "to evaluate the effectiveness of ... smart home healthcare and health informatics laboratories, and a novel laboratory course that focuses on experiential health informatics training" (p.184) | •TIGER (2009) The TIGER Virtual Demonstration Collaborative Team: A TIGER Collaborative report<br>•IMIA (2010) Recommendations on Education in Biomedical and Health Informatics | •Novel laboratory course on remote patient monitoring & clinical decision making with sensor data<br>•Specific smart home for healthcare laboratory; a HI training laboratory; inter-active on-ground & online lectures; & hands-on exercises to capture, mine, analyse, and visualise data | •Little focus on innovation, remote patient monitoring education & experiential training | •Hands-on practice provides the opportunity for experiential learning<br>•Focuses on real life challenges | •More skilled laboratory staff to provide support during lass |

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Sorensen & Campbell<br>(2016)<br>USA | "the objectives were to provide faculty with simple teaching strategies that promoted ease of integrating an academic EHR (AEHR) across a curriculum, as well as to steadily increase students' use of an AEHR" (p.716). | •AACN (2008) The essentials of Baccalaureate Education for professional nursing practice<br>•ANA (2015) Nursing: Scope and Standards of Practice | •Integration of AEHR in foundational through to intermediate & advanced undergraduate levels | •Nursing schools struggle to integrate AEHRs into their curricula, with shortage of competent faculty identified as barrier<br>•76% of new graduates do not feel prepared to access & use EHR in patient care<br>•Instructors' lack of time<br>•Resistance to new technology | •AEHR can provide students with learning opportunities through the navigation of technology, patient assessment, and decision making & expose them to standardised nursing language, evidence-based practice & ability to document patient information<br>•Integration of an AEHR with case studies better prepares nursing students to recognise critical patient cues within patient data, leading to more appropriate nursing diagnoses<br>•Faculty appreciated having an innovative way to educate and one point of contact for both faculty & students<br>•Increased course scores for those | •Faculty to share their innovative teaching strategies for AEHR integration<br>•Super-users/ faculty champions<br>•Skills and simulation laboratory coordinator provided further assistance with AEHR integration in scheduled laboratories |
| Theron, Redmond, & Borycki<br>(2017)<br>Canada | "to increase the competency of undergraduate nursing students to find and evaluate online health information, a Digital Health Assignment was created for second year nursing students" (p.328) | •CASN (2012) Nursing Informatics Entry-to-Practice Competencies for Registered Nurses | •Students joined a closed Facebook group linked to the professor's course page<br>•They selected an online site of interest & appraised site for trustworthiness using the TOHI Scale<br>•They also posted peer feedback to Facebook | •Many students lack skills to appropriately find & evaluate online health information<br>•Students make quick & superficial judgments about the quality of online health information<br>•Students actual abilities were lower than perceived abilities<br>•The instructors found challenges in locating & marking the assignments in Facebook<br>•Implementation & evaluation of the DHA was limited by having a small sample size & convenience sample in this pilot | •Students' self-efficacy enhanced by comparing peer evaluations | •Nurse educators can continue to work with librarians & faculty experts to increase students' knowledge & create opportunity for appraising not only online health information, but also all health information |
| Theron et al.<br>(2019) | "to describe how students' informatics competence was enriched through the development, and implementation of a Credibility, Argument, Purpose, and Evidence (CAPE) guide compared to the previously implemented checklist as part of a Digital Health Assignment (DHA)" (p.2) | CASN (2012) Nursing informatics: Entry-to practice competencies for registered nurses | •Development of the Digital health Assignment | •Students' eHealth literacy skills are largely substandard<br>•Discrepancy between students' confidence in their ability to search & appraise health information & the quality of information they retrieved | | |

| **Author Year** | **Aim/ purpose of study** | **Competency frameworks** | **Enablers** | **Barriers** | **Benefits** | **Faculty development** |
|---|---|---|---|---|---|---|
| Theron, Borycki & Redmond (2017) Canada | To review digital literacy, including reviewing "the current literature focusing on teaching digital literacy as part of informatics, specifically related to undergraduate students and young people" (p.150). | •CASN (2012) Nursing informatics: Entry-to practice competencies for registered nurses | •Perceptions of Students Regarding Their Digital Literacy Appraisal Skills | •Few student nurses learn about EHR in classroom context due to the lack of availability<br>•Lack of qualified faculty that understand technology from a conceptual, technical, & practice-based point of view<br>•Inaccuracy of online sources of information<br>•Many students lack skills to seek & evaluate online health information | •Nurses use information & knowledge to inform practice & educate individuals, families & communities with information that will assist them in making healthcare decisions that will positively impact their quality of life | •Collaboration between educators & librarians provides students with resources to find & evaluate online health information |
| Topol (2019) UK | "proposes three principles to support the deployment of digital healthcare technologies throughout the NHS" (p.11) | •NMC (2018) Standards for nurses<br>•NICE (2018) Evidence standards framework for digital health technologies | •Ensure genomics, data analytics & AI are prominent in undergraduate curricula<br>•Future healthcare professionals need to understand the possibilities of digital healthcare technologies & ethical & patient safety considerations<br>•Students must gain appropriate level of digital literacy at the outset of their study for their prospective career pathway.<br>•Offer opportunities for healthcare students to work in areas such as engineering or computer science & equally attract graduates in these areas to begin a career in health, to create & implement technological solutions that improve care and productivity in the NHS | •Uneven data quality<br>•Gaps in information governance<br>•Lack of expertise<br>•Resistance to change & scepticism | •Early benefits of AI & robotics will include the automation of mundane repetitive tasks that require little human cognitive power, improved robot-assisted surgery & optimisation of logistics<br>•Healthcare economic benefits<br>•Early, effective & sustained staff engagement at all levels, especially front-line staff, is a pre-requisite for technology enabled transformational change to be successful | |
| Vottero (2017) USA | "to provide an overview of how to structure informatics content for undergraduate and graduate nursing programs either as a course or integrated into the curriculum" (p.22) | •ANA (2015) Nursing Informatics: Scope and Standards of Practice<br>•AACN (2008) The Essentials of Baccalaureate Education for Professional Nursing Practice<br>•QSEN (2007) Project<br>•QSEN (2013) Graduate competency KSAs<br>•TIGER (2009) TIGER Informatics Competencies Collaborative (TICC) Final Report | •Provides a description of standalone course content or an integrated curriculum | •Many faculty equated NI with providing distance learning, online learning & web-based instruction.<br>•Variations across curricula and programs<br>•Curriculum compression is experienced by many faculty who are trying to fit additional content requirements into an already tightly packed nursing curriculum<br>•Faculty's lack of knowledge or specialty certification in NI | •A variety of education strategies given to teach & assess NI for undergrad & post grad | |

| Author<br>Year | Aim/ purpose of study | Competency frameworks | Enablers | Barriers | Benefits | Faculty development |
|---|---|---|---|---|---|---|
| Wilbanks, Watts & Epps (2018)<br>USA | "a discussion on the benefits and disadvantages of using educational EHRs, barriers and facilitators to implementing educational EHRs, and best practices for incorporating educational EHRs into current educational curriculums" (p.261) | | •Provides a list of best practices for AEHR implementation | •Cost in acquiring the technology & software & human labour<br>•Requirement for internet connectivity<br>•Requirement for ICT staff<br>•Educational EHRs also require a lot of time from faculty who use it because they have to generate the clinical simulations & incorporate them into their curriculum<br>•Many faculty will often skip the documentation portion of the simulation if they are behind schedule & need to make room for other activities<br>•Note: Literature only sourced from North America. | •Exposing students to CDS tools before clinical rotations to prepare to use them to guide care decisions<br>•AEHRs can be implemented & used to improve students' IT competencies<br>•EHR more effectively taught in clinical simulations due to contextual factors involved in using EHR in real-world settings<br>•Students properly trained to use EHR are less likely to make cognitive errors in clinical decision-making<br>•Benefit of using educational EHRs is that these can introduce students to the field of informatics<br>•A major advantage of educational EHRs is the ability to teach students patient-centered care & disease state management using technology in a safe environment | •Faculty support, training, & adequate financial support are essential to a successful educational EHR |

# Appendix B1: Email Permission - Scoping Review Table

**From:** Micah Peters <Micah.Peters@unisa.edu.au>
**Sent:** Friday, 22 September 2023 12:32 PM
**To:** Lisa Reid
**Cc:** Didy Button
**Subject:** RE: Request to use scoping review frameworks table

CAUTION: Only open links and attachments you're expecting.

Hi Lisa,

Thank you for the interest in our work.

Happy to grant permission to use the framework with citation.

Best of luck with your project.

Kind regards

Micah

-

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**Adjunct Associate Professor Micah DJ Peters PhD | Director – ANMF National Policy Research Unit (Federal Office)**
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**Pronouns**: He/Him
**Pronunciation**: Mai-kuh

# Appendix B2: Delphi Study Protocol

## Nursing Informatics and undergraduate nursing curricula

## A Delphi Study protocol


## Abstract

### Introduction

Nurses are increasingly required to work with digital information systems, with competence in the use of information technologies closely linked with the ability to work in contemporary healthcare. However, despite the early adoption of Nursing Informatics (NI) in Australia, barriers to engagement and proficiency remain, including poor computer literacy, limited professional development and a lack of undergraduate education. Following a scoping review of contemporary published literature on NI in undergraduate nursing education, this Delphi study aims to elicit expert opinion on embedding NI into undergraduate nursing curricula, with recognition of the tacit knowledge and value of expert judgment.

### Methods and analysis

This Delphi study will be developed in adherence with the reporting guidelines as described in *Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: recommendations based on a methodological systematic review (Jünger et al., 2017)* and published on the Equator Network (2022). The CREDES Guideline (Jünger et al., 2017) aligns with Hasson and Keeney's (2011) call to strengthen the methodological rigour of Delphi studies and was used in the development of this *a priori* protocol.

**Ethics and dissemination:** Ethics approval has been obtained for this Delphi study (Project ID: 2156) from the Flinders University's Human Research Ethics Committee and has been determined to be low risk.



**Keywords:** Nursing, Informatics, Undergraduate, Education, Curriculum


## Introduction

A scoping review was conducted to explore the extent of contemporary literature on NI into undergraduate nursing curricula and to inform the Delphi study phase of the study. The emergent themes from the selected sources of evidence are described below.

### Barriers to NI education in undergraduate nursing programs

Barriers to NI education in undergraduate nursing programs emerged as a theme underpinned by the following sub themes:

#### *Lack of Understanding of NI*

A lack of understanding of NI, the role of NI in patient care outcomes and NI applications, and a lack of consistent taxonomy and language related to NI were identified as barriers, with faculty perceiving NI competence with an ability to work with digital tools in education.

#### *Limited infrastructure and resources*

Computer crashes, power outages, and hardware and software not working, a lack of technical support and poor infrastructure, poor internet connectivity, and the development, cost and maintenance of hardware and software were identified as barriers.

#### *Lack of student access to digital technologies and associated resources*

A lack of access to devices and associated software, policies on student use of mobile devices and digital technologies, and concerns regarding the legal and ethical implications of undergraduate nursing students accessing patient information were identified as barriers.

#### *Belief in the Digital Native*

The term *Digital Native* has been used to describe students who had grown up with digital technologies and “think and process information fundamentally differently from their predecessors” (Prensky, 2001, n.p.) was noted. However, Sethares (2017), stated that this does not address the need for information literacy and higher-level informatics principles.

#### *Evolving nature of NI and digital technologies*

The rapid introduction of digital technologies resulted in a lack of understanding of definitions of NI concepts or how to apply them to the curriculum. This was highlighted by Chauvette et al. (2022, n.p.), who stated that NI “is an elusive concept complicated by the evolving complexity of the digital tools that nurses are expected to use in the clinical environment”.

#### *Faculty resistance and technological stress*

Faculty resistance and technological stress were linked to traditional modes and methods of teaching, a lack of understanding of digital technologies and Informatics, a lack of acceptance of NI, a lack of digital competence and limited faculty educational opportunities.

#### *Lack of NI competencies, recommendations, guidelines and evidence-based educational strategies*

A lack of contemporary Informatics competencies and limited recommendations, guidelines and evidence-based educational strategies were identified, with Cummings et al. (2017, p. 331), noting that “standards, guidelines, and codes of conduct regarding access and use of digital technology in healthcare environments have been outpaced”.

### Digital and computer literacy in the undergraduate nursing population

Digital and computer literacy in the undergraduate nursing population emerged as a theme underpinned by the following sub themes:

#### *Digital literacy in undergraduate nursing education*

The need for computer and digital literacy for students and faculty was identified, with Chauvette et al. (2022) noting that nursing faculty struggled to define digital literacy, as it pertained to NI, and tended to equate computer skills with Informatics competency.

#### *Assessment of computer and digital literacy*

Assessment of computer and digital literacies were recommended, including the use of pre-existing NI competency frameworks and assessment tools, basic computer proficiency assessments, student engagement surveys and other assessment tools.

#### *Enhancing computer and digital literacy*

The importance of developing basic computer skills, including the ability to perform database searches, access online courses and resources, perform web searches, use social media, use learning management systems, and word processing prior to commencement of undergraduate Nursing studies were identified.

### Interventions, tools and applications used in Nursing Informatics education in undergraduate nursing programs

Interventions, tools and applications used to embed NI into undergraduate nursing programs, included barcode medication administration, electronic health records, computer patient order entry, standardised electronic assessment forms, telehealth applications, technology-enabled clinical simulation tools and digital learning platforms.

### Faculty development related to NI

Seminars and workshops, mentorship, partnerships with clinical facilities, and access, development and purchase of educational resources were linked with enhancing computer and digital literacies, with Bonnel et al. (2018, p. 195) reminding faculty that "although the tools we use will change, broad teaching learning principles assist students in gaining comfort with basic concepts and changing technologies".

### NI competency standards, frameworks and tools

Nursing competency standards and frameworks applied in the selected studies, included those from the American Association of Colleges of Nursing (AACN) (2008), the American Nurses Association (ANA) (2008; 2015), the Canadian Association of Schools of Nursing (CASN) (2012; 2013), the National League for Nursing (NLN) (2008) and Quality and Safety Education for Nurses Institute (QSEN Institute) (2009, 2022a, 2022b). Australian NI standards included those from the Australian Nursing and Midwifery Council (ANMC) (2006; 2012) the Australian Nursing and Midwifery Federation (ANMF) (2015), and the Nursing & Midwifery Board of Australia (NMBA) and Southern Cross University (2015). More broadly, Health Informatics competency standards and frameworks were identified.

## Rationale for the Delphi study

The rationale for the choice of the Delphi technique includes justification of the choice of the Delphi technique and recognition of the tacit knowledge and value of expert judgment (Jünger et al., 2017). In the proposed study, expert opinion will be sought by using the Delphi Technique, regarding the embedding of NI into undergraduate nursing curricula.

## Methods

### Expert panel

The Delphi technique seeks to collect information from experts on the phenomenon of interest, who have "the required status, experience or knowledge of interest to the researcher" (Whitehead & Whitehead, 2016, p. 112). For the proposed study, the selection of experts will include Nurse Informaticians, experts in NI and Nurse educators, as these populations are deemed to be experts in either education, NI or both.

#### *Recruitment of expert panel*

Recruitment of participants for the Delphi study will be through email, social media and contact with professional Nursing and Health Informatics bodies and will use a proforma approved by the Human Research Ethics Committee (HREC project number 2156). Potential participants who respond to the recruitment information, will be provided with a participant information and consent form and requested to return the signed document.

#### *Panel size*

Keeney et al. (2001) state that the sample size is dependent on the purpose of the project, the Delphi design selected and the time frame available for data collection. A heterogenous sample is more likely to ensure a wide range of opinion is collected (Keeney, Hasson, & McKenna, 2001), and as such, for the proposed study, the selection of experts will include Nurse Informaticians and experts in NI (n=20) and Nurse educators (n=20), with the understanding that attrition throughout the study may result in a smaller population overall.

#### *Anonymity of participants*

Anonymity of group members removes inherent biases, such as conformity and peer pressure (Chalmers & Armour, 2019; Fink-Hafner et al., 2019; Nasa, Jain, & Juneja, 2021); however, complete anonymity is not guaranteed, due to the researcher knowing the group members and the likelihood that the group members know each other, particularly in a specific phenomenon of interest (Keeney, Hasson, & McKenna, 2011). The quasi-anonymity of the experts, in the proposed study will be maintained through assigning a code number to each group member, with the code key only accessible to the researcher and the PhD supervisors.

### Pilot testing of questionnaire

Pilot testing of a survey instrument is recommended to avoid inherent researcher bias (Davidson, 2013), to enhance the validity and reliability of the study findings (Jünger et al., 2017; Keeney, Hasson, & McKenna, 2011; von der Gracht, 2012), to determine the feasibility of data collection procedures (Brooks, Reed, & Savage, 2016; In, 2017; Leon, Davis, & Kraemer, 2011; Morin, 2023; Spurlock, 2018; Teresi et al., 2022), and is a valuable step that can eliminate poorly worded questions and eliminate errors prior to dissemination to the Delphi panel (Clibbens, Walters, & Baird, 2012; Jillson, 2002; Varndell, Fry, & Elliott, 2021). In the proposed study, the first-round questionnaire developed from the findings of the scoping review will be pilot tested to determine the validity and reliability of the survey instrument.

#### *Pilot test participants*

The aim is to recruit a sample of ten participants who are Nurse educators, and therefore have the same inclusion/ exclusion criteria as the main study.

##### *Recruitment of pilot test participants*

Recruitment of pilot test participants will be via email. Potential participants who respond to the recruitment email, will be provided with the *Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study. Pilot Test of a Delphi questionnaire (HREC project number 2156) Participant information and consent form* and requested to return the signed document, prior to progressing to the initial stage of the pilot testing procedure***.***

#### *First round of pilot testing*

Pilot test participants will be sent the first round of the questionnaire. The answers and feedback from each (returned) questionnaire will be input into a summary document and the questionnaires will be evaluated to determine if the participants understood all questions and interpreted questions in the same way; the participants understood the instructions for the questionnaire, including returning of completed questionnaires; and the participants were motivated to complete the questionnaire. Suggested changes to the questionnaire will be identified, considered and implemented (where appropriate). These changes will be reflected in the second round of the questionnaire.

### Consensus

The definition of consensus should be an *a priori* criterion (Jünger et al., 2017). In the proposed study, consensus will be facilitated by the researcher through the iterations of questionnaires to achieve a convergence of opinion, with the understanding that consensus does not imply that a solution or correct answer has been found, but rather that agreement has been reached by the experts (Keeney, Hasson, & McKenna, 2011). As per Barrios et al. (2021), in *Consensus in the delphi method: What makes a decision change?,* a 75% threshold for consensus is sought and where this cannot be obtained, this will be clearly addressed in the study findings.

## Rounds of Delphi

Iterative rounds of questionnaires are used to solicit information from experts. In the proposed study, potential participants will be advised of a maximum of four rounds of questionnaires and accompanying structured interviews which will take no more than 60 minutes.

### Use of reminders

Participants will be asked to return the completed questionnaires within 14 days, with this time frame aiming to limit response times but with the understanding that time limits may need to be modified if response rates were low. Reminders for completion of the First and Second Round Questionnaires, which will consist of free text questions, will be sent out on the due date and seven and fourteen days later, with the final questionnaire submission date five weeks after the first questionnaires were sent out to participants. The Third and subsequent round Questionnaires, which will contain less free text and predominantly consist of Likert questions, will be sent out with one reminder seven days later.

**Non-response**

Participants who do not return the survey instruments or respond to reminder emails will be removed from the study after 5 weeks. The response rates to all rounds of the Delphi study will be recorded in the findings.

## Data analysis

The Classical Delphi technique starts with open-ended questions to generate and facilitate ideas and to elicit opinion, which can generate large amounts of data (Keeney, Hasson, & McKenna, 2011; Procter & Hunt, 1994), with careful analysis of qualitative and quantitative data sets (Hasson, Keeney, & McKenna, 2000). The first round of the Delphi study often involves qualitative data and can be analysed with a thematic analysis approach (Brady, 2015; Holey et al., 2007; Kennedy, 2004; Naserrudin et al., 2022; Sim et al., 2018; Simmons, Barker, & Barnett, 2023; Whitehead, 2008; Woodcock et al., 2020), content analysis approach (Arakawa & Bader, 2022; Hasson, Keeney, & McKenna, 2000; Keeney, Hasson, & McKenna, 2011; Powell, 2002; Spranger et al., 2022), or a descriptive analysis approach (Blaschke, O'Callaghan, & Schofield, 2017; Holey et al., 2007; Rasmussen et al., 2023; Sim et al., 2018; Xu et al., 2022; Zareshahi, Mirzaei, & Nasiriani, 2022), with most studies using a combination of analysis approaches. Powell (2002, p. 379), in *The Delphi technique: myths and realities*, noted that “methods of data analysis appear to vary according to the purpose of the Delphi study, structure of the rounds, types of questions and numbers of participants”. *Demographic sample profiling* can also be used in Round 1, to provide a profile of the expert panel (Keeney, Hasson, & McKenna, 2011). In the second and subsequent rounds, Keeney et al. (2011, p.86) recommended the use of an SPSS database to provide percentages of “the overall response to each statement”.

For the proposed study, NVIVO, a qualitative data analysis software tool will be used for reflexive thematic analysis. Reflexive thematic analysis, as described by Braun and Clarke (Braun & Clarke, 2019, 2022; n.d.; Braun et al., 2019; Braun, Clarke, & Rance, 2014) will be used to analyse qualitative data and determine themes. Descriptive statistics will be used to analyse the demographic data obtained in the First Round Questionnaire and to analyse the Likert scales in the Third and Fourth Round Questionnaires.

**Flow chart development**

A flow chart will be developed to provide an audit trail and strengthen the dependability of the study findings.

## Results

Chalmers and Armour (2019) caution that findings presented in Delphi studies may be undermined by a lack of methodological rigour and clarity and recommend the use of the CREDES Guideline to address these issues. The findings of the Delphi rounds will be disseminated to the PhD supervisors, the Delphi experts and experts external from the study to strengthen external validity.

## Publication and dissemination

Prior to submission of the PhD thesis and publication of journal articles, the findings, conclusion and recommendations of the proposed study will be externally validated using the same procedure as above.

## Funding sources

This Delphi study will be undertaken to meet the partial requirements of a PhD. The PhD candidacy is funded by Commonwealth Grant Scheme (CGS), as part of an Australian Government higher education initiative.

## Conflict of interest

The authors declare no conflict of interest.

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# Appendix B3: HREC Ethics Approval Email

2156- Low Risk Modification Approval

donotreply@infonetica.net
To: Lisa Reid
Cc: Didy Button; Mark Brommeyer; Katrina Breaden

Reply | Reply all | Forward
Mon 22/04/2024 9:15 AM

CAUTION: Only open links and attachments you're expecting.

Dear Mrs Lisa Reid,

We are pleased to advise that the requested modifications to the below project have been **approved** on 22 April 2024.

**Project ID:** 2156

**Project Title:** Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study

**Chief Investigator:** Mrs Lisa Reid

**Approved Co-Investigator/s:** Dr Elizabeth (Didy) Button, Mr Mark Brommeyer, Dr Katrina Breaden -

**Approved Personnel:** -

**Supervisory Panel:** Mr Mark Brommeyer, Dr Elizabeth (Didy) Button, Dr Katrina Breaden -

**Expiry Date:** 24/04/2025

**Conditions of Approval:** -

You can access the application in the ResearchNow Ethics & Biosafety system.

Please don't hesitate to contact the Ethics & Compliance Office if you have any questions.

Regards,

---

Ms Camilla Dorian

Research Development and Support
human.researchethics@flinders.edu.au

Flinders University
Sturt Road, Bedford Park, South Australia, 5042
GPO Box 2100, Adelaide, South Australia, 5001



Please note: this is the current ethics approval. Previous ethics approvals are available on request.

# Appendix B4: Email Recruitment Proforma - Pilot Test

Dear Sir/ Madam,

My name is Lisa Reid, and I am a PhD candidate at the College of Nursing and Health Sciences, Flinders University, South Australia. I am a Registered Nurse and the chief investigator for the study titled: ***Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study*** - ***Pilot test of a Delphi questionnaire***

This project is supported by Flinders University, Office of Graduate Research and the College of Nursing and Health Sciences. The project has been approved by Flinders University's Human Research Ethics Committee (HREC: 2156).

This study will address an identified knowledge gap by adding to the body of knowledge on Nursing Informatics and defining Nursing Informatics as a field. This knowledge map will be used to inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula.

The Pilot Test of the First Round Questionnaire for the Delphi Study will be used to strengthen the validity and reliability of the questionnaire and reduce the risk of researcher bias.

**Benefits of the study**

The sharing of your experiences will be invaluable in addressing the current deficits understanding of Nursing Informatics and will be used to shape undergraduate Nurse education and continual professional development education for Nurses regarding to Nursing Informatics.

**Inclusion criteria**

You are eligible to participate in this Pilot Test if you are:

- A Nurse Informatician
- An expert in Nursing Informatics
- Or a Nurse educator

**Participant involvement and potential risks**

If you agree to participate in the Pilot Test of the Delphi Questionnaire, you will be asked to:

- Review and provide feedback on the Delphi Questionnaire
- Please be advised that you will be asked to review the same document TWICE, in accordance with Pilot test protocol

**If you decide to participate or have further questions**

I would value the opportunity to further discuss the study with you via phone at a time that suits you. If you are amenable to this, please contact me either at lisa.reid@flinders.edu.au or via phone on +61434676142.

Thanking you in anticipation,

**Chief Investigator**

Mrs. Lisa Reid R.N. (Registered Nurse)

College of Nursing and Health Sciences

Flinders University

Email: lisa.reid@flinders.edu.au

Tel: 0434 676 142

# Appendix B5: Participant Information and Consent Form – Pilot Test

Flinders University

## PARTICIPANT INFORMATION SHEET AND CONSENT FORM

**Title:** Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study.
Pilot Test of a Delphi questionnaire (HREC project number 2156).


**Chief Investigator**
Mrs. Lisa Ann Reid
College of Nursing and Health Sciences
Flinders University
Tel: (+61) 434 676 142

**Supervisor**
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Mr. Mark Brommeyer
College of Business, Government and Law
Associate Supervisor
Tel: +61 (0)8 8201 7758
Email: mark.brommeyer@flinders.edu.au


My name is Lisa Reid, and I am a PhD candidate at the College of Nursing and Health Sciences, Flinders University. I am undertaking this research as part of my PhD. For further information, you are more than welcome to contact my supervisor. Their details are listed above.

**Description of the study**
This project is supported by Flinders University, Office of Graduate Research and the College of Nursing and Health Sciences. The project has been approved by Flinders University's Human Research Ethics Committee (HREC project number 2156).

**Purpose of the study**

This study will address an identified knowledge gap by adding to the body of knowledge on Nursing Informatics and defining Nursing Informatics as a field. This knowledge map will be used to structure education for university faculty and Nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of Nursing Informatics competencies which align with the graduate attributes for specific tertiary institutions.

**Benefits of the study**

The sharing of your experiences will be invaluable in addressing the current deficits understanding of Nursing Informatics and will be used to shape undergraduate Nurse education and continual professional development education for Nurses regarding Nursing Informatics.

**Inclusion criteria**

You are eligible to participate in this Pilot Test if you are:

- A Nurse Informatician
- An expert in Nursing Informatics
- Or a Nurse educator

**Participant involvement and potential risks**

If you agree to participate in the Pilot Test of the Delphi Questionnaire, you will be asked to:

- Review and provide feedback on the Delphi Questionnaire
- Please be advised that you will be asked to review the same document TWICE, in accordance with Pilot test protocol

**Withdrawal Rights**

You may decline to take part in this Pilot Test. If you decide to take part and later change your mind, you may withdraw at any time without providing an explanation. To withdraw, please contact the Chief Investigator to have your data removed from the study or you may just refuse to answer any questions or not participate in the Pilot Test at any time. Any data collected up to the point of your withdrawal will be securely destroyed.

**Confidentiality and Privacy**

Only researchers listed on this form have access to the individual information provided by you. Researchers will take all possible steps to ensure privacy and confidentiality will be adhered to at all times.

The research outcomes may be presented at conferences, written up for publication or used for other research purposes as described in this information form. You will not be named, and your individual information will not be identifiable in any research products without your explicit consent.

No data, including identifiable, non-identifiable and de-identified datasets, will be shared, or used in future research projects without your explicit consent. Please provide your consent to this by ticking the appropriate box on the Consent Form at the end of this form.

**Data Storage**

The information collected will be stored securely on a password protected computer and/or Flinders University server throughout the study. Any identifiable data will be de-identified for data storage purposes unless indicated otherwise. All data will be securely transferred to and stored at Flinders University for no more than 10 years after publication of the results. Following the required data storage period, all data will be securely destroyed according to university protocols.

**How will I receive feedback?**
On completion of the Pilot Test, a brief summary of the outcomes will be provided to all participants via email.

**Ethics Committee Approval**
The project has been approved by Flinders University's Human Research Ethics Committee (HREC project number 2156).

**Queries and Concerns**
Queries or concerns regarding the research can be directed to the research team. If you have any complaints or reservations about the ethical conduct of this study, you may contact the Flinders University's Research Ethics and Compliance Office team either via telephone (08) 8201 2543 or by emailing the Office via human.researchethics@flinders.edu.au.

Thank you for taking the time to read this information sheet which is yours to keep.

If you accept our invitation to be involved, please sign the enclosed Consent Form.

## CONSENT FORM

**Title:** Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study.
Pilot test of a Delphi questionnaire (HREC project number 2156).

**Consent Statement**

☐ I have read and understood the information about the research, and I understand I am being asked to provide informed consent to participate in this research study. I understand that I can contact the research team if I have further questions about this research study.

☐ I am not aware of any condition that would prevent my participation, and I agree to participate in this project.

☐ I understand that I am free to withdraw at any time during the study.

☐ I understand that I can contact Flinders University's Research Ethics and Compliance Office if I have any complaints or reservations about the ethical conduct of this study.

☐ I understand that my involvement is confidential, and that the information collected may be published. I understand that I will not be identified in any research products.

☐ I understand that the information collected may be published and that my identity may be revealed.

I further consent to:

☐ completing a questionnaire
☐ sharing my de-identified data with other researchers
☐ my data and information being used in this project and other related projects for an extended period of time (no more than 10 years after publication of the data)
☐ being contacted about other research projects

**Signed:**



**Name:**

**Date:**

# Appendix B6: Pilot Test Questionnaire - Round 1

## Developing a distinct body of knowledge on Nursing Informatics

## A mixed-methods study: Pilot Test

**(Dotted lines and additional spacing removed for purpose of Appendix)**

1. **Understanding of Nursing Informatics**
   (a) In your own words, how would you define Nursing Informatics?
   (b) How is Nursing informatics relevant to Nursing?
2. **Infrastructure and resources**
   (a) What infrastructure and resource facilitators and barriers have you encountered in the use of Nursing Informatics in undergraduate nursing education?
3. **Student access to digital technologies and associated resources**
   (a) What facilitators/enablers and barriers/inhibitors have you encountered in students accessing digital technologies, both in the university and clinical placement settings?
4. **Digital Native**
   (a) In your own words, what does the term Digital Native mean to you?
   (b) How does the concept of the Digital Native inform nursing education?
5. **Evolving nature of Nursing Informatics and digital technologies**
   (a) In your workplace, do you have access to new digital healthcare technologies? If, so, what types of new digital healthcare technologies?
   (b) Are you confident in the use of these technologies?
6. **Faculty resistance and technological stress**
   (a) How has your role changed because of digital healthcare technologies and Nursing Informatics?
   (b) Do you have any concerns regarding your own digital literacy?
7. **Nursing Informatics competencies, recommendations, guidelines, and evidence-based educational strategies**
   (a) Do you use Nursing Informatics competency standards in your role? Please list them.
   (b) What best practice guidelines or evidence-based strategies inform your practice regarding the use of Nursing Informatics?
8. **Digital literacy in undergraduate nursing education**
   (a) In your own words, how would you define computer literacy?
   (b) In your own words, how would you define digital literacy?
   (c) Is there a difference between computer literacy and digital literacy?
9. **Assessment of computer and digital literacy**
   (a) Have you assessed your own computer and digital literacy? If so, what tools have you used?
   (b) In your opinion, should undergraduate nursing students have their computer and digital literacy assessed? If so, when? How frequently? How could the results be used across the program of education?
10. **Enhancing computer and digital literacy**

(a) Do you feel confident in your computer and digital literacy?

(b) How might these competencies be strengthened, for both faculty and undergraduate nursing students?

**11. Interventions, tools, and applications used in Nursing Informatics education in undergraduate nursing programs**

(a) What digital healthcare technologies have you used in undergraduate nursing education?

(b) What additional tools do you believe would enhance undergraduate nursing education?

**12. Faculty development relating to Nursing Informatics**

(a) Have you undertaken professional development relating to Nursing Informatics? If so, please describe the nature of this education.

(b) What professional development would enhance your understanding of Nursing Informatics?

**13. Nursing Informatics competency standards, frameworks, and assessments**

(a) What Nursing Informatics competency standards, frameworks or assessments inform your practice?

(b) Of what value would Nursing Informatics competency standards, frameworks or assessments have in the program of nursing education you are involved with currently?

*Thank you for completing this questionnaire.*
*Your assistance is greatly appreciated.*
*Please return via email to: lisa.reid@flinders.edu.au*

**Chief Investigator**
Mrs. Lisa Reid R.N.
College of Nursing and Health Sciences, Flinders University

# Appendix B7: Pilot Test Questionnaire - Round 2

### Developing a distinct body of knowledge on Nursing Informatics

### A mixed-methods study: Pilot Test

*Dear participant,*
*Thank you for completing the questionnaire for this pilot study.*
*You will notice that many of the questions are the same (or similar), this is to assess the face validity of the questions.*
*Please respond to the questions and include any feedback regarding how the questionnaire could be improved.*

Changes from the Pilot test questionnaire Round 1 are highlighted in italics.
Please note: sections in italics were not included in the Questionnaire given to participants. Headings for questions removed and text boxes, rather than dotted lines included (these have been removed for the purpose of the Appendix).

***Question modified to include additional descriptor.***
1. In your own words, how would you define *or describe* Nursing Informatics?

**Question modified to include additional descriptor.**
2. *In your own words,* how is Nursing Informatics relevant to nursing?

***Deleted*** *– Question 2 (a) What infrastructure and resource facilitators and barriers have you encountered in the use of Nursing Informatics in undergraduate nursing education?*
***Deleted -*** *Question 3 (a) What facilitators/enablers and barriers/inhibitors have you encountered in students accessing digital technologies, both in the university and clinical placement settings?*
***Questions were identified as having too many elements and confusing terminology. Now reflected in Questions 3-6.***

*3. In your own experience, what are the enablers for the use of Nursing informatics in undergraduate nursing education?*

*4. In your own experience, what are the barriers for the use of Nursing informatics in undergraduate nursing education?*

*5. In your own experience, what are the enablers for the use of Nursing informatics in undergraduate clinical placement?*

*6. In your own experience, what are the barriers for the use of Nursing informatics in undergraduate clinical placement?*

7. In your own words, how would you define computer literacy?

**Deleted** - Question 8 (b) *In your own words, how would you define digital literacy?*
**This question was identified as implying that there *was* a difference.**

8. Is digital literacy different to computer literacy? *If so, how?*

**Deleted –** Question 6 (a) How has your role changed because of digital healthcare technologies and Nursing Informatics?
**Question identified as assuming that the participants' role had changed – a leading question.**
**Deleted** – Question 10 (a) - Do you feel confident in your computer and digital literacy?
**Question identified as eliciting a yes/ no response only.**

*9. Do you have any concerns regarding your own computer and/or digital literacy? If so, please identify your concerns.*

**Deleted** - Question 10 (b) How might these competencies be strengthened, for both faculty and undergraduate nursing students?
**Question identified as repetitive and not eliciting the anticipated response.**
**Question now reflected in Question 10.**

*10. How could your computer and/or digital literacy be improved?*

11. Have you assessed your own computer and digital literacy? If so, what tools have you used?

12. In your own words, what does the term Digital Native mean to you?

13. How does the concept of the Digital Native inform nursing education?

**Deleted -** *Question 9 (b) In your opinion, should undergraduate nursing students have their computer and digital literacy assessed? If so, when? How frequently? How could the results be used across the program of education?*
**Question was identified as having too many elements.**
**Now reflected in Questions 14 & 15.**

*14. In your opinion, should undergraduate nursing students have their computer and digital literacy assessed?*

*15. If so, how could these assessments be embedded across the curriculum?*

**Deleted –** Question 5 (a) In your workplace, do you have access to new digital healthcare technologies? If, so, what types of new digital healthcare technologies?
**Question was identified as having too many elements.**
**Deleted –** Question 11 (a) What digital healthcare technologies have you used in undergraduate nursing education?
**Question identified as repetitive and not eliciting the anticipated response.**
**Now reflected in Questions 16-17**

*16. In your workplace, do you use digital health technologies (i.e. electronic health records)?*

*17. If so, what digital health technologies do you use?*

**Deleted –** Question 5 (b) Are you confident in the use of these technologies?
**Now reflected in Question 18**

*18. Are you confident in the use of digital health technologies in your workplace?*

**Deleted –** Question 7 (a) Do you use Nursing Informatics competency standards in your role? Please list them.
**Deleted –** Question 7 (b) What best practice guidelines or evidence-based strategies inform your practice regarding the use of Nursing Informatics?
**Question was identified as assuming understanding of "competency standards".**
**Now reflected in Questions 19 – 21.**

*19. The NMBA (2018) define competence as "the possession of required skills, knowledge, education and capacity". Do you use any Nursing Informatics competencies in your practice?*

*20. If so, please list them.*

*21. Do you feel competent in your use and understanding of Nursing Informatics?*

**Deleted –** Question 12 (a) Have you undertaken professional development relating to Nursing Informatics? If so, please describe the nature of this education.
**Deleted –** Question 12 (b) What professional development would enhance your understanding of Nursing Informatics?
**Now reflected in Questions 22-23**

*22. What education have you undertaken regarding Nursing Informatics?*

*23. What Nursing Informatics education would help translate your knowledge into practice?*

**Deleted** – Question 11 (b) What additional tools do you believe would enhance undergraduate nursing education?

*24. What Nursing Informatics education would help prepare undergraduate nursing students for the clinical setting?*

*Thank you for completing this questionnaire.*
*Your assistance is greatly appreciated.*
*Please return via email to: lisa.reid@flinders.edu.au*

**Chief Investigator**
Mrs. Lisa Reid R.N.
College of Nursing and Health Sciences, Flinders University

# Appendix C1: Email Recruitment Proforma - Delphi Study

Dear Sir/ Madam,

My name is Lisa Reid and I am a PhD candidate at the College of Nursing and Health Sciences, Flinders University, South Australia. I am a Registered Nurse and the chief investigator for the study titled:

***Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study***

This project is supported by Flinders University, Office of Graduate Research and the College of Nursing and Health Sciences. The project has been approved by Flinders University's Human Research Ethics Committee (HREC: 2156).

This study will address an identified knowledge gap by adding to the body of knowledge on Nursing Informatics and defining Nursing Informatics as a field. This knowledge map will be used to inform undergraduate nursing curricula development and provide a blueprint for the development of nursing informatics competencies for undergraduate nursing curricula.

**Benefits of the study**

The sharing of your experiences will be invaluable in addressing the current deficits understanding of Nursing Informatics and will be used to shape undergraduate Nurse education and continual professional development education for Nurses in regard to Nursing Informatics.

**Inclusion criteria**

You are eligible to participate in this study, if you are:

- A Nurse Informatician
- An expert in Nursing Informatics
- Or a Nurse educator

**Participant involvement and potential risks**

If you agree to participate in the research study, you will be asked to:

- Complete a maximum of four rounds of questionnaires regarding your understanding and experiences of nursing informatics
- There will be accompanying structured interviews which will take no more than 60 minutes and participation is entirely voluntary.

**If you decide to participate or have further questions**

I would value the opportunity to further discuss the study with you via phone at a time that suits you. If you are amenable to this, please contact me either at lisa.reid@flinders.edu.au or via phone on +61434676142.

Thanking you in anticipation,

R. Reid

**Chief Investigator**

Mrs. Lisa Reid R.N.

College of Nursing and Health Sciences

Flinders University

Email: lisa.reid@flinders.edu.au

Tel: 0434 676 142

# Appendix C2: Participant Information and Consent Form – Delphi Study

Flinders University

## PARTICIPANT INFORMATION SHEET AND CONSENT FORM

**Title:** Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study.
Delphi Study (HREC project number 2156).

**Chief Investigator**
Mrs. Lisa Ann Reid
College of Nursing and Health Sciences
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Mr. Mark Brommeyer
College of Business, Government and Law
Associate Supervisor
Tel: +61 (0)8 8201 7758
Email: mark.brommeyer@flinders.edu.au

My name is Lisa Reid, and I am a PhD candidate at the College of Nursing and Health Sciences, Flinders University. I am undertaking this research as part of my PhD. For further information, you are more than welcome to contact my supervisor. Their details are listed above.

**Description of the study**
This project is supported by Flinders University, Office of Graduate Research and the College of Nursing and Health Sciences. The project has been approved by Flinders University's Human Research Ethics Committee (HREC project number 2156).

**Purpose of the study**
This study will address an identified knowledge gap by adding to the body of knowledge on Nursing Informatics and defining Nursing Informatics as a field. This knowledge map will be used to structure education for university faculty and Nurses in the clinical setting, inform undergraduate nursing curricula development and provide a blueprint for the development of Nursing Informatics competencies which align with the graduate attributes for specific tertiary institutions.

**Benefits of the study**
The sharing of your experiences will be invaluable in addressing the current deficits understanding of Nursing Informatics and will be used to shape undergraduate Nurse education and continual professional development education for Nurses regarding Nursing Informatics.

**Inclusion criteria**
You are eligible to participate in this study if you are:
- A Nurse Informatician
- An expert in Nursing Informatics
- Or a Nurse educator

**Participant involvement and potential risks**
If you agree to participate in the Delphi Study, you will be asked to:
- Complete a maximum of four rounds of questionnaires regarding your understanding and experiences of nursing informatics
- There will be accompanying structured interviews which will take no more than 60 minutes and participation is entirely voluntary.

**Withdrawal Rights**
You may decline to take part in this Delphi Study. If you decide to take part and later change your mind, you may withdraw at any time without providing an explanation. To withdraw, please contact the Chief Investigator to have your data removed from the study or you may just refuse to answer any questions or not participate in the Pilot Test at any time. Any data collected up to the point of your withdrawal will be securely destroyed.

**Confidentiality and Privacy**
Only researchers listed on this form have access to the individual information provided by you. Researchers will take all possible steps to ensure privacy and confidentiality will be adhered to at all times.

The research outcomes may be presented at conferences, written up for publication or used for other research purposes as described in this information form. You will not be named, and your individual information will not be identifiable in any research products without your explicit consent.

No data, including identifiable, non-identifiable and de-identified datasets, will be shared, or used in future research projects without your explicit consent. Please provide your consent to this by ticking the appropriate box on the Consent Form at the end of this form.

**Data Storage**
The information collected will be stored securely on a password protected computer and/or Flinders University server throughout the study. Any identifiable data will be de-identified for data storage purposes unless indicated otherwise. All data will be securely transferred to and stored at Flinders University for no more than 10 years after publication of the results. Following the required data storage period, all data will be securely destroyed according to university protocols.

**How will I receive feedback?**
On completion of the Delphi Study, a brief summary of the outcomes will be provided to all participants via email.

**Ethics Committee Approval**
The project has been approved by Flinders University's Human Research Ethics Committee (HREC project number 2156).

**Queries and Concerns**
Queries or concerns regarding the research can be directed to the research team. If you have any complaints or reservations about the ethical conduct of this study, you may contact the Flinders University's Research Ethics and Compliance Office team either via telephone (08) 8201 2543 or by emailing the Office via human.researchethics@flinders.edu.au.

Thank you for taking the time to read this information sheet which is yours to keep.

If you accept our invitation to be involved, please sign the enclosed Consent Form.

## CONSENT FORM

**Title:** Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study.
Pilot test of a Delphi questionnaire (HREC project number 2156).

**Consent Statement**

- ☐ I have read and understood the information about the research, and I understand I am being asked to provide informed consent to participate in this research study. I understand that I can contact the research team if I have further questions about this research study.
- ☐ I am not aware of any condition that would prevent my participation, and I agree to participate in this project.
- ☐ I understand that I am free to withdraw at any time during the study.
- ☐ I understand that I can contact Flinders University's Research Ethics and Compliance Office if I have any complaints or reservations about the ethical conduct of this study.
- ☐ I understand that my involvement is confidential, and that the information collected may be published. I understand that I will not be identified in any research products.
- ☐ I understand that the information collected may be published and that my identity may be revealed.

I further consent to:

- ☐ completing a questionnaire
- ☐ sharing my de-identified data with other researchers
- ☐ my data and information being used in this project and other related projects for an extended period of time (no more than 10 years after publication of the data)
- ☐ being contacted about other research projects

**Signed:**

**Name:**

**Date:**

# Appendix C3: Delphi Study Questionnaire - Round 1

### Developing a distinct body of knowledge on Nursing Informatics

### A mixed-methods study: Delphi study

*Dear participant,*
*Thank you for completing the questionnaire for this pilot study.*
*You will notice that many of the questions are the same (or similar), this is to assess the face validity of the questions.*
*Please respond to the questions and include any feedback regarding how the questionnaire could be improved.*

**Changes from the Pilot test questionnaire Round 2 are highlighted in italics.**
**Please note: sections in italics were not included in the Questionnaire given to participants. (Text boxes removed for purpose of Appendix).**

1. In your own words, how would you define or describe Nursing Informatics?

**Question modified to avoid leading question.**

*2. Is Nursing Informatics relevant to nursing? If so, how?*

3. In your own experience, what are the enablers for the use of Nursing informatics in undergraduate nursing education?

4. In your own experience, what are the barriers for the use of Nursing informatics in undergraduate nursing education?

**Deleted** – Question 5. In your own experience, what are the enablers for the use of Nursing informatics in undergraduate clinical placement?
**Deleted** – Question 6. In your own experience, what are the barriers for the use of Nursing informatics in undergraduate clinical placement?
**Questions identified as being repetitive, with most participants referring to the responses from Questions 3 & 4.**

*5.* In your own words, how would you define computer literacy?

*6.* Is digital literacy different to computer literacy? If so, how?

*7.* Do you have any concerns regarding your own computer and/or digital literacy? If so, please identify your concerns.

*8.* How could your computer and/or digital literacy be improved?

**Deleted** – Question 11. Have you assessed your own computer and digital literacy? If so, what tools have you used?
**Question identified as having limited responses with minimal useful data.**

*9.* In your own words, what does the term Digital Native mean to you?

*10*. How does the concept of the Digital Native inform nursing education?

*11.* In your opinion, should undergraduate nursing students have their computer and digital literacy assessed?

*12.* If so, how could these assessments be embedded across the curriculum?

**Deleted** – Question 16. In your workplace, do you use digital health technologies (i.e. electronic health records)?
**Close-ended question with limited useful data – question merged with Question 17.**
**Deleted** – Question 17. If so, what digital health technologies do you use?
**Emphasis on ‘health’, as some responses related to generic digital technologies**

*13.* What digital *health* technologies do you use in your current position?

**No changes required, except for emphasis on 'health' as described above.**

*14*. Are you confident in the use of digital *health* technologies in your workplace?

**Deleted** – Question 19. The NMBA (2018) define competence as "the possession of required skills, knowledge, education and capacity". Do you use any Nursing Informatics competencies in your practice?
**Deleted** – Question 20. If so, please list them.
**Limited responses with minimal useful data – question deleted and new question added.**

*15. What Informatics competencies, recommendations, or guidelines inform your use of Nursing Informatics?*

**Deleted** - Question 21. Do you feel competent in your use and understanding of Nursing Informatics?
**Limited responses with minimal useful data due to close-ended question. Question deleted and new question added.**

*16. In your own words, how would you describe your own Nursing Informatics competence level?*

*17.* What education have you undertaken regarding Nursing Informatics?

**Deleted** – Question 23. What Nursing Informatics education would help translate your knowledge into practice?
**Limited responses with minimal useful data due to close-ended question. Question deleted and new question added.**

*18. What Nursing Informatics education would be helpful for you?*

*19.* What Nursing Informatics education would help prepare undergraduate nursing students for the clinical setting?

*Thank you for completing this questionnaire.*

*Your assistance is greatly appreciated.*

*Please return via email to: lisa.reid@flinders.edu.au*

**Chief Investigator**

Mrs. Lisa Reid R.N.

College of Nursing and Health Sciences, Flinders University

# Appendix C4: Delphi Study Questionnaire - Round 2

**Developing a distinct body of knowledge on Nursing Informatics**

**A mixed-methods study: Delphi study**

**(Dotted lines and text boxes removed for purpose of Appendix).**

*Dear Participant,*
*Thank you for completing the first questionnaire for this study.*
*Your answers have provided excellent information regarding key concepts and issues.*
*To provide me with a greater understanding of some concepts and issues, further clarification is required.*

1. In the first-round questionnaire, Nursing Informatics was defined as the use of nursing, computer and information science to better understand patient data for improved health outcomes and evidence-based care <u>and</u> managing and communicating data, information and knowledge to enhance nursing care, education, research and administration

- In your opinion, should anything be added to this definition of Nursing Informatics?

2. A question was raised regarding the relevance of the term Nursing Informatics and whether this was an outdated term that no longer reflected contemporary nursing practice in a digital environment.

- In your opinion, is the term Nursing Informatics relevant to contemporary nursing practice in a digital environment?
- What alternative terminology could be used?

3. In the first-round questionnaire, a lack of understanding of Nursing Informatics was identified – this included for nursing students, educators, nurses in clinical settings and university hierarchy.

- In your opinion, is Nursing Informatics adequately understood by these groups? If not, why not.

4. In the first-round questionnaire, computer literacy was defined as the ability to navigate and perform functions on a computer and perform basic troubleshooting. And digital literacy was defined as deeper level thinking than computer literacy with the use of various devices, platforms and software <u>and</u> the ability to find, evaluate, create, and communicate data, incorporating computer literacy within digital ecosystems.

- In your opinion, should anything be added to these definitions?

5. A question was asked regarding the term Digital Native and whether this accurately reflected the majority of undergraduate Nursing students. Prensky (2001) used the term Digital Native to describe students who have grown up with digital technology and "think and process information fundamentally differently from their predecessors".

- In your opinion, is growing up with technology linked with computer and digital literacy? Discuss.

*Thank you for completing this questionnaire.*
*Your assistance is greatly appreciated.*
*Please return via email to: lisa.reid@flinders.edu.au*

**Chief Investigator**
Mrs. Lisa Reid R.N.
College of Nursing and Health Sciences, Flinders University

# Appendix C5: Delphi Study Questionnaire - Round 3

## Developing a distinct body of knowledge on Nursing Informatics A mixed-methods study - 3rd Round

**Please note – spacing reduced for purpose of appendix.**

Dear Participant,
Thank you for completing the second questionnaire for this study.
Your answers have provided comprehensive information regarding key concepts and issues.
This survey addresses enablers and barriers for the use of Nursing Informatics in undergraduate nursing education and recommendations for specific topic content in the curriculum.
Please complete this survey by 17/06/2024.
Each participant has been provided with a different code to ensure that survey responses remain anonymous.
Please contact me at lisa.reid@flinders.edu.au if you have any questions.
Thank you for your continuing efforts,
Lisa

Q1 In your own experience, what are the enablers for the use of Nursing Informatics (NI) in undergraduate nursing education?
Please rate your agreement with each of the following statements:

| | Strongly disagree (1) | Somewhat disagree (2) | Neither agree nor disagree (3) | Somewhat agree (4) | Strongly agree (5) |
|---|---|---|---|---|---|
| Access to digital health technologies (1) | ○ | ○ | ○ | ○ | ○ |
| Technical support for students and university faculty (2) | ○ | ○ | ○ | ○ | ○ |
| Modern simulation resources (3) | ○ | ○ | ○ | ○ | ○ |
| Support from university hierarchy (4) | ○ | ○ | ○ | ○ | ○ |
| Education regarding a broad range of digital health technologies (5) | ○ | ○ | ○ | ○ | ○ |
| Development of digital literacy (6) | ○ | ○ | ○ | ○ | ○ |
| NI embedded throughout curriculum (7) | ○ | ○ | ○ | ○ | ○ |
| Curriculum driven by workforce requirements (8) | ○ | ○ | ○ | ○ | ○ |
| Curriculum informed by competency standards (9) | ○ | ○ | ○ | ○ | ○ |
| Linking NI with contemporary nursing practice (10) | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| NI as a standalone topic (11) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Use of NI in clinical placements (12) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Use of NI in simulation/ lab classes (13) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Faculty who understand NI (14) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Professional development of university faculty (15) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Development of NI competencies (16) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Standardised undergraduate Nursing curriculum (17) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Recognition of NI from peak Nursing bodies (18) | ◯ | ◯ | ◯ | ◯ | ◯ |

Q2 In your opinion, are there any other enablers for the use of Nursing Informatics in undergraduate nursing education?

Q3 In your own experience, what are the barriers for the use of Nursing Informatics (NI) in undergraduate nursing education?
Please rate your agreement with each of the following statements:

| | Strongly disagree (1) | Somewhat disagree (2) | Neither agree nor disagree (3) | Somewhat agree (4) | Strongly agree (5) |
|---|---|---|---|---|---|
| Costs/ funding (1) | | | | | |
| Lack of access to digital health technologies on placement (2) | | | | | |
| Lack of access to current digital health technologies in university (3) | | | | | |
| Lack of professional development for university faculty (4) | | | | | |
| Lack of technical support for students and faculty (5) | | | | | |
| Lack of incentive to include NI (6) | | | | | |
| Lack of integration of NI throughout curriculum (7) | | | | | |
| Overfull curriculum (8) | | | | | |
| Varying levels of digital literacy in students (9) | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Varying levels of digital literacy in university faculty (10) | ○ | ○ | ○ | ○ | ○ |
| Resistance to change from university faculty (11) | ○ | ○ | ○ | ○ | ○ |
| Resistance to change from university hierarchy (12) | ○ | ○ | ○ | ○ | ○ |
| Lack of understanding of NI from university faculty (13) | ○ | ○ | ○ | ○ | ○ |
| Lack of understanding of NI from university hierarchy (14) | ○ | ○ | ○ | ○ | ○ |
| Lack of understanding of NI from nurses in the clinical setting (15) | ○ | ○ | ○ | ○ | ○ |

Q4 In your opinion, are there any other barriers for the use of Nursing Informatics in undergraduate nursing education?

Q5 In your own opinion, what specific content (regarding Nursing Informatics) should be addressed in undergraduate nursing education?
Please rate your agreement with each of the following statements

| | Strongly disagree (1) | Somewhat disagree (2) | Neither agree nor disagree (3) | Somewhat agree (4) | Strongly agree (5) |
|---|---|---|---|---|---|
| Adopting new and emergent technologies (1) | ○ | ○ | ○ | ○ | ○ |
| Artificial Intelligence (2) | ○ | ○ | ○ | ○ | ○ |
| Digital literacy (3) | ○ | ○ | ○ | ○ | ○ |
| Data management (4) | ○ | ○ | ○ | ○ | ○ |
| Data security and privacy (5) | ○ | ○ | ○ | ○ | ○ |
| Digital devices (6) | ○ | ○ | ○ | ○ | ○ |
| Digital health (7) | ○ | ○ | ○ | ○ | ○ |
| EMR/ EHR - electronic health records (8) | ○ | ○ | ○ | ○ | ○ |
| EMM - electronic medication management systems (9) | ○ | ○ | ○ | ○ | ○ |
| Telehealth (10) | ○ | ○ | ○ | ○ | ○ |

Q6 In your opinion, is there any other specific content (regarding Nursing Informatics) that should be addressed in undergraduate nursing education?

# Appendix C6: Delphi Study Questionnaire - Round 4

## Developing a distinct body of knowledge on Nursing Informatics A mixed-methods study – 4th Round

**Please note – spacing reduced for purposes of appendix**

Dear Participant,
Thank you for the comprehensive and insightful information you have provided regarding the integration of Nursing Informatics into undergraduate nursing education.
This is the final survey for this study and provides a summary of the key findings from this study and the opportunity to provide any final information you believe is pertinent to the topic.
Please complete this survey by 25/07/2024.
Each participant has been provided with a different code to ensure that survey responses remain anonymous.
Please contact me at lisa.reid@flinders.edu.au if you have any questions.
Thank you for your enthusiasm in taking part in this study.
Kind regards,
Lisa

Q1 How would you describe your gender

○ Female (1)

○ Male (2)

○ Other (3)

○ Prefer not to say (4)

The enablers for the integration of Nursing Informatics into undergraduate nursing education, which reached the consensus level of 75% agreement, included:

- Access to digital health technologies
- Technical support
- Simulation resources
- Range of digital health technologies
- Digital literacy development
- Nursing Informatics embedded throughout curriculum
- Curriculum linked with competency standards
- Linking Nursing Informatics with contemporary nursing practice
- Use of Nursing Informatics in clinical placements
- Use of Nursing Informatics in simulation/lab classes
- University faculty who understand Nursing Informatics
- Professional development of University faculty
- Development of Nursing Informatics competencies
- Recognition of Nursing Informatics from peak Nursing bodies

Q2 In your opinion, are there any other enablers that should be included?

The barriers for the integration of Nursing Informatics into undergraduate nursing education, which reached the consensus level of 75% agreement, included:

- Costs/ funding
- Lack of access to digital technologies – placement
- Lack of access to digital technologies – university
- Lack of professional development - university faculty
- Lack of incentive to include Nursing Informatics in the curriculum
- Lack of integration of Nursing Informatics throughout the curriculum
- Overfull curriculum
- Varying levels of digital literacy - university faculty
- Lack of understanding of Nursing Informatics – faculty
- Lack of understanding of Nursing Informatics - university hierarchy
- Lack of understanding of Nursing Informatics - nurses in the clinical setting

Q3 In your opinion, are there any other barriers that should be included?

The recommendations for Nursing Informatics content in undergraduate nursing education, which reached the consensus level of 75% agreement, included:

- Adopting new and emergent technologies
- Artificial intelligence
- Digital literacy
- Data management

- Data security and privacy
- Digital devices
- Digital health
- Electronic Medical Records/ Electronic Health Records
- Electronic Medication Management Systems
- Telehealth

Q4 In your opinion, should any additional Nursing Informatics content be included in undergraduate nursing education?

Q5 Do you have any other information or comments you with to provide?

# Appendix D1: Graduate Attributes

**Research and critical thinking skills:** relates to the development of knowledge about theoretical frameworks and research methods to apply to new research problems; the ability to collect, synthesis and analyse data; the ability to articulate problems, questions, evidence and assumptions; and the application of high level research skills in the development of novel approaches (Office of Graduate Research, 2022). Through the research process, I identified relevant frameworks and research methods to address the study aims and research questions. I developed my understanding of pragmatism and the work of John Dewey, applying this theoretical underpinning to mixed-methods research. I explored the use of scoping review, the work of Arksey and O'Malley, underpinned by the recommendations from PRISMA-ScR and JBI Evidence Synthesis. I developed my understanding of the Delphi study approach and applied CREDES. I identified gaps in my knowledge of statistics and sought support to develop my competency in this area. Each of these aspects are articulated throughout this thesis.

**Depth of disciplinary expertise:** relates to the development of in-depth knowledge about the phenomenon of interest, as it relates to the relevant discipline; understanding when to seeks multidisciplinary knowledge, the application of academic and intellectual rigour to develop new ways of understanding; and the creation of a significant original contribution to knowledge (Office of Graduate Research, 2022). The development of in-depth knowledge about nursing informatics and the nursing profession was developed through the literature review, the scoping review and the Delphi study. Attendance at conferences and reading contemporary literature informed a broader understanding of digital health, beyond nursing informatics, and provided a deeper understanding of current global health care challenges. Application of both academic and intellectual rigour are evident in the REST (Research and Employability Skills Training) Program, which was completed throughout the candidacy and encouraged me to identify gaps in my understanding and seek valid solutions; as a consequence, I completed the 22 identified skills and achieved all of the graduate attributes (refer to *Appendix D1*).

**Personal and professional awareness:** refers to the practice of critical reflection on both the professional and personal self; working in an independent and self-directed manner; maintaining motivation and perseverance; and maintaining intellectual curiosity and a willingness to learn (Office of Graduate Research, 2022). Throughout my candidacy, I have engaged in self-reflection, have demonstrated a capacity to work in an independent and self-directed manner, and have maintained my intellectual curiosity. I have sought support as needed, have challenged myself to search for answers to my questions, and have maintained constant communication with my PhD supervisors. Importantly, despite the sudden ill health of my husband in the early stages of my candidacy and the special needs of my three boys, I have remained determined to complete my doctoral studies; this has been in no small part to the unwavering support of my family, friends, colleagues and supervisors.

**Project management and research integrity:** refers to the ability to implement multi-stakeholder, multiphase projects; maintaining awareness of and responding to challenges; aligning research to the institutional governance of Flinders University and College of Nursing and Health Sciences (Office of Graduate Research, 2022). I have demonstrated my ability to complete a multiphase, mixed-methods research project with multiple stakeholders, including the 61 Delphi study participants. I have identified challenges and sought solutions. For example, a common issue with Delphi studies is a reduction in participant response rates; in response to this challenge, I maintained individual and private communication with all participants, with the final questionnaire completed by 49 participants. I have also demonstrated adherence with the requirements of the University and the College, through the completion of the required milestones, throughout my candidacy.

**Integrity and ethics:** relates to adhering to the standards, policies and practices of Flinders University and adherence to Australian Code for the Responsible Conduct of Research; demonstrating integrity and ethics through data collection, analysis and dissemination of data;

critically reflecting on both personal and professional ethics; and contributing to a culture of respect and ethical conduct (Office of Graduate Research, 2022). In preparation for the research study, I completed the HDR/RHD Workshop Ethics and Integrity in Research with Humans Program by the University of Adelaide, Flinders University and the University of South Australia. I participated in ethics workshops and activities provided by the Flinders University Human Research and Ethics Committee and completed an ethics application (HREC 2156). As a tutor in undergraduate nursing ethics, I critically reflected on my personal and professional ethical obligations and ensure that my conduct with all parties throughout my candidacy adhered the standards, policies and practices of Flinders University and the Australian Code for the Responsible Conduct of Research.

**Effective communication skills:** relates to the ability to communicate with a diverse range of people; to identify appropriate methods of research dissemination; to participate in positive critical dialogue; and to write in a coherent and convincing manner (Office of Graduate Research, 2022). Throughout my candidacy, I have exhibited a high level of communication skills through the participation in conferences and professional groups, through discussions with my PhD supervisors, and through writing this thesis and publishing my research.

**Teamwork and collaboration:** refers to establishing and building relationships; working effectively with supervisors and colleagues; and motivating others to achieve their goals through interacting with their research (Office of Graduate Research, 2022). My ability to work as part of a team has been evident in my work as a tutor in the College of Nursing and Health Sciences, Flinders University and the Flinders Digital Health Research Centre, my interactions with my PhD supervisors, colleagues and research participants, and my interactions with fellow PhD candidates across Australia and globally.

**Engagement and impact:** refers to understanding of the potential impact of the research study and the contribution to the society; the seeking of opportunities to engage in two-way exchanges of knowledge; understanding of copyright and intellectual property; and the seeking of opportunities to disseminate the research globally (Office of Graduate Research, 2022). The initial reason for exploring nursing informatics and undergraduate nursing education, was to provide practical solutions to the workforces preparedness of graduate nurses; as a consequence, I actively engaged with nurses, other health care professionals, digital health experts and other key stakeholders throughout my candidacy, I have been an active participant in professional groups, have participated in the conferences regarding nursing education and digital health and have published as part of my research and with other researchers (please see below).

# Appendix D2: Co-Authorship Document

Office of Graduate Research
Room 003, Registry Building
Bedford Park, SA 5042
GPO Box 2100, Adelaide 5001 Australia
Email: hdrexams@flinders.edu.au
Phone: (08) 8201 3854
Website: https://students.flinders.edu.au/my-course/hdr
CRICOS Provider: 00114A

## CO-AUTHORSHIP APPROVALS FOR HDR THESIS FOR EXAMINATIONS

In accordance with Clause 5, 7 and 8 in the HDR Thesis Rules, a student must sign a declaration that the thesis does not contain any material previously published or written by another person except where due reference is made in the text or footnotes. There can be no exception to this rule.

a. Publications or significant sections of publications (whether accepted, submitted or in manuscript form) arising out of work conducted during candidature may be included in the body of the thesis, or submitted as additional evidence as an appendix, on the following conditions:
   I. they contribute to the overall theme of the work, are conceptually linked to the chapters before and after, and follow a logical sequence
   II. they are formatted in the same way as the other chapters (i.e. not presented as reprints unless as an appendix), whether included as separate chapters or integrated into chapters
   III. they are in the same typeface as the rest of the thesis (except for reprints included as an appendix)
   IV. published and unpublished sections of a chapter are clearly differentiated with appropriate referencing or footnotes, and
   V. unnecessary repetition in the general introduction and conclusion, and the introductions and conclusions of each published chapter, is avoided.

b. Multi-author papers may be included within a thesis, provided:
   I. the student is the primary author
   II. there is a clear statement in prose for each publication at the front of each chapter, recording the percentage contribution of each author to the paper, from conceptualisation to realisation and documentation.
   III. The publication adheres to Flinders Research Publication, Authorship and Peer Review Policy, and
   IV. each of the other authors provides permission for use of their work to be included in the thesis on the form below.

c. Papers where the student is not the primary author may be included within a thesis if a clear justification for the paper's inclusion is provided, including the circumstances relating to production of the paper and the student's position in the list of authors. However, it is preferable to include such papers as appendices, rather than in the main body of the thesis.

## STUDENT DETAILS

| | |
|---|---|
| Student Name | Lisa Ann Reid |
| Student ID | 2196298 |
| College | College of Nursing & Health Sciences |
| Degree | PhD |
| Title of Thesis | Developing a distinct body of knowledge on Nursing Informatics: A mixed-methods study |

## PUBLICATION 1

This section is to be completed by the student and co-authors. If there are more than four co-authors (student plus 3 others), only the three co-authors with the most significant contributions are required to sign below.

*Please note: A copy of this page will be provided to the Examiners.*

| | |
|---|---|
| Full Publication Details | Reid, L., Maeder, A., Button, D., Breaden, K., & Brommeyer, M. (2021). Defining Nursing Informatics: A Narrative Review. In M. Honey, C. Ronquillo, T.-T. Lee, & L. Westbrooke (Eds.), |
| Section of thesis where publication is referred to | Chapter 1; Chapter 2; Chapter 5 |

Student's contribution to the publication

| | | |
|---|---|---|
| 50 | % | Research design |
| 75 | % | Data collection and analysis |
| 75 | % | Writing and editing |

Outline your (the student's) contribution to the publication:

Primary and corresponding author and initially conceived of the paper.
The first draft of the manuscript was completed by the student.
Responded to feedback from the co-authors and revised the manuscript.
Submitted the manuscript to the conference convenors following agreement with all co-authors.

## APPROVALS

By signing the section below, you confirm that the details above are an accurate record of the students contribution to the work.

| | | | | | |
|---|---|---|---|---|---|
| Name of Co-Author 1 | Anthony Maeder | Signed | AMaeder | Date | 27 Aug 2024 |
| Name of Co-Author 2 | Didy Button | Signed | Didy Button | Date | 6 Sept 2024 |
| Name of Co-Author 3 | Katrina Breaden | Signed | | Date | 09 Sep 2024 |

## PUBLICATION 2

This section is to be completed by the student and co-authors. If there are more than four co-authors (student plus 3 others), only the three co-authors with the most significant contributions are required to sign below.

*Please note: A copy of this page will be provided to the Examiners.*

| | |
|---|---|
| Full Publication Details | Reid, L., Button, D., Breaden, K., & Brommeyer, M. (2022). Nursing informatics and undergraduate nursing curricula: A scoping review protocol. Nurse Education in Practice, 65, |
| Section of thesis where publication is referred to | Chapter 1; Chapter 4; Chapter 5; Chapter 7 |

Student's contribution to the publication

| | | |
|---|---|---|
| 75 | % | Research design |
| 75 | % | Data collection and analysis |
| 75 | % | Writing and editing |

Outline your (the student's) contribution to the publication:

Primary and corresponding author and initially conceived of the paper.
The first draft of the manuscript was completed by the student.
Responded to feedback from the co-authors and revised the manuscript.
Submitted the manuscript to the conference convenors following agreement with all co-authors.

## APPROVALS

By signing the section below, you confirm that the details above are an accurate record of the students contribution to the work.

| | | | | | |
|---|---|---|---|---|---|
| Name of Co-Author 1 | Didy Button | Signed | Didy Button | Date | 6 Sept 2024 |
| Name of Co-Author 2 | Katrina Breaden | Signed | K Bread | Date | 09 Sep 2024 |
| Name of Co-Author 3 | Mark Brommeyer | Signed | Mark Brommeyer | Date | 24.09.2024 |

## PUBLICATION 3

This section is to be completed by the student and co-authors. If there are more than four co-authors (student plus 3 others), only the three co-authors with the most significant contributions are required to sign below.

*Please note: A copy of this page will be provided to the Examiners.*

| | |
|---|---|
| Full Publication Details | Reid, L., Button, D., & Brommeyer, M. (2023). Challenging the Myth of the Digital Native: A Narrative Review. Nursing Reports, 13(2), 573-600. http://doi.org/10.3390/ |
| Section of thesis where publication is referred to | Chapter 2; Chapter 5; Chapter 7; Chapter 8 |

Student's contribution to the publication

| | | |
|---|---|---|
| 50 | % | Research design |
| 33 | % | Data collection and analysis |
| 50 | % | Writing and editing |

Outline your (the student's) contribution to the publication:

Primary author with Mr. Mark Brommeyer.
Corresponding author.
Shared responsibilities in initial conception of paper, completing all research steps and finalising the manuscript with Mr. Mark Brommeyer.
Shared responsibilities in data synthesis, interpretation and quality appraisal with all

## APPROVALS

By signing the section below, you confirm that the details above are an accurate record of the students contribution to the work.

| | | | | | |
|---|---|---|---|---|---|
| Name of Co-Author 1 | Didy Button | Signed | Didy Button | Date | 6 Sept 2024 |
| Name of Co-Author 2 | Mark Brommeyer | Signed | Mark Brommeyer | Date | 24.09.2024 |
| Name of Co-Author 3 | | Signed | | Date | |

## PUBLICATION 4

This section is to be completed by the student and co-authors. If there are more than four co-authors (student plus 3 others), only the three co-authors with the most significant contributions are required to sign below.

*Please note: A copy of this page will be provided to the Examiners.*

| | |
|---|---|
| Full Publication Details | Reid, L., Button, D., Breaden, K., & Brommeyer, M. (2024). Nursing Informatics: Competency Challenges for Nursing Faculty. In J. Bichel-Findlay, P. Otero, P. Scott, & E. Huesing |
| Section of thesis where publication is referred to | Chapter 2; Chapter 7; Chapter 8 |

| | | | |
|---|---|---|---|
| Student's contribution to the publication | 75 | % | Research design |
| | 75 | % | Data collection and analysis |
| | 75 | % | Writing and editing |

Outline your (the student's) contribution to the publication:

Primary and corresponding author and initially conceived of the paper.
The first draft of the manuscript was completed by the student.
Responded to feedback from the co-authors and revised the manuscript.
Submitted the manuscript to the conference convenors following agreement with all co-authors.

## APPROVALS

By signing the section below, you confirm that the details above are an accurate record of the students contribution to the work.

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|---|---|---|---|---|---|
| Name of Co-Author 1 | Didy Button | Signed | Didy Button | Date | 6 Sept 2024 |
| Name of Co-Author 2 | Katrina Breaden | Signed | K Bread | Date | 09 Sep 2024 |
| Name of Co-Author 3 | Mark Brommeyer | Signed | Mark Brommeyer | Date | 24.09.2024 |

# Appendix D3: REST Certificate

Flinders University

OFFICE OF GRADUATE RESEARCH CERTIFIES THAT

## Lisa Reid

HAS COMPLETED THE

# Research and Employability Skills Development Program

AND ATTAINED THE FOLLOWING SKILLS ACROSS THE DOCTORAL GRADUATE ATTRIBUTES

| GRADUATE ATTRIBUTE | SKILL | DATE COMPLETED |
|---|---|---|
| **Research and Critical Thinking** | Research Methods | 26 Jan 2022 |
| | Critical Thinking | 22 Nov 2021 |
| | Analysing and Evaluating Data | 2 July 2023 |
| **Depth of Disciplinary Expertise** | Literature Review | 22 Nov 2021 |
| | Thesis Writing | 3 Feb 2022 |
| | Argument Construction | 22 Nov 2021 |
| **Personal and Professional Awareness** | Personal Awareness & Growth | 22 Nov 2021 |
| | Time Management & Work-life Balance | 22 Nov 2021 |
| | Career Planning | 26 Jan 2022 |
| **Project Management and Research Strategy** | Research Project Management | 26 Jan 2022 |
| | Candidature Management | 22 Nov 2021 |
| | Research Strategy & Funding | 10 Feb 2022 |
| **Integrity and Ethics** | HDR Practice & Process | 22 Nov 2021 |
| | Research Practice | 2 July 2023 |
| **Effective Research Communication** | Research Dissemination | 22 Nov 2021 |
| | Academic Publishing | 22 Nov 2021 |
| | Communicating Research Impact | 22 Nov 2021 |
| **Collaboration and Leadership** | HDR Supervision | 22 Nov 2021 |
| | Collaboration & Leadership | 22 Nov 2021 |
| **Engagement and Impact** | Teaching | 22 Nov 2021 |
| | Industry Engagement | 22 Nov 2021 |
| | Entrepreneurship | 26 Jan 2022 |

PROFESSOR RAY CHAN
DEPUTY VICE-CHANCELLOR (RESEARCH)

CERTIFICATE GENERATED ON THE 5/9/24

CRICOS No. 00114A

# Flinders University Doctoral Graduate Attributes

**1. Research and Critical Thinking**
- Utilises comprehensive knowledge of relevant theoretical frameworks and research methods to apply the appropriate framework to new, abstract and complex research problems.
- Collects, synthesises and evaluates complex data, followed by insightful and critical analysis of results.
- Articulates, understands and questions ideas, assumptions, evidence and information to develop independent and critical thinking.
- Applies high level research and critical thinking skills to formulate unique hypotheses, alternative arguments and novel approaches.

**2. Depth of Disciplinary Expertise**
- Systematically acquires in-depth strategic understanding of a substantial body of knowledge which is at the forefront of their discipline internationally.
- Understands the boundaries of their primary discipline's knowledge base and knows when to access multi-disciplinary knowledge to enable an inter-disciplinary solution.
- Applies academic/intellectual rigour to challenge the status quo and develops new and innovative ways of understanding.
- Creates a significant, original contribution to knowledge through the production of relevant research outputs.

**3. Personal and Professional Awareness**
- Continuously reflects on practice, experience and own strengths and weaknesses to further develop the professional and personal self.
- Operates strategically in an independent and self-directed manner, identifying milestones, prioritising, planning, setting and meeting deadlines.
- Maintains motivation and demonstrates perseverance when significant setbacks and obstacles arise, seeking support and advice when needed.
- Curious, willing to learn and keeps an open mind, adapting to change by acquiring knowledge and identifying opportunities.

**4. Project Management and Research Strategy**
- Plans and implements complex, multiphase projects including stakeholder and resource management.
- Maintaining awareness of potential challenges and risks, adapting and re-aligning research to ensure strategic outcomes are achieved.
- Aligns research project to institutional governance and strategic direction of the college and university.
- Understands that no one solution is perfect and can reconcile research imperatives with competing outcomes, reconsidering decisions when needed.

**5. Integrity and Ethics**
- Respects the standards, policies and practices of Flinders University and the Australian Code for the Responsible Conduct of Research.
- Demonstrates research integrity and ethics in the collection, processing and dissemination of data and information.
- Develops an awareness of their professional and personal ethics, seeking to reconcile differences.
- Actively contributes to a culture of respect and ethical behaviour, including respectful interactions with a wide variety of research stakeholders.

**6. Effective Research Communication**
- Communicates and explains complex ideas to diverse audiences, including both specialist and non-specialist, through a range of methods.
- Determines the channel, method or mode of information dissemination in relation to the aims of communication, audience and type of information.
- Participates in positive critical dialogue, presenting ideas clearly and logically, actively reflecting on others' arguments and contributing to the information presented.
- Writes coherently and convincingly, constructing an academically rigorous argument to communicate an evidenced body of research.

**7. Collaboration and Leadership**
- Establishes and builds relationships, maintaining cooperative networks with a diverse range of people and stakeholders across discipline, international and sector boundaries.
- Works effectively with supervisors and colleagues by building professional relationships, maintaining open communication, resolving conflicts and working towards joint goals.
- Guides and motivates others in achieving goals, providing constructive and positive feedback and clear direction when required.
- Influences others' understanding of and interaction with their research through establishing credibility, trust and open engagement.

**8. Engagement and Impact**
- Understands the potential impact of their research, particularly the contribution their research makes to the economy, society, environment or culture.
- Seeks opportunities to create two-way knowledge exchange, sharing skills, technology, methods and expertise, with relevant audiences in Australia and internationally.
- Understands IP and copyright as they apply to their research and is aware of the importance of appropriate research dissemination.
- Ability to explore potential for international dissemination and application of their research, both within and outside of universities.

CRICOS No. 00114A