

**Medicina:
A Multiplatform Videogame to
Improve Language Skills in
International Nursing Students**

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*Thesis
Submitted to Flinders University
for the degree of*

Doctor of Philosophy
College of Nursing and Health Sciences
4 May 2024

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ABSTRACT

Background. In the Australian healthcare system, international nursing students represent a sizeable, positive, and vital part of a diverse nursing workforce for a culturally and linguistically diverse patient population. In addition to the benefits these students offer, international students may face important challenges. International nursing students often struggle with language acquisition especially related to specialised academic language such as medication names. New targeted pedagogical tools in nursing education are needed for this population. One potential tool is computer assisted language learning (CALL) videogames. Despite the potential benefits of CALL videogames, nursing educators have been slow to implement this technology, with few videogames previously evaluated.

Aims. The study aimed to develop and evaluate the Medicina multiplatform CALL videogame focused on medication names which seeks to improve language skills for international nursing students. Furthermore, the study aimed to evaluate Medicina's effect on language skills, psychological factors, game usage, usability, and perceptions of the videogame.

Method. Thirty-two international nursing students from universities across Australia took part in a multicentre trial. The study used a quantitative, quasi-experimental, one-group pretest-posttest design involving three phases (pretest, two-week intervention, and posttest). The multiplatform videogame was developed by the researcher and was playable via WebGL (desktop/laptop) or Android mobile devices. Data were obtained through online written questionnaires and comprehensive gamelogs via a Research Management System.

Results. Study findings support the effectiveness, usage, usability, and positive perceptions of the Medicina multiplatform CALL videogame. Medicina had positive effects on language skills including increasing familiarity with medication names, ease of recognition, confidence in understanding spoken medication names, and a non-significant increase in phonological awareness. International nursing students had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall MSLQ score at baseline and posttest. Gamelogs

revealed participants played a mean of 13.47 sessions of Medicina for a mean total time of 35 minutes, with a mean of 264 medication names answered correctly. Three patterns of engagement were identified. Participants strongly preferred the WebGL platform over Android devices. Avatar preference was more balanced, with most participants playing each of the avatars at least once. Medium was the preferred difficulty level overall, played by the highest proportion of players, sessions, and durations. Easy was the least popular difficulty level. Progression between difficulty levels happened on the first day within a mean of 11 minutes. Participants rated the usability of the Medicina videogame as excellent and above average, and had positive perceptions of Medicina and its features. Participants enjoyed the videogame and reported improved language skills, familiarity with medication names, confidence, understanding of Australian accents and word-parts, with benefits for nursing skills and clinical placements.

Conclusion. The aims of the research were met. The study provided novel insights and significant original contribution to knowledge, with important implications for the implementation of Medicina and for nursing education. Limitations (especially in the context of COVID) and future directions were discussed. CALL videogames such as Medicina may provide a beneficial, culturally responsive, strengths-based pedagogical tool in nursing education for international nursing students.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed: Adam Fletcher Koschade

Date: 4 May 2024

ACKNOWLEDGEMENTS

Firstly, I would like to thank my supervisor, Associate Professor Amanda Müller. Thank you for all your hard work, time, expertise, knowledge, and guidance throughout this process - it is most gratefully appreciated!

Secondly, thank you to my co-supervisors (Associate Professor Belinda Lange, Dr Trent Lewis, and Dr Brett Wilkinson) and internal milestone assessors (Dr Weifeng Han and Dr Didy Button) for your consultation, feedback, and support. I'd also like to express my gratitude to Flinders University, the HDR department, and the staff in the College of Nursing and Health Sciences for enabling me to conduct this research and providing assistance during my candidature.

In addition, thank you to the nursing educators at external universities and tertiary institutions for your support and assistance in the recruitment and data collection phase of this research. Similarly, special thanks to the nursing students who participated in this study. Thank you for your time and interest in playing Medicina and completing the questionnaires.

Lastly, thank you to my family for their support, belief, and encouragement. In particular, I want to thank my mother, Gillian. She was the most loving, brave, strong, and dedicated mother. Heartbreakingly, my mother was tragically taken in the final stages of this PhD and did not get to see me graduate. Gillian believed strongly in education, but never had the opportunity to follow her dream of attending university. So much of who I am comes from her wonderful influence, wisdom, kindness, and determination. Thank you from the bottom of my heart, always and forever.

DEDICATION

To my beloved mother Gillian Claire Koschade, whose recent untimely and tragic passing has left an indescribable void in my heart. I dedicate this thesis to you, in deepest loving memory.

CHAPTER 1 INTRODUCTION

1.1 Chapter Introduction

The research aimed to develop the Medicina multiplatform videogame, a computer assisted language learning (CALL) application available across multiple devices, to improve language skills of English as an Additional Language (EAL) nursing students. Furthermore, the study aimed to evaluate the effectiveness, game usage, usability, and perceptions of the multiplatform Medicina CALL videogame in a trial involving international nursing students in Australia. This chapter will briefly introduce the background, aims, and significance of the study relevant to international nursing students and computer assisted language learning. The theoretical framework, original contribution to knowledge, and research questions is outlined in this chapter. An overview of the structure of the thesis is also provided.

1.2 Aims, Background, and Significance

The demographics of the university classroom are changing, and universities are becoming increasingly culturally and linguistically diverse (CALD) institutions. International students – also known as foreign students or overseas students – now represent a large, rapidly expanding, and economically valuable population in the educational system. Over the past 20 years, the number of international students globally has nearly tripled from 1.95 million in 1997 to over 5.3 million in 2017 (UNESCO Institute for Statistics, 2020). Australia is at the forefront of international student migration issues, hosting the highest number of international students per capita (Babones, 2019). In 2019, there were 917,793 international students in Australia (Austrade, 2019). The number of international students enrolled in higher education in Australia has increased significantly in recent years – up 63% since 2015 and 11% in one year alone in 2019 (Department of Education and Training, 2019b). International students now comprise nearly one third (31%) of all students enrolled in Australian higher education (Department of Education and Training, 2019a). As Australia's fourth highest export, international education is worth an estimated \$37.6 billion to the Australian economy and supports 250,000 jobs nationally (Department of Education and Training,

2019c). Thus, for Australia's education system, international students represent a sizeable, growing, and economically valuable population. By far the largest source of international students is China – accounting for 37% of international students in higher education in Australia (Department of Education and Training, 2019b).

In the Australian healthcare system, international nursing students represent a positive and vital part of the development of a diverse nursing workforce and culturally competent care for a culturally and linguistically diverse patient population (Australian College of Nursing, 2023). However, in addition to their strengths and resources, international students may face important challenges in their education. Research into the needs of English as an Additional Language (EAL) nursing students have identified significant linguistic challenges. These language concerns include poor listening and reading skills, problems understanding lecture content, difficulties communicating in clinical settings and, in particular, problems with low-frequency academic and technical vocabulary such as medical terminology (e.g., Amaro et al., 2006; Crawford & Candlin, 2013; Donnelly et al., 2009; Leki, 2003; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Sanner & Wilson, 2008; Sanner et al., 2002; Starr, 2009). In fact, language difficulties were noted to be “the single most significant obstacle facing the ESL nursing student” (Olson, 2012, p. 26). Consequences of poor linguistic skills in EAL nursing students can be significant and include academic failure and removal from clinical placements, which may also have implications for patient safety (Jalili-Grenier & Chase, 1997; Müller, 2011a; San Miguel et al., 2006). As such, the unique needs of EAL nursing students, as well as the importance of developing culturally sensitive programmes of support, have become growing areas of research in recent years.

Before continuing the discussion of the research background, a note about terminology is warranted. One of the challenges in this field is the variety and interchangeability of core terminology. Common terms used include English as a Second Language (ESL), English as an Additional Language (EAL), English as a Foreign Language (EFL), English Language Learner (ELL), and English for Speakers of Other Languages (ESOL). In addition to the sheer number of

acronyms and names, concerns regarding the choice of terminology include cultural differences in usage, power dynamics, and inclusivity (e.g., Cunningham, 2019; Leung, 2022; Walkowitz, 2022). Although ESL has been well-known and widely used historically, EAL has more recently become the preferred term by researchers, educators, and professionals in this field (Leung, 2022; Walkowitz, 2022). In particular, scholars argue that English ‘as an Additional Language’ is a more inclusive and less pejorative than other common terms (Leung, 2022; Walkowitz, 2022). Hence, ‘English as an Additional Language’ (EAL) will be used in the current dissertation where possible. However, it was considered essential to mention the diversity of terms in the introduction for clarity, completeness, and identification within the context of previous research literature.

Although considerable research has identified important language difficulties among EAL nursing students (e.g., Amaro et al., 2006; Crawford & Candlin, 2013; Donnelly et al., 2009; Leki, 2003; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Sanner & Wilson, 2008; Sanner et al., 2002; Starr, 2009), comparatively less attention has been paid to support programmes to improve such skills and foster academic and clinical achievement. In addition, while international nursing students need more support for academic and clinical achievement, the effectiveness of current support programmes is limited by methodological problems and other issues (Crawford & Candlin, 2013; Seibold et al., 2007). Furthermore, most existing interventions do not incorporate a conscious focus on repeated exposure to specialised vocabulary which is crucial to developing automaticity, increasing language processing speed, and reducing cognitive load (Müller, 2011a; Schmitt, 2008; Webb, 2007).

One potential tool which may help EAL nursing students improve language skills is computer assisted language learning (CALL). Computers have been used in nursing for decades (Bitzer, 1966). Considerable research has provided evidence of the benefits of computer assisted learning generally for nursing-related knowledge and clinical nursing skills (e.g., Adams, 2004; Bloomfield et al., 2010; Conrick, 1998; Gleydura et al., 1995; Jeffries, 2001; Leasure et al., 2000; Lewis et al., 2001; Napholz & McCause, 1994; Tegtemeyer et al., 2001; Washer, 2001). The term CALL refers

to the use of Information and Communication Technology applications to aid language education. Research indicates that CALL encourages independence, flexibility, and self-direction, promotes individualised learning and active engagement with the information, reduces language learning anxiety, provides immediate feedback, improves motivation and enjoyment, allows repeated exposure while reducing instructional time, and develops computer literacy (Bloomfield et al., 2008; Lai & Kritsonis, 2006; Liu et al., 2002; Riasati et al., 2012). Furthermore, CALL using mobile devices, such as mobile phones, may have additional advantages such as accessibility, portability, connectivity, and spontaneity (Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). Thus, CALL applications may be well-placed in supporting the needs of international nursing students.

Despite these findings, surprisingly little research has been conducted into the use of CALL videogames in nursing education. A recent review of the literature found just four examples of computer-based videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). And notably, just two games identified focussed on linguistic-related skills among international nursing students (Müller, 2011b; Müller & Price, 2012). Moreover, none of those four videogames were also available across other platforms (such as mobile phones) and a further search of the literature did not identify any published studies evaluating mobile phone-based videogames in nursing education. Mobile devices such as mobile phones and tablets have historically been dependent on platform-specific technologies. Recently, however, mobile devices increasingly have access to web-based technologies, enabling mobile devices to access web-based CALL videogames. This is an important recent step regarding the utilisation of CALL applications as these mobile devices are no longer dependent on platform-specific technologies, enabling students on any device to access the same application. Currently, it appears that no study has investigated the development or effectiveness of multiplatform CALL videogames for improving language skills in EAL nursing students.

A focus on medication names is also significant. Medication use is the most common type of intervention in healthcare (Lim et al., 2022). In 2020-2021, over 314 million prescriptions for medications were dispensed in Australia in one year (Australian Institute of Health and Welfare, 2022). Medication administration and patient safety are fundamental concerns of nursing education and nursing care. Nurses spend considerable time dealing with medications, and medication errors, including those related to medication names, are common in hospitals (Keers et al., 2013). In fact, medication errors occur in up to 18% of in-hospital medication administration episodes in Australia (Roughhead et al., 2013). Research indicates that the two leading causes of medication errors committed by nursing students were communication problems and verbal medication orders (causing 55% of errors), and one of the leading types of medication errors involved participants being given the incorrect medication (Gunes et al., 2020). The World Health Organisation (WHO, 2017, p. 5), reports that “medication errors are a leading cause of avoidable harm in health care systems across the world”. Furthermore, these medication errors can have serious consequences for patient safety, including “severe harm, disability, and even death” (WHO, 2017, p. 5). On an economic level, the scale of medication errors is estimated to cost USD\$42 billion each year (WHO, 2017). As a result, the reduction of medication errors is a global healthcare priority (WHO, 2017). Accordingly, the Australian Government and the Australian Commission on Safety and Quality in Health Care have named “improving medication safety” as “a key area of focus” (Australian Commission on Safety and Quality in Health Care, 2017). And in 2017, Australia joined a global initiative aiming to halve medication errors (Australian Commission on Safety and Quality in Health Care, 2017).

Therefore, medication errors are a prevalent, serious, and costly problem which can lead to significant harm to patients (including morbidity and mortality) and is an area of national and international concern where new tools to improve outcomes are actively sought. The WHO (2017, p. 12) has urged educational and research institutions to become “catalysts for change” to reduce medication errors. Given the scope, significance, and nature of medication errors, pedagogical tools

in nursing education that target this problem are timely and crucial for patient safety. Hence, new educational tools providing international nursing students with safe opportunities to practice medication names, improve language skills (including listening skills and phonological awareness), and promote competence in this area of nursing education is strongly needed. As a result, research addressing medication names may have a positive impact on the safety and well-being of patients and families as well as nurses, other medical staff, hospitals, and the broader community and economy.

From a clinical perspective, the present study may also provide awareness, knowledge, understanding, and a potential tool to support the communicative competence of international nursing students during their studies, clinical placements, and subsequent nursing careers. By extension, the videogame may arguably support the overall well-being and success of EAL nursing students by supporting the development of vital language skills. However, it may also be of benefit and interest to nurses of all levels of experience, educational levels, and backgrounds to assist in learning processes for all manner of nursing related skills and knowledge. Furthermore, the findings of this study could also be generalisable to other skillsets for EAL nursing students and to international students in educational fields outside of nursing and health sciences, especially in professions requiring specialised academic language and vocabulary.

In terms of personal factors, the researcher has qualifications in the fields of information technology, sociology and historical studies, and applied linguistics, spanning over 20 years of experience. As a result, an interest in the field of CALL evolved over time. Learning of the previous and ongoing research within these important fields, the researcher became increasingly aware of the importance surrounding the combination of computer science, linguistics, and nursing education, and the potential benefits of combining these research disciplines together. It was the hope and belief of the researcher that this cross-disciplinary approach could be applied to nursing education to develop a pedagogical tool aiming to improve outcomes for nursing students, educators, patients, and the community. Through applying their background and interest within these diverse fields, the

researcher wanted to contribute to the ongoing research being conducted in CALL and nursing education.

In summary, international nursing students represent a valuable, sizeable, and significant group for nursing education and the healthcare system in Australia. Despite their strengths and resources, international nursing students face potentially important difficulties (which may affect academic and clinical outcomes) and are in need of targeted new support tools in nursing education. CALL applications including multiplatform videogames may offer a unique, culturally sensitive, strengths-based solution to the language challenges EAL nursing students may experience. However, there is a paucity of games available and a significant lack of research addressing this issue. This represents an important gap in the research literature. In addition, medication errors are a prevalent, serious, and costly problem which can lead to significant harm and is an area of national and international concern. Further research into the use of a multiplatform CALL videogame to improve the linguistic skills of EAL nursing students is needed and warranted. Such research may have important benefits for international nursing students, educators and educational institutions, patients and families, the healthcare sector, and the broader community.

1.3 Theoretical Framework

Prior to reviewing the research literature regarding EAL nursing students and CALL, it is important to have an awareness of the theoretical framework relevant to much of the research in this field. A major interest in research regarding language learning and second language acquisition is how people learn and become proficient in language. Language proficiency is broadly defined as a “language learner’s or user’s communicative abilities, knowledge systems, and skills” (Harsch, 2017, p. 250). How language proficiency is conceptualised and how it is related to performance in educational contexts has a fundamental role in language learning, language teaching, and assessment, and has been the subject of intense debate. One such theoretical debate in the field of language learning is whether language proficiency is a unidimensional or multidimensional construct (e.g., Cummins, 1979, 1981, 1999, 2000, 2003, 2013; Oller, 1976, 1978; Vollmer, 1981).

Researchers have argued that language proficiency is a single, unitary dimension. Known as the ‘unitary competence hypothesis’, this theory rejects the divisibility of language into different components or skills (which can thus be measured or taught) (Vollmer, 1981). The theory posits there is global language proficiency, such that all individual differences in language proficiency (both first and second languages) can be attributed to one factor. One of the major proponents of this theory was Oller (1978, p. 413), who argued that “there exists a global language proficiency factor which accounts for the bulk of the reliable variance in a wide variety of language proficiency measures”. Oller (1976, 1978) asserted that this global, unitary proficiency is closely related to IQ and general cognitive skills (such as Spearman’s G factor).

In opposition to the unitary competence model is the ‘divisible competence hypothesis’ (Vollmer, 1981). In divisible competence approaches, researchers have argued that language proficiency is a multidimensional construct, and that there are different underlying constructs which can be taught or tested separately. Arguably one of the seminal, most widely known theories on the multidimensional construct of language proficiency and academic performance is the work of researcher Jim Cummins (1979, 1981, 1999, 2000, 2003, 2013). Cummins’ model proposes that there are two distinct language proficiencies – conversational proficiency and academic language proficiency. Cummins (1981, 1999, 2000, 2013) argues that the two types of language proficiency differ in multiple ways when considering language acquisition (either as a child or an adult) and have a significant impact on academic outcomes.

Firstly, a core difference between the two proficiencies relates to the language content, setting, and usage. Conversational proficiency, also known as ‘Basic Interpersonal Communication Skills’ (BICS), is defined as “the ability to carry on a conversation in familiar everyday situations” (Cummins, 2013, p. 10). Thus, conversational proficiency is the language that is acquired by EAL students within social situations that is used within standard conversations and interactions (Crawford & Candlin, 2013). This type of language includes linguistic skills that are developed and used more through informal social exchanges. Examples include a face-to-face conversation with a

classmate or colleague about sport or weekend plans, or a phone conversation with a restaurant. Note that while conversational language is primarily oral, it can include written language also. Furthermore, it can include conversational interactions held in the classroom, where the type of conversation is centred on non-academic language, such as a teacher greeting students. The concept of conversational proficiency is related to what was termed ‘playground language’ in subsequent theories (Gibbons, 1991).

In contrast, academic language proficiency, originally called ‘Cognitive/Academic Language Proficiency’ (CALP), describes the formal language used in education and academia. Cummins defines academic language proficiency as “an individual’s access to and command of the specialized vocabulary, functions, and registers of language that are characteristic of the social institution of schooling” (Cummins, 2013, p. 10). It is used in academic settings (including universities), such as in classroom discourse, reading and writing research papers, and educational materials such as textbooks. Academic language proficiency may include general academic vocabulary as well as specialised terminology in specific fields (such as mathematics, science, or nursing). Development of academic language proficiency is considered crucial for academic performance and outcomes. The concept of academic language proficiency is closely related to what is known as ‘classroom language’ in the theory by Gibbons (1991).

Before continuing the discussion of the theory’s features, a note about terminology is warranted. Basic Interpersonal Communication Skills (BICS) and Cognitive/Academic Language Proficiency (CALP) were the original terms coined by Cummins and are widely known. However, the terms ‘conversational proficiency’ and ‘academic language proficiency’ respectively have more recently become the preferred term by Cummins and other researchers (Cummins, 2000). Hence, the terms ‘conversational proficiency’ and ‘academic language proficiency’ will be used in the current dissertation where possible. However, it was considered essential to include both sets of terms in this theoretical framework for clarity, completeness, and identification within the context of previous research literature.

A second way conversational and academic proficiencies may differ is the level of contextual support and cognitive demands involved (Cummins, 1981). In Cummins' model, contextual factors refer to the level of support available for understanding meaning, while cognitive demands relate to the amount of information that needs to be processed simultaneously in order to understand the meaning (including cognitive load). Conversational proficiency is typically described as being less cognitively intensive and more contextually embedded. Hence, the communication of meaning is generally supported by the immediate social context and interpersonal cues such as facial expressions and gestures. For example, interpersonal cues may include nodding, pointing, or holding an object. The vocabulary of conversational language is typically more concrete and involves more high-frequency, less-specialised vocabulary. In contrast, academic language proficiency involves more abstract language, with low-frequency, specialised vocabulary. This specialised vocabulary often includes words with multiple syllables, prefixes, suffixes, and roots (such as medical terminology). Due to the abstract nature, lack of contextual clues, potential need for background understanding of the topics, and impact on cognitive load, academic language is in general considered more cognitively demanding than conversational language.

That said, however, it is vital to understand that academic language is not a 'superior' or 'higher status' form of language proficiency than conversational language. Conversational language may also be highly sophisticated and complex (Cummins, 2000). The difference is that conversational language is not strongly related to the linguistic context of education/schooling and the outcome of academic performance. Furthermore, the notions of cognitive demands and contextual support in the model by Cummins are not absolute/discrete concepts, where they are either absent or present. Rather, these factors are conceptualised on a continuum. In later elaborations of the theory, Cummins depicts the issue as an intersection of the two continua (one relating to the range of contextual support, the other cognitive demands) resulting in four potential quadrants (Cummins, 2013).

Thirdly, a further distinction between the two language proficiencies relates to the amount of time it takes learners to acquire the skills and attain proficiency. Overall, language learners become proficient in conversational language much faster than academic language proficiency (Cummins, 1999). After reviewing the research, Cummins concluded that students acquire conversational fluency in the second language (L2) in approximately two years after arrival. In contrast, language learning students typically require at least five years (and frequently longer) to develop academic language proficiency (Cummins, 2013). Note that this refers to language learners who have immigrated to the L2 locations and are exposed to the L2 at school and wider community and relates to a functional or grade/peer-comparable levels of proficiency.

This difference in time frame required by language learning students to acquire academic language proficiency compared to conversational proficiency is a vital contribution of the theory and represents the primary reason why the distinction was introduced by Cummins (Cummins, 2013). Synthesising previous research regarding language acquisition, an analysis of more than 400 psychological assessments administered to English language learners in Canada's school system, and the prevailing unitary competence theory at the time, Cummins (2013) made some interesting discoveries. For example, the research indicated that teachers and psychologists erroneously assumed that students who had only been in the country for a few years had overcome all language difficulties. Consequently, when these students performed poorly on academic tasks and language testing, students were often stigmatised and falsely labelled as having learning disabilities or cognitive deficits and placed in remedial special education classes as a result. Cummins noted this may occur because teachers and psychologists typically spend little time talking with individual children, and in these conversations, children may be perceived to have much higher levels of language proficiency than they actually do because of their ability to hold good conversations on frequently discussed topics in social settings (Cummins, 2013). Thus, teachers tended to interpret a small sample of conversational speech as evidence of total language proficiency, even though academic language proficiency was frequently lacking. Hence, this "surface fluency" was a

deceptive, “linguistic façade” (Cummins, 1979, p. 199). This led Cummins to develop the model and emphasise the importance of extending and continuing explicit language instruction even after grade-appropriate conversational proficiency is attained.

Fourthly, Cummins emphasises that in order to develop academic language proficiency, explicit teaching is required. Cummins states that the development of academic language knowledge and skills “will *not* ‘just take care of itself’” but rather, “it requires explicit teaching with a focus on the genres, functions, and conventions of the language itself” (Cummins, 2000, p. 23). Cummins (1999) advocates the use of three components within teaching methods to promote academic language proficiency for EAL students: cognitive, academic, and language components. According to Cummins (1999), the cognitive components should include cognitively challenging instructions that encourage the use of higher order thinking as opposed to just memorisation. The academic component is suggested to include content-based EAL programmes and subject-specific information, such as nursing education to be integrated with language instruction. The language component is recommended to include critical language analysis focusing on specific aspects of language development such as phonics and grammar (Cummins, 1999). Hence, Cummins (1999) recommends explicit, targeted instruction for improving academic language proficiency. This is necessary for both attaining academic language proficiency and subsequent academic outcomes.

In addition, Cummins discusses the need for academic language instruction that is aware of and responsive to discrimination, prejudice, power structures, and sociocultural and socio-political issues (Cummins, 2000). This includes a supportive school-wide climate which values and respects language minority students, designing language teaching that begins with the strengths and talents of language students, and has high expectations for their academic achievement. Similarly, he highlights the need for leadership from the academic institution that makes the instruction and achievement of academic language proficiency in language minority students a priority. Cummins also advocates for customised language support programmes that explicitly teach both basic and higher-order language skills which meet the needs of language learning students. Some of the skills

mentioned include programmes that explicitly teach “letter sounds, sound blending, word recognition skills, writing skills, and metacognitive strategies for reading comprehension” (Cummins, 2000, p. 265).

One particularly relevant study that Cummins (2000) discusses is a study by Baugh (1999) which uses a ‘lyric shuffle’ game to develop academic language proficiency. In the game, students listen to songs and participate in games that reinforce vocabulary skills, language awareness skills, sentence formation, phonics skills, and other complex language skills. A benefit of the game method which is highlighted is that complex linguistic topics can be taught to students “without direct reference to the acquisition of dominant literary or linguistic norms” (Baugh, 1999, p. 36). Thus, Cummins encourages the development of a culturally relevant, strengths-based approach which seeks to improve academic language proficiency in an environment that values and supports language students from all levels of academic educators and leadership. This includes supporting game-based pedagogical tools that teach academic language skills.

The Cummins model of conversational and academic language proficiency is a theoretical perspective which has a significant influence historically on research regarding EAL students. It has led to considerable research and theoretical work including the development of multiple new theories that extend and elaborate on the initial model. Furthermore, it has had important implications and impacts on policy development in language learning and educational contexts. The theory has been referenced in policies regarding the types of educational support language learning students require, the amount and duration of funding necessary to support EAL students, and the need for language instruction to be extended past just the immediate arrival and conversational proficiency period (Cummins, 2013). It also has implications for policies regarding validity and ethics of linguistic and academic testing of EAL students. Awareness and use of Cummins’ model is so widespread in education that even Australian government departments discuss the theory and advocate its use. For example, the New South Wales Department of Education (2022) publishes a factsheet about Cummins’ theory and its implementation in the classroom.

However, criticisms have been raised about the Cummins model of academic language proficiency. One of the leading critics of the theory is Edelsky (1990), who disputes the existence of conversational proficiency and academic language proficiency and rejects hypotheses of oral and written language that are based on separate skills (i.e., divisible competence hypotheses like Cummins' model). Rather, she argues that the construct of academic language proficiency is merely "test-wiseness" (Edelsky, 1990, p. 65) and a "skill in instructional nonsense (SIN, if another acronym is needed)" (Edelsky, 1990, p. 69). Similarly, Edelsky opposes the theory on the argument that it is solely based on studies using test scores. Refuting these criticisms, Cummins (2000) argues that the constructs of conversational and academic language proficiency do exist and that neither their construct validity nor the relationship to education depend solely on test scores.

Furthermore, researchers such as Edelsky (2006) have labelled the model a 'deficit theory', in which the academic failure of language learning students is attributed to "low CALP" (meaning low academic language proficiency) rather than to inappropriate education and language instruction. A deficit theory is defined as a model in which "ELL students are to blame for falling behind due to their poor motivation, because they exhibit problematic behavior, or because they altogether lack socially appropriate behavior or academic capacities" (Neugebauer, 2008). In the case of the Cummins model, Edelsky (2006, p. 93) describes it as a theory that "locates failure in children's heads (in their language deficits, their cognitive deficits, their underdeveloped CALP)". This criticism represents an important, significant concern about the model.

Cummins strongly refutes the claim that his theory is a deficit model (Cummins, 2000, 2013). For example, where the theory discusses cognitive demands of tasks (for both conversational and academic language), this relates not to the cognitive ability of the individual language learner but instead describes the demands of the task itself. Some tasks objectively involve more or less cognitive load than other tasks – for example, saying hello in a second language (English or otherwise) is likely less cognitively demanding than describing the process of photosynthesis in a second language. Furthermore, academic language proficiency is not discussed as an isolated factor

caused by individual student failings (such as laziness). Rather, the distinction between the two proficiencies has been discussed as determined by societal influences, educational policy, educational practice, and power dynamics (Cummins, 2000). In fact, academic language proficiency is presented as an ‘intervening variable’ affected by many other variables outside the learner’s control rather than an independent, autonomous causal variable (Cummins, 2000). Moreover, Cummins discusses that the model was borne out of the aim to oppose deficit models and identify prejudicial, inequitable, and discriminatory educational policies and practices that were acting to deny language learning students from access to essential learning opportunities (Cummins, 2013). Thus, while the model does argue that lower academic language proficiency is correlated with poorer academic performance, Cummins refutes the claim that it is a deficit model and argues that it does not in any way state that the individual student is to blame. Rather, it is emphasised that lack of access to adequate, continuing, and effective language instruction, affected by sociocultural and socio-political factors (such as discrimination and power imbalances) outside the individual’s control is what leads to lower academic language proficiency.

Firstly, the criticisms of the Cummins model are acknowledged and are deeply concerning. The researcher does not in any way advocate or support a deficit model. However, the Cummins’ model of conversational proficiency and academic language proficiency is discussed because of its position as the theoretical framework underpinning much of the research in the field. It is arguably one of the seminal, leading theories in the field, frequently referenced in the research literature, with a significant impact on language teaching research, policy, and practice over the past four decades. In addition, it is relevant to the current research on a pedagogical tool designed to improve language skills in EAL nursing students using a videogame involving specialised academic vocabulary (medication names) in an academic setting (tertiary nursing education).

However, given the criticisms of Cummins’ model, a few points are warranted. Deficit-based approaches to research blame the international students for their challenges and situation, rather than the academic policies and educational practices which perpetuate discriminatory and

inequitable systems. When talking about challenges experienced by some international nursing students, it is important to be clear that the researcher and this research is not taking a deficit approach and is in no way ‘blaming the victim’. It is also important to note that the only Cummins model discussed in this chapter is the theory that distinguishes language proficiency into two dimensions (conversational and academic language proficiency). The theoretical framework does not include other theories also developed by Cummins.

Eschewing a deficit model approach, the current research study instead emphasises a strengths-based approach. Strengths-based perspectives focus on seeking to transform the systems and structures that perpetuate inequalities in outcomes for the education of international students, rather than assigning pathological labels to students and blaming them (Hammond & Zimmerman, 2012). Thus, the focus in strengths-based approaches is on changes in the educational system – not individual traits. The approach also focuses on the strengths and resources people possess, seeking to design respectful supports that engage and build on these strengths. In addition, it aims to empower people to take the lead in their learning processes. It is vital to understand that a strengths-based research approach does not deny or ignore the existence of problems or difficulties in the population of interest (Hammond & Zimmerman, 2012). Review and discussion of such challenges is permissible. Rather, a central tenet of the strengths-based perspective is that “the problem is the problem; the person is not the problem” (Hammond & Zimmerman, 2012, p. 3).

Working with international nursing students requires nursing researchers and nurse educators to be empathetic teachers who care about students and aim to support them. In seeking to take a strength-based approach, researchers should acknowledge and support the positive resources, attributes, values, and qualities international students possess. Furthermore, research must seek to support and draw from these strengths and capacities to develop the skills, competencies, and confidence to develop nursing skills. This includes encouraging independent learning and empowering international nursing students to participate in their own educational and professional

development. Thus, the research is underpinned by a theoretical framework of the Cummins model of conversational and academic language proficiency, drawing from a strengths-based perspective.

1.4 Significant Original Contribution to Knowledge

This thesis provides significant original contribution to knowledge. The novel insights and significant contributions achieved by this research encompass multiple aspects. These novel contributions can be found in the design and development of the videogame, the materials and methods of data collection employed, and the interesting and impactful findings identified.

The current study involved the design, development, and evaluation of a multiplatform CALL videogame to improve language skills in international nursing students. The multiplatform videogame entitled *Medicina* was built by the researcher for this study. The study redesigned and expanded an existing single-platform computer-based *Medicina* CALL videogame (Müller, 2011b) and used it as a basis to develop the new multiplatform CALL videogame. The development of the multiplatform *Medicina* videogame is outlined in detail in Chapter 3. Based on a review of games evaluated in published peer-reviewed research literature, this research was the first multiplatform version of *Medicina*, the first multiplatform CALL videogame for improving language skills in international nursing students, and the first multiplatform CALL videogame in nursing education more broadly.

The study combined two previous types of serious videogames as pedagogical tools (namely, computer-only CALL videogames and mobile phone-only CALL videogames) which have historically been developed and evaluated separately. It used recent technological advancements to combine the two intervention types to create a new multiplatform videogame, making it accessible to users of any laptop, desktop, or Android mobile device. While the design was influenced by Müller's (2011b, 2012, 2013) single-platform game, the videogame used in this study was developed and constructed by the researcher for the current research. The building process involved lengthy amounts of complex coding using multiple coding languages; the designing, rendering, and placement of multiple graphical assets, sprites, animations, and audio files; building of the game

actions and interactions; attention to multiplatform-related issues such as touch screens; and the construction of the gameplay, content, and features in a novel multiplatform game. It involved a new delivery medium (two platforms via WebGL and Android), new game assets (such as avatar graphics), new gameplay features (including three difficulty levels with time limitations), and new authentication procedures. The development of the game required new technologies (such as different game engine, file formats, software, coding languages, and databases), including the creation of the unique backend system stored in an SQL database and developed by the researcher using JSON, C# and PHP scripting language for this study. From these actions, the researcher built the two new versions of the game (WebGL and Android), the comprehensive backend system, gamelogs, and research management system necessary to run the game and study.

In terms of educational videogames evaluated in the research literature, *Medicina* was one of only four computer-based videogames in nursing education identified (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). It is also the first of the four videogames to develop and evaluate a multiplatform version deployable on mobile platform. In addition, while mobile phone-based videogames have previously been used in other educational fields (such as second language learning), a search of the research literature conducted as part of this study found no existing mobile phone-based videogames for international nursing students or nursing students in general. Hence, the research expanded an existing pedagogical tool (mobile phone-based CALL videogames), applying it to a new field (nursing education), as well applying it to a new, sizeable, and growing demographic (international nursing students). In addition, the study used the pedagogical tool for an issue not targeted previously via the technology (phonological awareness and specialised medical vocabulary, especially medication names).

The project also involved the design and development of a 'Research Management System', built by the researcher for this study. The Research Management System provided one central easily accessible electronic location for participants for all aspects of the study. This study contained multiple materials to be accessed at different points over three phases (pretest, intervention period,

and posttest). Using the website, the pretest survey, WebGL game play, Android game download, and posttest survey were all accessed and completed in one place. This simplified and centralised the process for both the participants and researchers. It also provided a platform that was safe, secure, and easy for participants to use. In addition, the website helped the researcher to control the sequence of events in the study. Importantly, the Research Management System's back-end system also enabled the development, collection, and storage of the comprehensive gamelogs for the researcher – a crucial part of the study. Furthermore, the study was a multicentre trial involving participants from 12 external universities across Australia. Consequently, the system provided a location that could be accessed by participants from any learning institution at any time and from anywhere, enabling data collection to be conducted remotely online. This was especially vital given the context of the COVID-19 pandemic.

Another aspect of the original contribution to knowledge of this study is its design as a multicentre research trial. The benefit of multicentre trials includes a more diverse or heterogeneous sample population which increases the external validity (generalisability) of the results. In total 48 external tertiary institutions in Australia were contacted for involvement in the study (see Table A1 in Appendix A). The final number of Australian universities agreeing to be involved in the multicentre trial was 12 universities with a Bachelor of Nursing programme (Appendix A). The multicentre sites spanned the country, representing one Australian territory and six out of six states in Australia (Table A1). This study is the first multicentre evaluation of *Medicina*, a CALL videogame for international nursing students, or a computer-based videogame in nursing education using an Australian sample. It is also one of the few published multicentre evaluation studies of computer-based videogames in the field of nursing education worldwide (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). Similarly, the study is one of the very limited number of multicentre studies of serious games in health education published in the research literature more broadly (Gorbanev et al., 2018).

In addition, this is the first study to explore the impact of the Medicina multiplatform videogame on language skills among international nursing students. Furthermore, compared with the published evaluation studies identified in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018), this study is only the second investigation of a CALL videogame in nursing education (Müller, 2011b) which includes quantitative evaluation of the videogame's effect on language skills in this population or context. Research question one stated, "Does the use of the Medicina multiplatform videogame improve language skills in EAL nursing students?". Results showed Medicina had a positive effect on language skills including increasing familiarity with medication names, improving the ease of recognising medication names, increasing confidence in understanding spoken medication names, and a non-significant increase in phonological awareness. Thus, answering research question one, the study's findings indicated that the Medicina multiplatform videogame does improve language skills among international nursing students. Furthermore, given the higher than typical level of language proficiency prior to entering the study, the results showing that playing Medicina improved what was already advanced language skills are perhaps more surprising and promising. It might be assumed that improvement in language skills would not occur in advanced learners, such as in the current sample. Despite this, the participants in this study showed improved language skills in the posttest after playing Medicina. This finding highlights the need for and value of support programmes targeting language skills among international nursing students from all skill levels and backgrounds, including among more advanced learners.

Furthermore, one of the significant original contributions to knowledge of this study is the use of comprehensive gamelogs to identify player usage patterns. Extensive and detailed gamelogs were built by the researcher to investigate the way players use and interact with the videogame in multiple vital areas such as engagement levels, frequency of gameplay, duration of gameplay, scoring (including number of medication names answered correctly), avatar choice, platform choice, difficulty levels (both usage and progression), and different event patterns (such as first

play, highest play, and final play). Compared with the published evaluation studies identified in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018), this research is the first evaluation of a CALL videogame in nursing education to use comprehensive gamelogs to identify in-depth player usage patterns. This method enabled the collection of a large number of quantitative, objective, direct, and real-time measurements of participant behaviour. Compared with traditional questionnaire methods (which may involve brief, delayed, subjective, self-reports), gamelog data may not only provide more substantial information about player behaviours, but may also increase the validity of the results by reducing or avoiding the impact of recall bias, social desirability bias, testing effects, and participant fatigue. Using this novel data collection method, multiple new insights and knowledge was identified in the current study. Research question three asked, “How do EAL nursing students use and interact with the Medicina multiplatform videogame?”. Multiple novel findings were identified regarding player usage patterns including overall engagement, duration/frequency played, scoring, avatar preference, device preference, and difficulty levels. For example, gamelogs revealed participants played Medicina on a mean of 13.47 sessions for a mean total time of 35 minutes. The mean total score was 65,882 which indicated a mean of 264 medication names answered correctly by participants playing the Medicina videogame. Three patterns of engagement were identified (no engagement, lighter engagement, and deeper engagement). Therefore, answering research question three, the study showed positive levels of game usage and engagement including high levels of exposure to medication names among international nursing students playing Medicina. This is crucial to improving language skills for specialised vocabulary, developing automaticity, increasing language processing speed, and reducing cognitive load (Müller, 2011a; Schmitt, 2008; Webb, 2007).

The present research is also important for being the first of its kind to identify patterns of platform usage preferences. Compared with the past evaluation studies identified in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012), this is the first evaluation of CALL videogames in this field or population to evaluate player usage patterns

regarding platform selection. The results of the study identified new knowledge regarding platform use. Previous research has emphasised the advantages of mobile-based CALL videogames (e.g., Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). However, the findings of the current study indicated that participants were significantly more likely to play the game using the web-based platform (using desktop or laptop devices) rather than the mobile platform version (using Android mobile devices). Potential rationale for this preference were discussed in section 6.5.2 in Chapter 6. This represents a significant original contribution to knowledge and highlights the value of developing multiplatform versions of CALL videogames in nursing education. The findings also support the value of studying a videogame available on multiple platforms in a single study.

The study is also novel for being the first to investigate difficulty levels in this field and population (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). This investigation included examination of students' pattern of usage of difficulty levels and progression between levels and led to many new insights. For example, Medium was the preferred difficulty level overall, played by the highest proportion of players, the highest proportion of sessions, highest mean number of sessions, highest mean time, and most likely to be the final difficulty level played. Easy was the least popular difficulty level. Patterns of gameplay revealed participants most often started with the easy level first, before moving to medium and hard. Notably, the study identified an immediate rapid progression between difficulty levels within a mean of 11 minutes of using the videogame for the first time.

In addition, this is the first evaluation to include an investigation of avatar selection patterns in such videogames among international nursing students. The findings of gamelogs indicate that both avatars were used. There was a fairly even split between the two avatars, with results showing that most participants (59%) tried both avatars at least once. In addition to the quantitative data, feedback from participants in the posttest questionnaire provided further novel knowledge regarding avatar usage in the videogame. Medicina's avatars and the multisensory stimuli featuring the

avatars were a common theme in the feedback from participants. More than two thirds (70%) of feedback questionnaire respondents had positive comments about the avatar characters and liked their inclusion in the game. Participants reported that they “like the characters” (‘P6’) and felt the avatar character “makes [the game] more interesting” (‘P7’) and “gives some attractions for players” (‘P2’). While describing their positive opinion of the avatars in the game, one participant emphasised the benefit the avatars added for realism, saying the avatars provided “good visual distraction. In clinical environment, especially the Paediatric Department, there will be a lot of distractions. Clean background would make the game too easy compared to reality” (‘P5’). Another participant highlighted the interaction of the avatars, immediate multisensory feedback, motivation, narrative, and realism of *Medicina* in the nursing education context:

The characters in the game are cleverly designed with nurses, me and patients. If I get it right, the nurse gives me encouragement, which is very important. If I get it wrong, there could be very serious consequences for the patient. (‘P4’)

Therefore, findings indicated that avatars were positively perceived by participants, and that avatars potentially had an effect on interactivity, motivation, enjoyment, and engagement. Furthermore, comments from participants indicated that avatars may add a sense of realism and identification with the characters and narrative of the videogame in the nursing education context. Therefore, despite being a seemingly non-essential element of learning and the videogame overall, the findings of the study suggest that international nursing students viewed avatars as helpful in some way to their learning.

The study is also novel for its investigation of psychological factors in this population and topic. The Motivated Strategies for Learning Questionnaire (MSLQ) was developed by Pintrich and colleagues (1991). The MSLQ is one of the most widely used questionnaires designed to measure academic motivation and learning strategies in university students (Wang et al., 2023). The MSLQ is a validated scale which has been tested across a wide variety of content/university topics (such as medical students, chemistry, statistics education) as well as diverse populations and cultures

(Duncan & McKeachie, 2005). This study used a short-form MSLQ to measure intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall total MSLQ score. Psychological states were measured both at baseline (pretest) and again after using the videogame (posttest). This is the first study to examine baseline state-based psychological factors in this population, pedagogical tool, and/or target skill, using multi-item psychological pretest-posttest measure (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). Similarly, this is the first evaluation to investigate the effect of the CALL videogame on psychological factors using the MSLQ (or any other standardised scale) in a pretest-posttest design. Results showed that participants had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall MSLQ score at baseline and at posttest. Non-significant improvements in extrinsic motivation, task value, and overall MSLQ were also found at posttest. Thus, answering research question two, international nursing students had positive psychological feelings regarding learning medication names via the videogame both before and after playing *Medicina*. International nursing students strongly believed that medication names were valuable and important to learn, and felt motivated and confident to do so using *Medicina*. This represents a significant and novel insight regarding CALL videogames, international nursing students, and nursing education.

Another contribution to knowledge of this study is the use of the System Usability Scale (SUS) to measure the usability of the videogame (Brooke, 2013). The SUS is a validated scale, is the most frequently used standardised questionnaire in studies evaluating the usability of serious games, and is reliable in studies with small sample sizes (Brooke, 2013; Sauro, 2013; Tullis & Albert, 2008; Tullis & Stetson, 2004; Yáñez-Gómez et al., 2017). This is the first evaluation of a videogame in nursing education to investigate the videogame's usability via the System Usability Scale (or other standardised usability scale) (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). This study found the *Medicina* multiplatform videogame had a median usability (SUS) score of 82.5 of out 100, which is positive, above average, and 'excellent' on

adjective-related interpretations. Participants reported that Medicina was easy to use and learn, they felt confident using the videogame, would like to use the game frequently, and thought that the elements of the videogame (such as levels, avatars, and controls) were well-designed. Thus, as the first evaluation of the usability of this pedagogical tool, the results indicated that Medicina has a high degree of usability and a positive user experience among the sample of international nursing students. The findings support the suggestion that the Medicina multiplatform videogame is well-designed and was developed in a way that may promote usability, user experience, motivation, engagement, and active participation with the learning content. The results highlight the potential usability of Medicina for implementation in nursing education practice.

In addition, this was the first study to explore international nursing students' perceptions of the Medicina multiplatform videogame. The results showed participants enjoyed the videogame and reported improved language skills, familiarity with medication names, confidence, understanding of Australian accents and word-parts, with benefits for nursing skills and clinical placements. Key positive features highlighted by participants included difficulty levels, time limitation, multisensory stimuli, immediate feedback, avatars and characters, background audio, fun and enjoyable gameplay, challenge, narrative, and realism. Thus, answering research question five, international nursing students had positive perceptions of the Medicina videogame, its features, and its effects on improving language skills and outcomes in nursing education. As part of the exploration, a particularly interesting finding was that participants had strongly positive reactions to the avatars, difficulty levels, multisensory immediate feedback, and background audio. Comments indicated that these features were especially positively perceived by international nursing students, and potentially had an effect on interactivity, motivation, enjoyment, and engagement. The feedback also indicated these features may add a sense of realism and identification with the characters and narrative of the videogame in the nursing education context. Therefore, despite being seemingly non-essential elements of learning and the videogame overall, the findings of the study suggest that international nursing students viewed these features as helpful to their learning.

Although not intended or anticipated, the current study also highlighted the impact of a devastating, prolonged global pandemic such as COVID-19 on academic support programmes and postgraduate student research, especially concerning marginalised and vulnerable groups such as international nursing students. The impact of the COVID-19 pandemic on all aspects of our lives is anecdotally well known, but arguably not yet fully encapsulated in research. Thus, documentation and discussion of the impact of the COVID pandemic on support programmes and research involving international nursing students in Australia may be considered in and of itself a significant original contribution to knowledge of the current research.

1.5 Research Questions

1. Does the use of the Medicina multiplatform videogame improve language skills in EAL nursing students?
2. What are EAL nursing students' psychological feelings (such as task value, confidence, motivation, test anxiety) regarding learning medication names via a videogame? And what is the impact of the Medicina multiplatform videogame on such psychological-related factors in EAL nursing students?
3. How do EAL nursing students use and interact with the Medicina multiplatform videogame?
4. What is the usability of the Medicina multiplatform videogame?
5. What are EAL nursing students' perceptions of the Medicina multiplatform videogame?

1.6 Structure of the Thesis

This dissertation consists of seven chapters. The first chapter introduces the research, explaining the aims and background of the study, the theoretical framework, the research questions, and the significant original contribution to knowledge of the study.

Chapter 2 presents a comprehensive review of the research literature including international nursing students and computer assisted educational videogames in nursing education and language learning. The potential benefits of a multiplatform computer assisted language learning videogame

as a culturally sensitive, strengths-based pedagogy for international nursing students are also discussed.

Chapter 3 discusses how the Medicina multiplatform videogame was developed and constructed by the researcher. Background and rationale for technological choices and game design choices will be examined. Technological choices discussed include the device platforms, game engines, assets, and security. The chapter further explores game design choices and features such as avatar, difficulty levels, narrative/authenticity, time limits and scoring. Game design phases and gameplay experience are also described.

The fourth chapter explains the methodology and methods used in this study. In particular, the chapter discusses the study design, participants, sampling, materials, data collection methods, data analysis, ethical considerations, and methodological challenges.

Chapter 5 focuses on the findings of the study. Firstly, the chapter presents the demographics of the participants and the characteristics of the sample. Secondly, the chapter examines the results in relation to the research questions in this study.

Chapter 6 presents a discussion of the research findings. The results are discussed in detail, including comparisons with previous research literature as well as the study's aims and research questions. Interesting and novel findings are also explored.

Chapter 7 provides the conclusion of the thesis. The chapter explores significant original contributions to knowledge and implications of the findings for nursing education practice. In addition, the chapter identifies limitations of the study and posits suggestions for further research.

1.7 Chapter 1 Conclusion

The current research aimed to develop a multiplatform CALL videogame called Medicina to improve language skills in international nursing students. Furthermore, the study aimed to evaluate the effectiveness, game usage, usability, and player perceptions of the multiplatform Medicina CALL videogame in a trial involving international nursing students in Australia. The first chapter has outlined the background, aims, and significance of this research. As well as introducing the

rationale behind this study, the chapter discussed the study's theoretical framework (Cummins' model of conversational proficiency and academic language proficiency), original contribution to knowledge, and the proposed research questions. In addition, the structure of the thesis with a brief outline of subsequent chapters was provided.

The next chapter provides a review of the existing literature on the international nursing students, CALL, computer-based videogames in nursing education, and mobile-based videogames in language learning. In addition, the potential benefits of CALL for international nursing students will be discussed.

CHAPTER 2 LITERATURE REVIEW

2.1 Chapter Introduction

In Chapter 1, the theoretical underpinnings, aims, background, significant original contribution to knowledge, and research questions for this study were examined. This chapter presents a literature review discussing and evaluating previous research on international nursing students and CALL in a global context. Furthermore, Chapter 2 provides an overview of the research underpinned in the study and describes limitations and gaps in previous research. The topic of this research is a highly specialised focus which incorporates topics from multiple diverse fields. Such fields include nursing education, language learning (including teaching English to speakers of other languages and CALL), and information technology (such as computer-based and mobile-based educational videogames). A review of the research literature identified no studies of CALL videogames in nursing education (for international nursing students or nursing students broadly) that used mobile devices (either as a mobile-only or multiplatform videogame). Therefore, given the lack of research directly in the narrow specialist field, it was necessary to conduct multiple separate literature reviews on the different themes in order to be sufficiently wide in scope to gain proper understanding of the existing literature relevant to this topic.

This chapter is organised thematically and divided into three main parts. Part 1 focuses on a review of the research concerning international nursing students including their strengths and challenges, and programmes of support. Part 2 presents literature reviews of CALL. This section includes two individual systematic reviews which examine computer-based videogames in nursing education and CALL using mobile devices for language learning more broadly. Part 3 fuses the two primary literature review themes together by presenting a discussion of the potential benefits of CALL as a culturally sensitive, strengths-based pedagogical tool for international nursing students.

It is relevant to note that the systematic literature review on computer-based gaming in nursing education (section 2.4.2) has been published as a co-authored paper in the peer-reviewed 'Nursing Education Perspectives' journal. Authorship approvals for this publication are provided in

Appendix B. Similarly, there are also intentions by the researcher to submit the systematic literature review on mobile phone-based videogames in language learning (section 2.4.4) and the discussion of CALL videogames as a culturally sensitive pedagogy (section 2.5) for publication in academic journals in the future.

2.2 Approach to Literature Review

A comprehensive and ongoing search was conducted using multiple methods including electronic academic databases, checking references lists of identified studies (also known as bibliographic mining or backward citation searching), expert referral, and references already known to the researcher. Academic databases searched included Gale, PubMed, Eric, Sage, Jstor, Emerald, Oxford, ACM Digital, Ovid, Cambridge, and Web of Science (among others). Peer-reviewed journal articles, edited book chapters, conference proceedings, secondary sources (such as previous literature reviews), and grey literature (such as government reports) were examined. In terms of language, the literature sourced was written in English. The primary literature review was conducted in 2017-2018 in the early years of candidature. In addition, updated searches were conducted to ensure recency of research. For example, the systematic literature on mobile phone-based videogames in language learning was originally conducted in 2017, but was reperformed and rewritten in full in 2021. Furthermore, literature was reviewed across the length of the candidature (2017 to 2024) as new sources and issues were identified.

The search terms were multiple and varied and included broad filters such as ‘international nursing students’, ‘ESL nursing students’, and ‘EAL nursing students’ as well as more specific key terms. One of the challenges in reviewing literature in this research is the variety and interchangeability of core terminology. For example, ESL (English as a Second Language), EFL (English as a Foreign Language), EAL (English as an Additional Language), and ELL (English Language Learner). International students are sometimes referred to as overseas students and foreign students. Similarly, the many terms for devices like mobile phones, mobiles, cell phones, smartphones, or by brand names (such as iPhones and Android). There are also often differences in

spelling between terms - such as programmes versus programs. Hence, searches were conducted using a broad range of terms to capture research using the diverse terminology where possible.

A discussion of inclusion/exclusion criteria is warranted to clarify what this literature review includes as well as what it does not include. To conduct the literature review, inclusion and exclusion criteria were considered which were informed by an understanding of issues and the goals and scope of the research. Overall, the primary inclusion criteria were research related to international nursing students and/or videogames (computer-based, mobile phone-based, or multiplatform) for educational purposes among nursing students (or language learning, depending on the particular section of the literature review). There are diverse terminologies and ways of describing the type of pedagogical videogame of interest, such as digital game-based learning, serious games, and educational games. However, an understanding of the concept of the educational videogames in this research was drawn from the work of Mayer and Johnson (2010). According to Mayer and Johnson (2010), there are four common features of games. Namely, games are rule-based, responsive (learner-controlled), challenging, and cumulative, with players progressing in the goals of the game (Mayer & Johnson, 2010). The definitions by Mayer and Johnson (2010) informed the focus of the literature review to be educational videogames played on the platforms of interest, with a set of rules that govern play, aims/goals to be achieved, bound by a time limitation, and with a competitive aspect. Realism, however, was not considered an inclusion criterion.

Furthermore, for parts two and three of the literature review, educational videogames played via computer and/or mobile devices were the focus of this research. Consequently, other types of games or interventions such as board games, card games, face-to-face games, distance learning, eLearning, simulations (such as high-fidelity patient simulation), virtual patients, console-based videogames, virtual reality, and augmented reality were excluded. Considering the expanding and evolving nature of CALL videogames, some may disagree with this interpretation. However, although such modalities may potentially offer a learning experience for nursing students, they do not fit the framework established and were not included in this research.

The literature review undertaken in this chapter primarily takes the form of a narrative review. The narrative review aims to explore and identify the current state of knowledge from the literature relevant to the current study and bring to light gaps in the previous research (Baker, 2016). The topic of this research is a highly specialised, niche focus which incorporates topics from multiple diverse fields. Such fields include nursing education (including international nursing students and medical terminology), language learning (including teaching English to speakers of other languages and CALL), and information technology (such as computer-based and mobile-based educational videogames). These ideas and fields have historically been studied separately in research. Given the specialised scope of the research and the diversity of fields involved, it was not possible to encapsulate the issues in one single literature review. Hence, multiple different narrative literature reviews were performed and are presented in this chapter. For example, one review of the literature conducted by the researcher focussed on international nursing students including their strengths and needs, and existing programmes of support. In addition, another review of the literature performed by the researcher was conducted concerning computer assisted language learning including the use of computer-based and mobile-based videogames in nursing education and language education. Literature was also investigated on cultural aspects relevant to the topic and population in the context of implementing CALL for international nursing students.

In addition to the narrative reviews, two systematic literature reviews were also conducted. The first systemic review investigated computer-based videogames in nursing education, while the second reviewed mobile-based videogames in language learning. The precise approach, search terms, and methodology used in these particular reviews are discussed in each of the systematic reviews individually. In particular, detailed information about the systematic review methods are available in sections 2.4.2.3 and 2.4.4.3 of chapter 2.

2.3 International Nursing Students – Strengths, Challenges, and Support

Considerable research has been conducted focusing on international nursing students. In order to investigate the needs and strengths of EAL nursing students, as well as existing support

programmes, a literature review was conducted. A range of primary (e.g., original research papers), secondary (e.g., literature reviews), and grey literature sources were consulted to identify relevant research in the discipline of nursing education concerning international students. The literature review identified multiple needs and strengths of international nursing students and found evidence to indicate that a range of linguistic, social, psychological, and cultural factors may have a significant impact on the performance of EAL nursing students (e.g., Crawford & Candlin, 2013; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Sanner & Wilson, 2008; Starr, 2009). Some of this section is organised by authors to highlight prominent scholars in this field, while also synthesising and comparing the findings. In total, 23 papers regarding international nursing students were included in this narrative review (Amaro et al., 2006; Andrade, 2006; Cooper-Lara, 2024; Crawford & Candlin, 2013; Devkota, 2023; Donnelly et al., 2009; Havery, 2018; Kangere, 2016; Leki, 2003; Malu & Figlear, 1998; Mbulu, 2015; Müller, 2011a; Obi et al., 2018; Olson, 2012; Onovo, 2019; Robinson, 2018; Ropponen et al., 2023; Salamonson et al., 2008; San Miguel et al., 2006; Sanner & Wilson, 2008; Sanner et al., 2002; Seibold et al., 2007; Starr, 2009).

An important and major focus of research regarding international nursing students relates to language skills (e.g., Amaro et al., 2006; Cooper-Lara, 2024; Crawford & Candlin, 2013; Devkota, 2023; Donnelly et al., 2009; Havery, 2018; Kangere, 2016; Leki, 2003; Malu & Figlear, 1998; Mbulu, 2015; Müller, 2011a; Obi et al., 2018; Olson, 2012; Onovo, 2019; Robinson, 2018; Ropponen et al., 2023; San Miguel et al., 2006; Sanner & Wilson, 2008; Sanner et al., 2002; Starr, 2009). In fact, language difficulties were noted to be “the single most significant obstacle facing the ESL nursing student” (Olson, 2012, p. 26). For example, Müller (2011a) examined the English language needs of EAL nursing students and identified unique and important linguistic difficulties in this population and their consequences for academic and clinical performance. Reading, writing, listening, and speaking are considered the four macro language skills (Hinkel, 2010). While each of these skills is important in the nursing context, Müller noted particular difficulties with listening

and reading skills in EAL nursing students. For example, international nursing students may have problems understanding what is said during class or in clinical handovers and difficulty reading medication labels. As a result, Müller recommended a focus on listening and reading skills such as vocabulary being taught in the spoken format along with written lists. In addition, Müller identified significant difficulties experienced by EAL nursing students in terms of specific vocabulary such as medical terminology and medication names. Müller (p. 18) argues that although “knowledge of medical terminology is commonly expected across the nursing discipline,” this represents an area of significant difficulty for EAL nursing students. Furthermore, Müller identified repeated exposure as a significant factor in the linguistic proficiency of EAL nursing students. According to Müller (p. 18), “a lack of repeated exposure is an underlying contributor to poor vocabulary knowledge and fluent language reception and production”. Müller argues that repeated exposure is crucial to developing automaticity, increasing language processing speed, and reducing cognitive load. Therefore, Müller emphasises the need for a conscious focus on vocabulary acquisition with repeated exposure for the development of automaticity. The consequences of poor linguistic skills in EAL nursing students include failing academic assignments and difficulties with (or even removal from) clinical placements. Thus, the findings of the study by Müller provide support for the development of interventions focussed on specialised vocabulary skills (such as medication names) for EAL nursing students to develop listening skills combining spoken and written stimuli using methods that facilitate repeated exposure.

The central importance of language difficulties in EAL nursing students was also highlighted by Starr (2009). Starr (2009, p. 481) identified common issues experienced by EAL nursing students which were separated into two main categories termed “challenges” that hinder success and “reinforcements” that help EAL nursing students. Starr (2009) emphasised the issues of language and culture and how they relate to the performance of EAL nursing students in the context of the academic environment and cultural support. Starr (2009) argued that language skills were directly influential in the success or failure of EAL nursing students. In addition, Starr (2009)

believed that language could be considered independently within the discussion as a means of highlighting its importance within nursing education and also as a separate issue, but also went on to state that language is included within the three components of resources, academics, and culture as well (Starr, 2009). Starr (2009) argued that most EAL nursing students have good conversational proficiency and struggle with the English academic language proficiency required for nursing, making language a challenge rather than a reinforcing resource for most EAL nursing students. This is consistent with the Cummins (1999) model and with findings of previous research identifying difficulties experienced with academic language proficiency in EAL nursing students (Müller, 2011a).

Furthermore, Salamonson and colleagues (2008) argue that English language acculturation is an integral contributing factor of EAL nursing student attrition rates. Acculturation is a multidimensional process of change affecting EAL students' language use, cultural patterns and values, attitudes, and behaviours (Obi et al., 2018; Salamonson et al., 2008). Acculturation is also argued to be related to behaviours affecting a student's physical and psychological health as well as self-awareness and social identity (Salamonson et al., 2008). The process of acculturation itself can be affected by a student's generational status, gender, and length of residency (Salamonson et al., 2008). The study conducted by Salamonson and colleagues (2008) examined 273 EAL nursing students in Australia in a quantitative design. The effect of acculturation on EAL students was examined by correlating the academic achievements of first-year EAL nursing students with the English Language Acculturation Scale (Salamonson et al., 2008). The results indicated that higher language acculturation scores are positively correlated with better academic achievement in EAL nursing students. The study explored the relationship between acculturation, academic language proficiency, and academic achievement. The authors argued that acculturation should be considered as being an important aspect influencing EAL student language needs, performance, and university retention (Salamonson et al., 2008). Using the Cummins (1999) model of language acquisition, Salamonson and colleagues (2008) suggested that EAL students' acculturation and academic

achievement could be improved by a focus on building academic language proficiency. While the study suggested a correlation between acculturation and EAL nursing students' academic achievement, no conclusion could be made regarding the existence or direction of a causal relationship between the two variables. However, the study by Salamonson and colleagues (2008) does provide support for further research to develop ways of targeting academic language proficiency and the implications such an educational tool may potentially have for EAL nursing student success.

Similarly, the importance of academic language difficulties has also been emphasised by other researchers. In one of the seminal papers in this field, Crawford and Candlin (2013) reviewed the challenges faced by international nursing students in adjusting to the language, culture, and academic English as well as the effectiveness of language support programmes for these students. The authors found that the key difficulties experienced by EAL nursing students include language difficulties and problems communicating in the clinical setting and academic environment (Crawford & Candlin, 2013). In the academic setting, problems were identified with lectures due to both the speed of language presented as well as the vocabulary used in the classroom environment (academic language proficiency) (Crawford & Candlin, 2013). These findings are supported by considerable research noting language difficulties in clinical and academic contexts among international nursing students (e.g., Amaro et al., 2006; Donnelly et al., 2009; Leki, 2003; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; Sanner & Wilson, 2008; Sanner et al., 2002; Starr, 2009).

Furthermore, previous research has found evidence to indicate that social, psychological, academic, and cultural factors may also affect the achievement of EAL nursing students in addition to linguistic difficulties (e.g., Amaro et al., 2006; Cooper-Lara, 2024; Crawford & Candlin, 2013; Devkota, 2023; Kangere, 2016; Obi et al., 2018; Onovo, 2019; Malu & Figlear, 1998; Müller, 2011a; Robinson, 2018; Ropponen et al., 2023; Sanner & Wilson, 2008; Seibold et al., 2007; Starr, 2009). For example, emotional stress, fear of failure, lack of self-confidence, test anxiety, financial

pressures, discrimination, and homesickness were discussed as important factors influencing outcomes for EAL students in adjusting to language and culture (Cooper-Lara, 2024; Crawford & Candlin, 2013; Devkota, 2023; Obi et al., 2018; Onovo, 2019; Kangere, 2016; Robinson, 2018; Ropponen et al., 2023). Similarly, a qualitative study of 17 international nursing students by Amaro and colleagues (2006) found that key barriers to success included a combination of personal needs (such as family responsibilities and time pressures), cultural barriers (such as difficulties with communication, assertiveness, and discrimination), language difficulties, and lack of academic support programmes.

A qualitative study by Malu and Figlear (1998) also examined impediments to success for EAL nursing students. Data were obtained using open-ended interviews, observations, and analysis of the academic and clinical records of the students (Malu & Figlear, 1998). Using discourse and text analysis, Malu and Figlear (1998) identified four main problems affecting EAL nursing students as: second language development, differing expectations of nursing education, a fear of failure, and unfamiliarity with a participatory learning model. Of these four issues highlighted by Malu and Figlear (1998), fear of failure and a lack of familiarity with the participatory learning model may represent interesting cultural factors which may be a barrier to success and warrant further discussion. Unfortunately, however, the paper by Malu and Figlear (1998) focused on a case study of one participant only. Moreover, the paper fails to provide in-depth information regarding fear of failure and unfamiliarity with a participatory model, including examples of how these problems manifested in the students, their consequences, and targeted strategies for intervention. This represents a significant limitation of the paper by Malu and Figlear (1998). However, based on the results of this study, Malu and Figlear (2001) subsequently recommended the use of computer technology to assist with EAL students with both language development and academic knowledge whilst promoting independent learning by the students.

Similarly, the challenges facing international nursing students identified by Starr (2009) included the stigma, racial discrimination, and stress placed on students by the false perceptions that

some educators have of EAL students that they may be less intelligent than their English-speaking counterparts. According to Starr (2009), the impact and stress associated with these incorrect negative perceptions also cause significant strain on the confidence of EAL nursing students and their self-image. Starr (2009) also found that many EAL nursing students felt unprepared for examinations, had difficulties due to lack of familiarity with academic learning contexts, and felt that there was inadequate support for this population in this matter. Furthermore, it was noted that EAL students were often reluctant to directly ask for help from teachers due to cultural factors and stigma. These results are consistent with the findings of Sanner and Wilson (2008) and Amaro and colleagues (2006). However, Starr (2009) argued the strongest reinforcements that help EAL student success are self-motivation and personal strengths as well as supportive teachers. Among the solutions to these findings, Starr (2009) emphasised the importance of developing customised language support programmes which address these challenges and reinforcements. In addition to their direct benefits, such programmes may further help students via raising awareness among nursing educators and reducing stigma and discrimination towards international nursing students.

The interaction between factors affecting EAL nursing students' success were also investigated by Sanner and Wilson (2008). Sanner and Wilson (2008) interviewed three EAL nursing students in three individual interviews each over a six-month period in qualitative, open-ended interview structure. The questions focused on the participants' life history and experiences in the nursing programme (Sanner & Wilson, 2008). The results indicated that one of the primary factors affecting EAL nursing students was a dislike of and lack of familiarity with the participatory learning style involving dialogue with teachers which was at odds with their previous educational experiences (Sanner & Wilson, 2008). This result is consistent with the findings of Malu and Figlear (1998). In addition, the study by Sanner and Wilson (2008) found that EAL nursing students were self-conscious and reluctant to speak in class because of past experiences of discrimination and stereotyping by teachers and other students due to their accents and status as EAL students. The results were limited by a small participant group (three students). However, the research provides

further evidence of discrimination and stereotyping in classroom teaching spaces towards EAL nursing students and the impact these have on learning and achievement. The findings also provide support for the development of new pedagogical tools enabling more informal and user-controlled modes of learning for EAL nursing students.

Although considerable research has been devoted to EAL nursing students' language challenges and strengths, comparatively less attention has been paid to support programmes to improve such skills and foster academic and clinical achievement. Furthermore, in studies that have been conducted regarding programmes of support, attendance at interventions for EAL nursing students has been highlighted as a common issue. For example, a study by Seibold and colleagues (2007) evaluated a programme to support EAL nursing students in an Australian university. Twenty EAL nursing students participated in the Teaching and Learning Enhancement Scheme (TALES) programme which involved three mentors meeting fortnightly with the students over two semesters (Seibold et al., 2007). Seibold and colleagues (2007) described similar concerns with language skills and cultural difficulties affecting student performance as discussed by previous researchers (e.g., Müller, 2011a; Sanner & Wilson, 2008; Starr, 2009). As a result, the support programme focussed on general English skills, colloquial English, medical terminology and abbreviations, clinical handovers, reflective writing, resume writing, and interviews (Seibold et al., 2007). Using questionnaires and focus group interviews, the results of the study indicated that the majority of the nine students who completed the programme found the classes to be helpful in improving communication skills, cognitive skills, and computer skills (Seibold et al., 2007). However, low attendance at classes over the course of the support programme was a common issue which may affect the students' linguistic development and academic performance as well as the validity of the study. Specifically, out of 20 students who started the course, an average of only nine students attended the classes in the second semester and completed the data collection (Seibold et al., 2007). Seibold and colleagues (2007, p. 65) suggest that low attendance possibly reflects "the requirements of individuals within the group for varying levels of help". However, the attrition levels may also

reflect increasing difficulties with employment, finances, and family commitments. For example, it was noted that two of the nine students criticised travel requirements (Seibold et al., 2007). This is consistent with the results of other studies which have identified financial stress, employment demands, and family obligations as challenges resulting in the lower academic achievement of EAL nursing students (e.g., Amaro et al., 2006; Andrade, 2006; Devkota, 2023; Kangere, 2016; Obi et al., 2018; Robinson, 2018; Starr, 2009). Thus, the findings of the study by Seibold and colleagues (2007) provide support for the development of new support programmes, particularly those that allow more flexible, informal, and user-controlled modes of learning. Research suggests such features may also reduce the impact of student attrition (and the contributing factors) in interventions for EAL nursing students.

The need for improved programmes of support targeting academic language for international nursing students has been emphasised by key scholars in this field. For example, Crawford and Candlin (2013) examined the effectiveness of language support programmes for international nursing students. The authors concluded the programmes showed mixed results in terms of success. Although some studies showed positive results, difficulties with these programmes and conflicting results overall could be attributed to factors including methodological problems (Crawford & Candlin, 2013). In addition, the authors found a major limitation of the existing support programmes was that they did not attempt to teach more complex or context-specific language appropriate to learn specialised academic language, in accordance with the Cummins (1999) model of academic language proficiency. This included the use of colloquial language and nursing-specific medical language as well as feedback measures in order to aid the students' ability to understand the processes of language development. Thus, Crawford and Candlin (2013) argued that language support programmes require improvements to better develop academic language proficiency in international nursing students. This was critical as academic and clinical settings require the use not only of conversational proficiency but also academic language proficiency. Crawford and Candlin (2013) emphasised the importance of academic language proficiency-focused support and its

relationship to the requirements for registered nurses in the case of EAL nursing students. As a result, Crawford and Candlin (2013) recommended the need for further development of support programmes for EAL nursing students with a focus on the advanced and technical English required in universities and healthcare settings. Therefore, the findings outlined by Crawford and Candlin (2013) provide further support for the development of support programmes for EAL nursing students. The need for tools that build academic language proficiency including nursing-related medical terminology for international nursing students is particularly needed and warranted.

In summary, a significant amount of research has been conducted into the needs of EAL nursing students which have identified important strengths and challenges in this population and their implications for academic and clinical performance. Linguistic challenges found by previous research include poor listening and reading skills, difficulties understanding lecture content, and problems communicating in clinical settings. In particular, difficulties were noted with specialised vocabulary, medical terminology, and academic language proficiency vital for academic and clinical settings in nursing education. However, as well as language difficulties, psychological, social, academic, and cultural difficulties related to anxiety, fear of failure, academic teaching styles, finances, work and family demands, stereotyping, and discrimination were noted to create additional challenges for EAL nursing students. Despite the need for support, research suggests there is a paucity of effective tailored language support programmes available for international nursing students. Therefore, the review of the literature highlighted the need for more research into support programmes for EAL nursing students as proposed for the present study. Furthermore, while researchers have discussed psychological factors in EAL nursing students, it appears that no studies have measured psychological factors in this population and context. For example, this absence of existing research regarding psychological factors is noted in the context of learning medical terminology such as medication names, either at baseline or in relation to programmes of support using CALL videogames. This represents an important gap in the research literature.

2.4 Computer Assisted Language Learning

2.4.1 Computer Assisted Learning in Nursing Education and Language Education

The term computer assisted language learning (CALL) refers to the use of computer-based technology to facilitate the educational process specifically with regard to second language acquisition. Although a variety of terms have been used in the research literature including e-Learning and Computer Mediated Language Learning, the term CALL will be used in this review. Previous research has found evidence of many positive effects of CALL on language acquisition (e.g., Almekhlafi, 2006; Grgurović et al., 2013; Lai & Kritsonis, 2006; Liu et al., 2002; Peterson et al., 2020; Zhao, 2013; Zou et al., 2021). In particular, research suggests that CALL encourages independence, flexibility, and self-direction, promotes individualised learning and active engagement with the information, reduces language learning anxiety, provides immediate feedback, improves motivation and enjoyment, allows repeated exposure while reducing instructional time, and develops computer literacy (Bloomfield et al., 2008; Lai & Kritsonis, 2006; Liu et al., 2002; Peterson et al., 2020; Riasati et al., 2012; Zou et al., 2021).

An important review of digital games in language education was recently conducted by Peterson and colleagues (2020). The literature review identified 26 learner-based studies evaluating CALL videogames which were informed by social and cognitive theories of second language acquisition. Although limitations were noted, the review provided evidence that CALL videogames may improve language skills (particularly vocabulary learning), improve language-related social and cognitive skills, have affective benefits, and are positively received by language learners. For example, the findings indicated that CALL videogames may provide vitally-needed repeated exposure to the target language, facilitate the development of crucial language skills including reading and listening, increase language output, and enhance retention and understanding of new vocabulary. In addition, digital games were shown to improve collaboration and socialisation skills of language learners, build cross-cultural knowledge and skills, and enable problem solving opportunities which facilitate language development. Furthermore, it was noted that CALL

videogames provide a learner-focussed environment that may increase motivation and “reduce barriers to learning”, thereby facilitating language development (Peterson et al., 2020, p. 81). In particular, Peterson and colleagues (2020, p. 81) argued that “digital games provide access to a low-stress context, where the influence of affective factors, that can inhibit learning, such as anxiety and lack of confidence, is significantly reduced”.

However, despite the potential benefits, the review by Peterson and colleagues (2020) highlighted the concerning lack of serious games evaluated in the research in the field of CALL to date. The analysis showed that the majority of the 26 games investigated in the extant literature for their impact on language learning were ‘commercial off the shelf’ games. Most papers evaluated massively multiplayer online roleplaying games (MMORPGs), with the most common being ‘World of Warcraft’. The second most popular game type evaluated was simulation games, such as ‘The Sims’. It is important to note that these ‘commercial off the shelf’ games are designed for entertainment, not education. They were not designed for language learning among EAL students. In contrast, ‘serious games’ are purpose-designed educational games specifically developed to target language learning (or other educational goals). In the review by Peterson and colleagues (2020), only four serious games meeting the inclusion/exclusion criteria were identified in the published literature (Franciosi et al., 2016; Hitosugi et al., 2014; Suh et al., 2010; Zheng et al., 2009). Despite the very limited number of serious games available, the review noted that the serious games evaluated were effective in improving language skills (especially vocabulary learning), intercultural interaction, and language socialisation. Consequently, the authors concluded that serious games show “promising findings” and that “further research involving this type of game is warranted” (Peterson et al., 2020, p. 85).

Overall, the analysis revealed a significant paucity of serious CALL videogames available which have been evaluated in the research literature. Despite substantial theoretical work in this area which has emphasised the benefits of CALL videogames, the review demonstrates that there is an important gap in the research in terms of studies evaluating the application of CALL videogames

to meet the real-world needs of EAL learners. Furthermore, the authors noted that a major limitation of the existing research was the evaluation of only very limited factors in each study. For example, studies tended to focus only on language skills, or only affective factors. Accordingly, Peterson and colleagues (2020) recommended that future CALL research which evaluates multiple variables in the same study (such as both language skills and psychological factors) is strongly needed.

Turning from language learning to nursing, computers have been used within the field of nursing since the 1960's (Bitzer, 1966). A large number of studies over recent decades have endeavoured to investigate the impact of CALL and computer-based learning generally compared to traditional teaching methods on nursing-related knowledge and clinical nursing skills (e.g., Adams, 2004; Bloomfield et al., 2010; Conrick, 1998; Gleydura et al., 1995; Jeffries, 2001; Leasure et al., 2000; Lewis et al., 2001; Müller, 2011b; Napholz & McCanse, 1994; Tegtemeyer et al., 2001; Washer, 2001). For example, Bloomfield and colleagues (2008) conducted an analysis of twelve studies investigating the impact of computer assisted learning on clinical nursing skills. The reviewed papers were published between 1997 and 2006 with a focus on clinical skills, such as medication administration and blood pressure management as well as testing theoretical knowledge (Bloomfield et al., 2008). The outcomes of the studies were measured through the evaluation of skill performance with the use of structured checklists. All 12 studies reported using a control or comparison group to test the efficacy of the computer assisted learning method. The results of the study indicated predominately positive results on the effect of computer assisted learning on nursing skills and knowledge (Bloomfield et al., 2008). However, design weaknesses in the studies included lack of pretesting, and lack of testing for potential confounding variables. Therefore, further research is needed into the use of computer assisted learning methods in nursing skills with a general paucity of evaluative studies and a need for more rigorously designed research (Bloomfield et al., 2008). However, despite considerable research into the benefits of computer-based learning, a review of the literature (Pront et al., 2018) identified just four examples of computer-based

videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012).

However, before proceeding to the systematic literature reviews regarding CALL, a note about presentation and tabulation of the studies is warranted. Two multi-page supplementary tables summarising the games/papers examined in the upcoming systematic literature reviews are provided in Appendix C (Tables C1 and C2). Table C1 provides a summary of the studies of videogame-based learning in nursing education identified in the first systematic literature review (section 2.4.2). In particular, the table outlines the game name, reference (author and date), game stage, and important advantages and game features for each of the 14 papers relating to four games identified in the systematic review (Table C1). Similarly, Table C2 provides a summary of the studies of mobile-based videogames in language learning exam found in the second literature review (section 2.4.4). More specifically, the table outlines the game name, reference (author and date), platform, country of evaluation, target language, language skill, task type, participants (such as numbers, ages, and source), study design, and focus of the evaluation for five games identified meeting the inclusion criteria (Table C2). Taking into consideration the length and complexity of the two systematic literature reviews conducted and reported in the following sections, the aim of these literature summary tables is to provide an easy-to-read synopsis and comparison of the research literature and games evaluated. In total, 19 papers featuring nine games are presented.

2.4.2 Gaming in Nursing Education: A Literature Review

2.4.2.1 Citation

The following paper was published in the peer-reviewed journal *Nursing Education Perspectives* (Wolters Kluwer Health). Reprinted with permission. Authorship approval forms are provided in Appendix B. This is a non-final version of an article published in final form in:

Pront, L., Müller, A., Koschade, A., & Hutton, A. (2018). Gaming in nursing education: A literature review. *Nursing Education Perspectives*, 39(1), 23-28.

<https://doi.org/10.1097/01.NEP.0000000000000251>.

2.4.2.2 Abstract

Aim: The aim of this research was to investigate videogame-based learning in nursing education and establish how videogames are currently employed and how they link to the development of decision-making, motivation, and other benefits. **Background:** Although digital game-based learning potentially offers a safe and convenient environment that can support nursing students developing essential skills, nurse educators are typically slow to adopt such resources. **Method:** A comprehensive search of electronic databases was conducted, followed by a thematic analysis of the literature. **Results:** Evaluations of identified games found generally positive results regarding usability and effectiveness of videogames in nursing education. Analysis of advantages of videogames in nursing education identified potential benefits for decision-making, motivation, repeated exposure, logistical, and financial value. **Conclusion:** Despite the paucity of games available and the methodological limitations identified, findings provide evidence to support the potential effectiveness of videogames as a learning resource in nursing education.

The theory of gaming as a teaching strategy was introduced by Dewey and the gestalt theorists at the beginning of the 20th century (Hanna, 1991). Although digital game-based learning has the potential to offer a safe and convenient environment that could lead to nursing students developing essential skills, nurse educators are typically slow in adopting this resource (Hogan, Kapralos, Cristancho, Finney, & Dubrowski, 2011). Ongoing education and technological advances have meant that children engage with resources such as videogames at an early age. As a result, the cognitive and psychomotor learning requirements of today's students are arguably different from those of previous generations (Black, 2010; Carstens & Beck, 2005). The progression into higher education of these digitally savvy learners requires investigation and ignited an inquiry into the literature of videogame-based learning in nursing.

Today's university students have digital awareness and access to a broad range of technological tools/resources aimed at promoting their learning. Black (2010, p. 99) describes these learners as "digital natives" with a "plug-and-play" view to their learning needs. Nursing students

seek new media technologies in their education (Lynch-Sauer et al., 2011), and although digital experiences do not replace immersion in the clinical environment, they offer a vital context within which to build decision-making skills.

We sought to investigate the potential benefit of videogame-based learning in nursing, with a specific focus on decision-making, motivation, and nursing-related skills, and how videogames are currently employed. A challenge in an investigation of this type is the expansive language in this sphere of learning. Terms such as simulation, games, virtual games, digital games, e-learning, virtual reality, and digital learning tools all relate to a virtual videogame for education. Although many of the above modalities offer a learning experience for participants, they do not always fit the framework perceived by our research team. Therefore, to add clarity to this discussion, our interpretation of a videogame required clarification.

Our understanding is drawn from the context of nursing education and the work of Mayer and Johnson (2010), who clarify four common features of games for education, which include: 1) rule-based, allowing players to understand the environment; 2) responsive, allowing the learner to experience control; 3) challenging; and 4) cumulative, so that the current state of the environment reflects the player's previous actions and shows progress toward goals. These criteria led us to define an educational game as one that has clearly identified outcome goals/aims to be achieved within a set of rules that govern play, is bound by time limitation, and is of a competitive nature. Replication of reality is not considered an essential requirement, as the game itself determines the context congruent with the goals or aims identified. Because of the rapid expansion and development of educational gaming, many may disagree with our interpretation.

2.4.2.3 Method

A comprehensive search employing the search query ("nursing student" OR "nursing students") AND ("video game" OR "videogame" OR "computer game" OR "digital game" OR "electronic game" OR "serious game") was conducted up to February 2016 within Gale, PubMed, Taylor and Francis Online, Informa, Eric, Sage, Jstor, Emerald, Oxford, ACM Digital, Wiley Online,

SpringerLink, Ovid, Directory of Open Access Journals, Berkeley Electronic Press, BMJ Journals, Universities' Research Repository South Australia, and Google Scholar. The search elicited manuscripts referring to a wide variety of perceptions of virtual learning. To investigate and achieve the proposed aims of this discussion, inclusion and exclusion criteria informed by the presented understanding of games were established. The primary inclusion criteria were computer-based videogames for educational purposes of nursing students evaluated in original research articles.

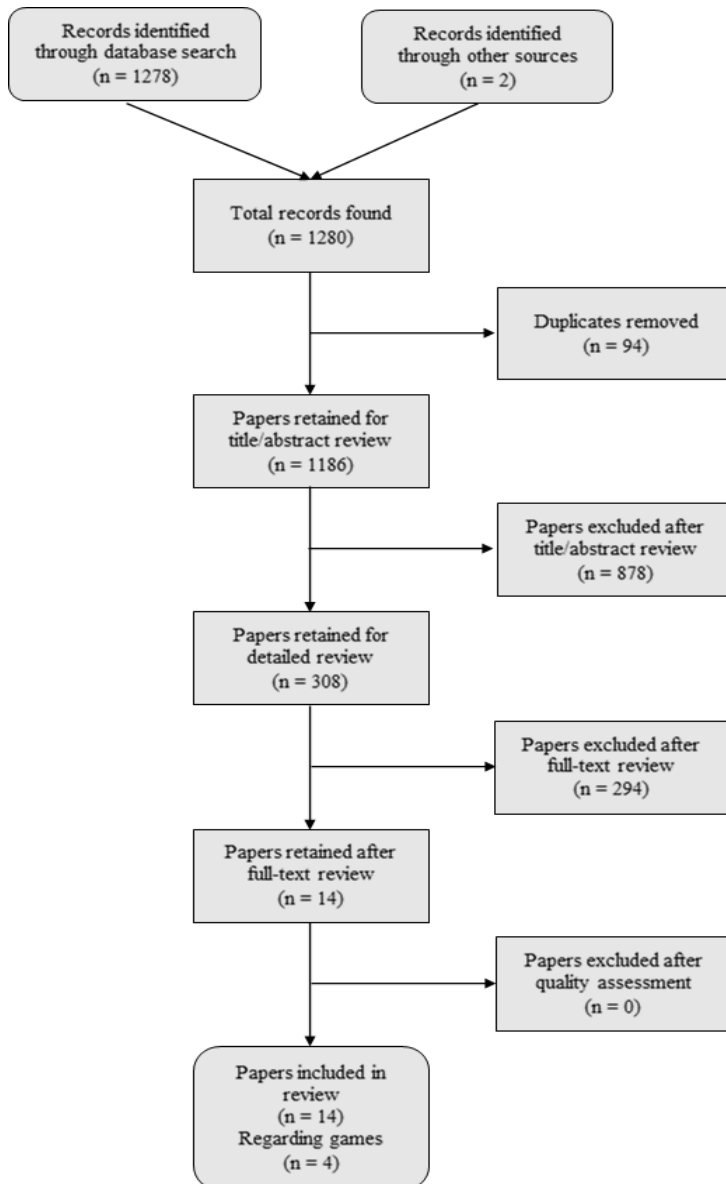
Since videogames were the focus of this review, games such as card games, board games, face-to-face quizzes/games, simulations (digital or nondigital, e.g., high-fidelity patient simulation), virtual reality, virtual patients, distance learning, and eLearning were excluded. Games for other professions or for use by patients were also excluded, as were review papers, papers retrieved without full text (e.g., abstracts only), and papers written in languages other than English.

The initial search identified 1,278 citations, whereas two records were identified through other sources (expert referral). After 94 duplicates were removed, the titles and abstracts of the remaining 1,186 titles were reviewed. Based on the inclusion and exclusion criteria, 878 papers were excluded after the title/abstract review, leaving a total of 308 papers for detailed review. Review of the full text of these papers resulted in 294 identified as not meeting the criteria. The remaining 14 papers were assessed for quality using the Critical Appraisal Skills Programme (Public Health Resource Unit, 2006) tool, but none were excluded based on this assessment. Overall, 14 articles pertaining to four games met the inclusion criteria and were included in this review (see Figure 1 for PRISMA diagram).

In addressing the aims of this discussion, each author reviewed the literature using the Critical Appraisal Skills Programme (Public Health Resource Unit, 2006) to establish rigor. Thematic analysis followed, which generated discussion within the team to establish congruency and transparency of interpretation. Human subject approval was not obtained as data were sourced from the literature.

Figure 1.

Prisma Flow Diagram of Study Selection



2.4.2.4 Results

2.4.2.4.1 What Is Already Out There for Nursing Education? The reviewed literature identified 14 papers related to four games matching the inclusion/exclusion criteria: 1) Medication Game (Foss et al., 2014; Foss, Mordt, Oftedal, & Lokken, 2013; Mordt, Tillerli, Lokken, & Foss, 2011), 2) Medicina (Müller, 2011b, 2012, 2013; Müller & Mathews, 2013), 3) Brevissima (Müller & Price, 2012), and 4) Continuing/Higher Education in Research Methods Using Games (CHERMUG) game (Boyle, 2012; Boyle & MacArthur, 2013; Boyle, MacGregor, Van Rosmalen, Manea, & Penanen, 2014; Boyle, Van Rosmalen, MacArthur, et al., 2012; Boyle, Van Rosmalen, &

Manea, 2012; Johnston, Boyle, MacArthur, & Manion, 2013). Three of the games were described in multiple papers, addressing differing aspects such as design, development, and evaluation. A supplementary table summarising the games/papers is available in Appendix C (Table C1).

Foss and colleagues' (2013) Medication Game aims to educate nursing students for simple mathematical and medication calculation skills as well as standard medical units and expressions. This computer-based videogame is divided into three sections for training, self-testing, and examination. The training section aims to familiarize and educate nursing students on the topics of numeracy, conversion, and practical medical calculation. Students must use the mouse to answer as many questions as possible in one minute. Points are awarded for correct answers (providing immediate feedback), and the time limit can be reduced to increase the level of challenge (promoting confidence and timely decision-making). As part of the game's reward system, highest scores are saved to provide motivation for students to play multiple times. Self-testing involves answering random tasks on numeracy, conversion, and practical medical calculation. A total point score is displayed with progress presented on a graph; a ranking of highest scores provides competition. In the examination section, users are presented with previous examination questions (Foss et al., 2013, p. 592).

To evaluate the efficacy of the Medication Game, Foss et al. (2014) conducted a randomised controlled trial over four and a half weeks with students in a baccalaureate nursing course on medication calculation at two Norwegian universities; 201 students participated. Students were randomly assigned to a control group (traditional lectures and task-solving classes) or a gamer group (along with routine classes, they played the game as often as desired). Data were collected via examination results after the intervention, gaming metadata, and a questionnaire.

Although the pass rate was higher for the gamer group, this difference was not statistically significant. When examining the gamer group alone, results indicated gamers who passed the exam had higher game scores and used the self-tests more frequently than those who failed the examination. Based on these results, Foss et al. (2014) concluded that playing the game frequently

had a positive influence on examination results, indicating the effectiveness of videogames for teaching specialized skills in nursing education.

From the gaming metadata, Foss et al. (2014) found that the frequency and duration of gameplay was very low (on average, one group completed only one self-test). This may suggest dissatisfaction with the game design and have significant impact on engagement. The findings may be limited by missing game metadata for 43 percent of gamers and differences in the primary outcome measure (exam) between the campuses. Therefore, although the Foss et al. study provides some evidence to suggest that videogames have a positive effect on nursing students, the conclusions are limited due to concerns with game design and methodology.

The Medicina videogame was developed in response to an analysis of the needs of international nursing students. Identified difficulties in listening and low-frequency vocabulary deficiencies (especially medication names) were viewed as barriers to success in academic and clinical settings (Müller, 2011a). Müller (2012) developed the computer-based videogame to increase phonological awareness, improve listening skills, improve reaction times, and allow for multiple exposures to both written and spoken vocabulary, specifically pharmacological terminology.

Medicina users hear a verbal command to locate a medication and use the mouse to select an option among five written, labelled medication bottles within a four-second time limit. Feedback is given by a cartoon nurse avatar. If the correct answer is chosen, the nurse (shown holding the bottle with the selected name) says "Yes" and repeats the correct name. If the incorrect answer is given, the nurse says "No" and pronounces the incorrect name. Failing to choose an option or choosing three incorrect answers ends the game. The game incorporates four different speaking voices and a continuous stream of hospital-related background noise.

Müller (2011b) evaluated the efficacy of Medicina with 25 international nursing students enrolled in a graduate nursing degree at Flinders University. A pretest/posttest design was conducted over an eight-week period; the study used quantitative and qualitative methods, and the

same word recognition test was used for the pretest and posttest. During the intervention, participants played *Medicina* via computer as many times as they desired (Müller & Mathews, 2013). Results indicated an increase in word form recognition, with posttest scores significantly higher than pretest scores (Müller, 2011b). Thus, *Medicina* is effective in increasing phonological awareness to improve the ability of international nursing students to identify medication names. However, although the effect sizes observed were large, the study had a small sample and did not include a control group.

The *Brevissima* computer-based videogame, designed by Müller and Price (2012), aims to teach medical abbreviations to international nursing students. Nursing students listen to a looped sentence including common medical abbreviations (380 unique abbreviations are used). On the screen, medication capsules containing written medical abbreviations fall from the top of the screen, and a nursing student avatar, holding a medication bottle, is at the bottom. Players use the arrow keys to move the avatar to catch the capsule matching the abbreviation to the spoken sentence while avoiding the distraction capsules. If the correct answer is selected, points are awarded, and the avatar responds happily; if an incorrect answer is chosen, the pills spill out of the bottle, the avatar cries, and the player lose all points. A hospital bed appears randomly during gameplay to disrupt predictability; if it falls on the avatar, the player is squashed and loses pills but retains points. As the player progresses, capsules fall at faster rates and at different trajectories. After the game, the sentence and medical abbreviation are displayed along with the ratio of caught-to-missed abbreviations. The game includes two difficulty levels, five speakers, hospital-related background noise, and changing hospital-related background pictures. The nursing student avatar, dressed in the university's clinical placement uniform, is selected by the student.

Müller and Price (2012) used a qualitative survey to evaluate perceptions of *Brevissima* in a sample of 11 international nursing students. Over a two-week period, participants answered five questions regarding usability, problems and potential improvements, patterns of game use, opinions regarding the avatar, and perceived usefulness of the game as an educational resource. Students

perceived *Brevissima* to be useful for linguistic development such as listening skills, word form, and use of medical abbreviations, particularly in clinical contexts. Participants' opinions of the gameplay were positive, with users finding the game fun and relaxing; avatars added realism and emotion to the educational process. More than one third of participants spontaneously mentioned game scores during feedback, with scoring providing a source of motivation and self-assessment. The findings are limited by the small sample size and lack of a quantitative study to evaluate effectiveness.

The *CHERMUG* game, developed by Boyle and colleagues (Boyle, 2012; Boyle & MacArthur, 2013; Boyle et al., 2014; Boyle, Van Rosmalen, MacArthur, et al., 2012; Johnston et al., 2013), aims to develop nursing and social science students' understanding of research methods and statistics. In planning the game, the authors conducted multiple needs analyses, including user requirements and attitudes toward games for learning among nursing students and conducting cognitive task analyses (Boyle & MacArthur, 2013; Boyle, Van Rosmalen, MacArthur, et al., 2012; Boyle, Van Rosmalen, & Manea, 2012). The game underwent numerous changes over the course of the project timeline and analyses.

The final version of *CHERMUG* incorporates 11 smaller games in two subsections focused on the theme of obesity and related issues such as nutrition (Boyle et al., 2014). Eight games are quantitative and accessed online; three are qualitative and can be downloaded onto computers for student access. In terms of gameplay, the quantitative subsection includes hangman, multiple-choice, drag-and-drop, and tic-tac-toe-style activities; qualitative games include drag-and-drop, design mini-games, and coding mini-games. Feedback is provided after each response and includes rewards and scoring.

Testing of the *CHERMUG* game was undertaken through multiple pilot tests in three phases; 1,034 participants in 26 cohorts consisted of staff and students from nursing and social science disciplines across five European universities (Boyle et al., 2014). Because of the substantial changes made during the project timeline and the significant differences in participants, materials, game

iterations, and subsections of games tested, it is difficult to provide a detailed outline of methods used or compare results. Overall, the results of the pilot tests provide evidence suggesting that the game was seen as easy to use, motivating, interesting, and valuable for learning (perceived competence; Boyle et al., 2014). However, findings between evaluations are inconsistent, with some showing a preference for quantitative games and others preferring qualitative games. Randomized control trial results were not statistically significant.

Conclusions are further limited because of a number of methodological concerns (Boyle et al., 2014). First, the evaluation of the CHERMUG game was conducted in a single lab session in which students were given 90 minutes to complete all pre- and posttesting and play the game. Students did not have the opportunity to play the games in full and repetitively, as in a typical intervention period of weeks or months. The authors identified this as an issue prior to testing, stating that "it was thought unlikely that the CHERMUG mini-games would lead to better performance over this short time period." Second, no randomized controlled trial appears to have been conducted using the entire CHERMUG game. Rather, randomized controlled trials in the third evaluation phase used a small subset of two to six of the 11 games that comprise the CHERMUG game. Third, the pilot analyses did not evaluate the effects of the intervention on objective skill but asked students to rate their self-perceived competence (self-efficacy) as a subjective measure. There are further concerns with randomization procedures (with differences between groups before intervention) as well as participant attrition (76 percent dropped out in one evaluation). Despite these concerns, the initial findings regarding usability and usefulness are positive and promising.

In summary, only four games were identified that met the established criteria. Overall findings of the studies suggest predominantly positive results for usability and effectiveness of videogames in nursing education. Methodological issues were noted that may reduce the validity of findings. Videogaming is an evolving learning platform. Other games identified in the grey literature were not studied for their educational benefits or published in the academic literature and were not included in this review.

2.4.2.4.2 Advantages of Videogames. The reviewed literature revealed a number of recurring themes regarding the potential advantages of videogaming as a learning tool for nursing students. Given the general lack of research currently published in this field, an exploration of the benefits of videogames in nursing education was thought to be warranted.

One of the aims of this review was to examine how videogames are linked to developing decision-making in nursing education. Demand on the nursing profession to make clinical decisions about clients under strict time-restrained conditions leads to uncertainty and risk (Ebright, Patterson, Chalko, & Render, 2003). Such pressure is particularly evident in outpatient and community settings where nurses need to perform complex problem-solving activities involving clients with multifaceted disease processes within an ever-changing environment (Schofield et al., 2011; Wolff et al., 2009). Nursing students are increasingly required to make time-efficient, informed clinical reasoning and problem-solving decisions around assessment, planning, implementation, and evaluation of individual client care (Aitken, Faulkner, Bucknal, & Parker, 2002).

Foss et al. (2013, p. 592) claim that time pressure with videogames "forces players to make intuitive decisions about the correct answers," whereas the authors of *Brevissima and Medicina* (Müller & Mathews, 2013; Müller & Price, 2012) argue the benefits of improved response time and accuracy. While the precise mechanism through which videogames may improve decision-making is unclear, features such as multisensory stimuli, time limitations, feedback, and repeated exposure may have an influence in several ways.

First, videogames improve cognitive skills, increasing the speed of processing while maintaining accuracy (Dye, Green, & Bavelier, 2009), improving reaction time (Latham, Patston, & Tippett, 2013), and enhancing attention skills such as visuospatial attention and the ability to disregard irrelevant stimuli (Latham et al., 2013; Mishra, Zinni, Bavelier, & Hillyard, 2011). Second, the interactivity and immediate feedback provided by videogames enable students to make sense of previous decisions, provoking deeper thinking and active learning in subsequent games via a cycle of constant decision-making (Ritterfeld, Shen, Wang, Nocera, & Wong, 2009). Third,

videogames allow nursing students to practice making decisions in a safe, realistic, simulated setting, encouraging the exploration of decisions and the capacity to take risks without the fear of real-life consequences that are impossible to replicate within the real world for reasons of safety, cost, and time (Kato, 2010; Lynch-Sauer et al., 2011; Susi, Johansson, & Backlund, 2007). Moreover, videogames offer experience in making decisions through repeated exposure, which is particularly significant given the importance of experience in clinical decision-making for nurses (Bakalis & Watson, 2005; Banning, 2008; Garrett, 2005; Gillespie & Paterson, 2009; Tanner, 2006).

Repetition is a particularly valuable feature of videogames for learning and mastery of content and was highlighted by the authors of each of the four videogames. For example, Müller and Price (2012, p. 156) assert goals "to automatise the recognition process," with limited opportunity to repeat the activity, contributes to minimizing learning outcomes (Müller, 2011a, p. 18). Thus, repeated exposure and automaticity were significant factors in the development of the *Medicina* videogame (Müller & Mathews, 2013).

Automaticity is a term that refers to the "ability to perform a task with little effort and few attentional resources" (Stefanidis, Scerbo, Sechrist, Mostafavi, & Heniford, 2008, p. 211). Cognitive load theory supports this notion as attention required to "filter" multiple stimuli hinders learning (De Jong, 2010, p. 105). Enhancing automaticity is thought to increase the speed of processing and decrease cognitive load through familiarity. Familiarity is developed through repeated exposure, requiring less time to be spent recognising and recalling words or cues (Frey & Fisher, 2010; Müller, 2011a). Consequently, increased concentration and attentional capacity are available for other tasks such as meaning making and comprehension of clinical activities and decision-making.

The importance of repeated exposure, repeated practice, and increased automaticity for learning has been emphasized in a variety of fields including medical education (Andersen, Mikkelsen, Konge, Caye-Thomasen, & Sorensen, 2015; Castanelli, 2009; Ericsson, 2004;

Stefanidis et al., 2008); reading (Frey & Fisher, 2010); language development (Van Moere, 2012; Webb, 2007); mathematical calculations (Woodward, 2006); and chess, sport, and music (Ericsson, 2004). Research regarding automaticity emphasizes repeated exposure (repeated practice) as crucial for development (Frey & Fisher, 2010; Van Moere, 2012), and levels of exposure are required (Müller, 2011a; Stefanidis et al., 2008; Webb, 2007). Videogames allow for an infinite number of repeated exposures to the target skill, which means they are uniquely placed to support development of automaticity.

Evidence also suggests that repeated practice conducted in multiple short sessions distributed across time is more effective in improving performance than repetition conducted in one session (Andersen et al., 2015). Videogames are suited to playing in short bursts over time, and students can choose the duration of play. However, Castanelli (2009, p. 905) asserts that repetition alone is not sufficient for learning as "motivation and feedback are also essential if performance is to continue to improve." Fortunately, in addition to repetition, constant feedback and motivation are among the main characteristics of videogames. Thus, the benefits of repeated exposure leading to automaticity provide support for the value of videogames as a resource for nursing education.

Motivation is considered one of the major advantages of videogames in nursing education and was emphasized by authors of the four reviewed games. For example, Foss et al. (2014, p. 346) argued that the positive effects of the Medication game may include "increased motivation and active learning reinforced by instruments of entertainment." Medicina was described as a "fun game" (Müller, 2013, p. 292) that increased motivation "through a diversification of delivery methods" (p. 162), leading to increased confidence to engage in clinical placements and classes. Compared to traditional learning methods, students reported feeling excitement, interest, and reduced boredom.

Müller and Price (2012) highlighted key features of the Brevissima game that promote motivation in nursing students. For example, student interaction is achieved through constant spatial movement and touch selections, engagement with multisensory stimuli, as well as time limitations.

In addition, the feedback and scoring system provides reward for effort in a genuine and continuous way.

Further evidence supports arguments made by these authors, with research indicating that videogames can increase motivation (e.g., Dondlinger, 2007; Granic, Lobel, & Engels, 2014; Lee & Peng, 2006). In a review of educational videogames, Dondlinger (2007, pp. 22-23) concluded "all find that motivation to play is a significant characteristic of educational videogames." Exactly how or why players are motivated through this platform is unclear. However, it seems that these distinct design elements are key: narrative context, rules, goals, rewards, multisensory cues, and interactivity, immersion (Bellotti, Berta, & De Gloria, 2010; Lee & Peng, 2006). The opportunity to apply subject matter in a new context (Rieber, 1996) and transference are also important.

Amory, Naicker, Vincent, and Adams (1999) found that students preferred adventure and strategy games with stimulating sound, graphics, use of technology, and storylines. Furthermore, Garris, Ahlers, and Driskell (2002) identified fantasy, rules/goals, sensory stimuli, challenge, mystery, and control as key videogame characteristics that trigger intrinsic motivation and self-directed repeated gameplaying as part of the game cycle. Hence, videogames may be a useful educational tool in nursing education to increase motivation, promote engagement, and encourage repeated gameplay in order to promote automaticity in decision-making.

There are also important logistical and financial advantages of using videogames as a learning tool for nursing students. Universities face significant financial and practical demands with limited budgets, staffing, and resources coupled with large numbers of students with varying levels of needs often located across multiple campuses. As part of the development of the *Medicina*, Müller and Mathews (2013) examined the financial, logistical, and policy-based arguments that support the use of digital game-based learning tools for nursing students. Videogame-based learning offers students independence in learning outside the classroom at a time and place convenient to them.

Consequently, their use in nursing education may relieve the workload for teachers while providing

additional learning opportunities. The logistical and financial benefits for nursing education suggest that videogames can be a cost-efficient and time-efficient educational resource.

The financial and logistical advantages of videogames may also benefit nursing students for whom financial pressures, employment demands, and family responsibilities have a negative impact on academic performance (Crawford & Candlin, 2013; Salamonson, Everett, Koch, Andrew, & Davidson, 2012; Rochford, Connolly, & Drennan, 2009; Starr, 2009) and may contribute to high levels of attrition (Kanji, White, & Ernst, 2006; Schwarze & Gerler, 2015; Seibold, Rolls, & Campbell, 2007). Videogames have the advantage of being widely available, highly flexible, and user-controlled. The use of these resources may influence academic performance and minimize attrition in intervention programs. They are unlikely to increase financial stress as students typically have access to a computer and videogames can be made available at minimal cost. In summary, the potential advantages for nursing education include improved decision-making, increased motivation, and increased repetition (automaticity), as well as important logistical and financial benefits.

Several potential disadvantages of videogames have been discussed, including design as crucial to usability and effectiveness and the need for conscientious planning from an evidence-based approach. Videogames can be time-consuming, costly, and complex to develop, requiring special skills or technical ability (Kato, 2010; Müller & Mathews, 2013). Furthermore, they may not be the most efficient or appropriate educational tool for every need or audience (Meredith, Achterbosch, Turville, & Venkatraman, 2012).

In terms of implementation of videogames in the curriculum, potential disadvantages include the creation of stress or embarrassment for students due to lack of experience with gaming or incorrect answers. There is a need for instruction or debriefing, particularly related to the competitive element, which may be perceived as negative (Foss et al., 2013). Importantly, this review of the literature suggests that there is currently insufficient evidence regarding the effectiveness of videogames as an educational resource for nursing students. There do not appear to

have been any systematic reviews of long-term benefits at this stage (Girard, Ecalte, & Magnan, 2013).

2.4.2.5 Conclusion

A general paucity of research regarding videogames within nursing education exists, particularly in terms of the limited number of games that are currently available. This research established comprehensive search criteria to conduct an appropriate and extensive review of research available in this field. As a result, four videogames meeting the criteria were identified. These games provide generally positive evidence regarding usability and effectiveness in nursing education. Based on the papers reviewed, a number of important issues regarding advantages of videogames as an education tool in nursing education were discussed. Key features, such as rules/goals, time limitations, rewards and feedback, constant engagement, immersion, multisensory stimuli, storylines, control, availability, flexibility, user-centeredness, and personalized design, were highlighted. These aspects may have specific advantages for developing decision-making, improving motivation, facilitating repeated exposure, and providing financial and logistical benefits for students and educators. Such benefits make videogame-based learning uniquely placed to target specific skills and needs required within nursing education. In terms of limitations, the scope of this review and the specific inclusion/exclusion criteria may be considered too narrow. Future research should focus on the development of new videogames and new experimental studies to examine the effectiveness of videogames in nursing education.

2.4.3 Mobile Phone-Based CALL Videogames in Nursing Education

The previous section of the literature review outlined the extant research regarding computer-based videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). However, all four videogames identified were single-platform games using computer devices only. None were multiplatform games that used both mobile and computer devices.

A comprehensive review of the literature was conducted seeking to locate published studies evaluating multiplatform CALL videogames in nursing education. The primary inclusion criteria were multiplatform videogames available on computer devices and mobile devices including mobile phones for educational purposes of nursing students evaluated in published peer-reviewed original research articles. Since videogames were the focus of this review, games such as card games, board games, face-to-face quizzes/games, simulations (digital or nondigital, e.g., high-fidelity patient simulation), virtual reality, virtual patients, distance learning, and eLearning were excluded. Games for other professions or for use by patients were also excluded, as were review papers, papers retrieved without full text (e.g., abstracts only), and papers written in languages other than English. Academic databases searched included Gale, PubMed, Eric, Sage, Jstor, Emerald, Oxford, ACM Digital, Ovid, Cambridge, and Web of Science. However, no published studies meeting the criteria were identified. Subsequently, the scope was widened, and a detailed review was performed searching for single-platform videogames in nursing education that used mobile phones only. The same general exclusion criteria and search methods were employed. Again, no papers evaluating videogames meeting the criteria were identified. Given the lack of games identified in this narrow field, the decision was made to expand the search outside of nursing education to investigate mobile phone-based videogames in language learning.

2.4.4 Mobile Phone-Based Videogames in Language Learning: A Systematic Literature Review

2.4.4.1 Abstract

The aim of this paper is to investigate mobile phone-based videogames in language learning. It examines what games are currently employed in this field and explores trends among the games and the research evaluating them. Computer assisted language learning (CALL) is an evolving field of research incorporating a diverse range of information and communication technologies to aid language education. With the significant popularity of mobile devices and improving technology allowing more sophisticated use, there is a rapidly increasing interest in the use of mobile technology for supporting language learning. Despite the potential benefits provided by such

technology, the use of mobile phone-based videogames in language learning has received little attention among researchers and educators. To examine the role of mobile phone-based videogames in language learning, a literature review was conducted involving a comprehensive search of 11 electronic databases. The literature review identified five games matching the established inclusion/exclusion criteria. Analysis of the five games suggested generally positive results in terms of the use and effectiveness of mobile phone-based videogames in language learning. Aspects noted in the analysis include features of game design and content, results of the evaluations, advantages and disadvantages, linguistic and cultural factors, game implementation and availability, trends in publications, and methodological issues were discussed. Despite the limited number of games researched and the methodological limitations identified, findings provide evidence to support the use and effectiveness of mobile phone-based CALL videogames as an educational resource for language learning. This review highlights the need for more research on CALL videogames playable using mobile phones and for this research to be published in reputable academic journals.

2.4.4.2 Introduction

Computer assisted language learning (CALL) is an evolving field of research involving the use of a diverse range of information and communication technology (ICT) applications to aid language education. With the growing popularity of mobile devices and improving technology allowing more sophisticated use, there is a rapidly increasing interest in the use of mobile technology to support language learning. CALL activities which are mediated via portable handheld mobile devices such as mobile phones which are “available anytime, anywhere” may also be referred to as mobile assisted language learning (MALL) or m-learning (Kukulka-Hulme & Shield, 2008, p. 3). Mobile devices on which CALL games have been played include handheld game consoles (such as Nintendo DS), handheld personal computers (e.g., personal digital assistants and tablets) and mobile phones (both feature phones and smartphones).

Key characteristics and advantages of CALL using mobile devices include flexibility, portability, connectivity, spontaneity, availability, interactivity, user-friendliness, permanency,

accessibility, immediacy, and situating of language learning activities into everyday life (Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). Thus, mobile technology-based CALL allows the individual to control their own language learning process and progress, enhancing motivation, autonomy, and proficiency in an engaging and personalised way (Miangah & Nezarat, 2012).

Previous research has found evidence to suggest that CALL using a broad range of mobile devices is effective in supporting language learning (Burston, 2013; Cheng et al., 2010; Kim & Kwon, 2012; Levy & Kennedy, 2005; Lu, 2008; Oberg & Daniels, 2013; Ogata & Yano, 2004; Thornton & Houser, 2005; Viberg & Grönlund, 2012). For example, Viberg and Grönlund (2012) conducted a review of 54 studies published between 2007 and 2012 investigating the impact of mobile-based learning on second language acquisition. The studies reviewed focused on vocabulary acquisition, listening skills, and speaking skills. Results indicated positive attitudes towards the mobile technology use and improvements in language proficiency (Viberg & Grönlund, 2012). Additional language learning benefits cited by Viberg and Grönlund (2012) in the use of mobile-based learning included the ability to integrate the mobile technology in both formal and informal contexts, positive attitudes, enjoyable means of engaging learners in educational contexts, and the ability to focus on listening and speaking skills. Thus, the results of the review by Viberg and Grönlund (2012) provide support for the potential benefits and effectiveness of a mobile phone-based tool to support language learning students. However, the review by Viberg and Grönlund (2012) did not focus specifically on mobile phone-based CALL videogames and there have been important changes in the field (such as advances in smartphone technology and applications) since the review was published over a decade ago (in 2012). As such, an updated review investigating mobile phone-based CALL videogames is warranted.

Despite the advantages of CALL, the limitations of mobile devices (both in terms of hardware and software) may represent challenges to the success of CALL using this technology. Such disadvantages include small screen size, graphics and audio limitations, data storage, battery life,

network connection issues (e.g., dropouts), and memory capabilities (Chinnery, 2006; Lu, 2008; Miangah & Nezarat, 2012).

Taking these advantages and disadvantages into consideration, the development of smartphones has been described as a “game-changer” (Godwin-Jones, 2017, p. 4) in the field of CALL. Smartphone features include larger screens, improved audio-visual clarity, larger memory and data storage, higher data usage and data allowances from telecommunications providers, more powerful processors, faster connectivity and network speeds, improved software, and changes to graphic complexity and mobile phone capacity (Godwin-Jones, 2017). Hence, incorporating these technological changes, smartphones make important steps towards reducing the problems typically associated with other mobile devices (Godwin-Jones, 2011, 2017). These observations and changes are reasons why some games work on mobile phones. Thus, mobile phone-based learning incorporating smartphone developments and the use of mobile applications, also known as “apps”, represents an important area of research in the field of CALL.

Furthermore, an important subset of CALL is the use of educational games. While the theory of using games in learning is certainly not new, digital game-based education has the potential to provide students with a fun, engaging, safe, efficient, and convenient learning environment that may help students develop vital skills and knowledge. Today’s students have often played videogames from an early age, have a high level of digital awareness, and have a high degree of uptake of technological resources for their education (Black, 2010; Lynch-Sauer et al., 2011). Despite this, educators have been slow to adopt digital game-based learning for students and a review of the research literature did not identify any literature reviews specifically investigating mobile phone-based videogaming for language learning. This represents an important gap in the research literature.

Thus, the focus of the current paper is to conduct a literature review investigating digital videogame-based learning using mobile phones (and especially smartphones) in the discipline of language education. It aims to identify and examine what mobile phone-based videogames are

currently employed in CALL, as well as to explore the trends among these games both in terms of the games themselves and the research evaluating them.

2.4.4.3 Methods

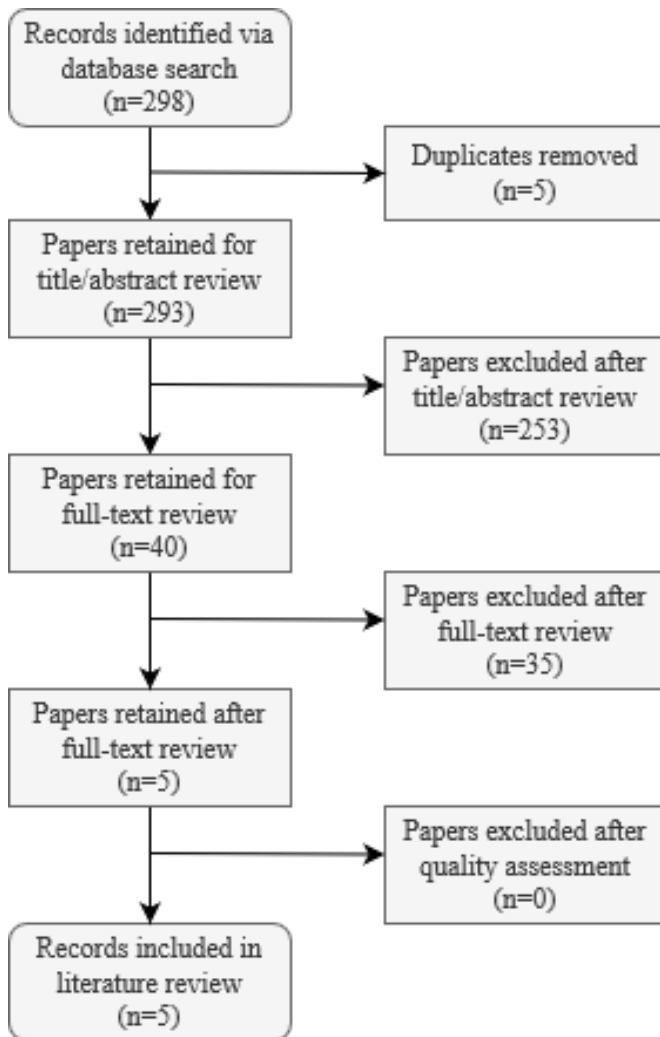
A comprehensive search employing the search query ("language learning" AND "game" AND ("mobile phone" OR "cell phone" OR "cellphone" OR "smartphone" OR "smart phone" OR "iphone")) was conducted within 11 academic databases (Gale, PubMed, Eric, Sage, Jstor, Emerald, Oxford, ACM Digital, Ovid, Cambridge, and Web of Science) up to January 2021. Human ethics approval was not obtained as the data were sourced from existing research literature. To investigate and achieve the proposed aim of this review, inclusion and exclusion criteria were established. The primary inclusion criteria were mobile phone-based videogames for educational purposes of language learning evaluated in original research articles written in English. Review papers, papers retrieved without full-text (such as abstracts only) and papers written in languages other than English were excluded.

A challenge in this investigation was the expansive language used in this sphere of learning. For example, terms such as mobile phone, cell phone and smart phone, along with their multiple spelling variations, are used by different countries at different times to refer to the device of interest. Furthermore, as the field rapidly expands and evolves, digital gaming for education is referred to using a wide range of terms and definitions. For the purposes of this review, educational videogames are defined as games of a fun and competitive nature, involving features such as time limitations, scoring, or rules, responsive to the learner and allow repeated gameplay for cumulative progress. This interpretation was influenced by the framework provided by previous researchers on the features of games for education (e.g., Clark & Mayer, 2011). Consequently, language learning mobile applications without such videogame elements (for example, apps that were purely dictionaries, translation tools or vocabulary lists in nature) were excluded from the current review. In addition, as mobile phone-based games were the focus of this review, other forms of educational games such as board games, face-to-face quizzes/games, simulations, virtual reality, augmented

reality, computer-based videogames, and games used via other mobile devices (such as iPads and Nintendo DS) were excluded due to important differences in use, features, benefits, and limitations which may make comparisons and conclusions difficult.

Figure 2.

Prisma Flow Diagram of Study Selection Related to Language Learning



The initial search identified 298 citations. After five duplicates were removed, the titles and abstracts of the remaining 293 titles were reviewed. Based on the inclusion and exclusion criteria, 253 papers were excluded after the initial title/abstract review leaving a total of 40 papers. Next, review of the full text of these papers resulted in 35 determined as not meeting the criteria and were subsequently excluded. The remaining five papers were assessed for quality using the Critical Appraisal Skills Programme (CASP) (Public Health Resource Unit, 2006) tool. However, none were excluded based on this assessment. In total, five articles pertaining to five individual games

met the inclusion criteria and were included in this literature review. See Figure 2 for the PRISMA diagram.

2.4.4.4 Results and Discussion

The literature review identified five mobile phone-based videogames for language learning matching the inclusion criteria: Idiomobile (Amer, 2014), GraphoGame (Jere-Folotiya et al., 2014), English Practice (Pham et al., 2018), BW Vocabulary (Thongsri et al., 2019) and Books vs Brains@PolyU (Kohnke et al., 2021). The design and evaluation of each game was described in individual papers. A supplementary table summarising the videogames is available in Appendix C (Table C2).

In summary, there was a notable paucity of games, with only five games meeting the established criteria in the current literature review of mobile phone-based gaming in language learning. Overall, results of the studies indicate positive findings regarding the use and effectiveness of mobile phone-based digital games in language education. However, methodological issues with the studies were noted which may reduce the validity of the conclusions. While each of the five games was unique, some interesting trends and differences were noted on aspects such as features of game design and content, results of the evaluations, advantages and disadvantages, linguistic and cultural factors, game implementation and availability, methodological issues, and trends in publications.

2.4.4.4.1 Game Design and Features. Each of the studies presented and tested a unique game with individual features. As a part of exploring what mobile phone-based CALL videogames are currently available in the field of language learning, the design and key features of each game was examined. For example, Idiomobile (Amer, 2014) is divided into three components: a game, quizzes, and flashcards. In the game component, players assist a character in selecting the correct idiom from the options provided for the given situation with specific narrative scenarios. The gameplay screen includes colourful animated graphics of the scenes (such as a restaurant or airport). Quiz features include immediate feedback, time limitation, and scoring. The game has 30 scenes

available, allowing users to learn novel stimuli during repeated gameplay. During the posttest interviews, features which participants noted were particularly enjoyable and beneficial included the sense of control, immediate feedback, interactivity, challenge, difficulty, repeated practice, and new idioms learnt with each play.

Similarly, the English Practice videogame includes quizzes and flashcards (such as multiple-choice questions and word/image matching games), grammar lessons and a chat room (Pham et al., 2018). Key features of English Practice include immediate feedback, scoring, repeated play, and novel stimuli, with an impressive 4400 sets of questions/lessons. The gameplay interface is colourful and sleek, including graphics and real-life photos of objects. The results of the evaluation found that the quiz section was the most popular part of the game, having the highest frequency of use and longest duration of gameplay. Based on the findings of the study regarding patterns of player behaviour, Pham and colleagues (2018) recommended that future games focus on simple tasks with short durations.

Students using GraphoGame (Jere-Folotiya et al., 2014), answer repeated trials of multiple-choice questions. First, students hear phonemes provided via audio through headphones and then must select the letter that matches the stimulus phoneme heard among 2-8 alternative options. There are different difficulty levels as the learner continues to play and progresses. Unfortunately, no images of the gameplay or discussion of the game interface or graphics were provided in the published paper by Jere-Folotiya and colleagues (2014). This makes it difficult to describe and evaluate the content and features of the game further or allow comparison with the other games identified.

The BW Vocabulary game (Thongsri et al., 2019) includes flashcards (containing the word spelling, pronunciation, meaning, and illustrative sentences), vocabulary list, spelling tests, and multiple-choice quizzes (including both Chinese to English, and English to Chinese tests). Similarly, Books vs Brains@PolyU (Kohnke et al., 2021) contains vocabulary (spelling, meaning, and pronunciation) separated into four disciplines (Engineering, Design, Business, and Nursing).

For each discipline, the app has four difficulty levels (beginner, elementary, intermediate, and advanced), with 30 questions at each level. In the colourful graphical user interface, players complete quiz questions in which the definition of the word is provided, and users must guess the correct word and spell it in the answer field using the letter options on the screen. Players must answer all questions in the level correctly before progressing to the next difficulty level. Students are given immediate feedback on their answer, and a feedback screen at the end of the level shows the correct and incorrect words with their respective definitions and pronunciation. Other features include point scores, tally of questions and correct answers, hints, and the ability to download the words to a vocabulary bank on the phone.

Overall, although each game was unique, patterns among the game design and features were evident. In particular, the most common types of tasks included flashcards and multiple-choice quizzes. The design frequently incorporated a colourful graphical user interface containing spelling and word meaning (in written/visual format), as well as word pronunciation (in audio and/or written format). Furthermore, recurring features found in the mobile phone-based games include immediate feedback, scoring/rewards, time limits, narrative situations, a sense of challenge, constant engagement, and multisensory stimuli (such as visual and auditory).

2.4.4.4.2 Language and Cultural Factors. The studies identified evaluated the effectiveness and usage of the games among participants located in a diverse range of countries – China (Thongsri et al., 2018), Hong Kong (Kohnke et al., 2021), Zambia (Jere-Folotiya et al., 2014), USA and the Middle East (Amer, 2014), and 203 countries worldwide (Pham et al., 2018). English was the target language studied in four of the games identified - English Practice (Pham et al., 2018), Idiomobile (Amer, 2014), BW Vocabulary (Thongsri et al., 2019), and Books vs Brains@PolyU. Two studies (Kohnke et al., 2021; Thongsri et al., 2019) involved participants whose first language was Chinese. The other two studies (Amer, 2014; Pham et al., 2018) did not provide specific details of the first language of participants. However, both these papers included participants from multiple populations, such as more than 200 countries for the study by Pham and colleagues (2018), which

likely includes a diverse range of linguistic and cultural backgrounds in these studies. Screenshots indicate that three of the four English target language videogames were presented solely in English. However, the BW Vocabulary videogame (Thongsri et al., 2019), which aims to teach English as a second language to participants in China, uses both Chinese and English language in its Graphical User Interface to aid in language development. The only game with a target language other than English was GraphoGame (Jere-Folotiya et al., 2014), which teaches ciNyanja – one of the official languages of Zambia. These trends regarding the languages and cultural diversity of both the apps and their users suggest that both the issue (language learning) and the educational resource (mobile phone-based videogames) are of broad international relevance and interest which can be applied across cultural and linguistic divides.

In addition, the specific language skill the games aimed to teach varied across the games. For example, GraphoGame (Jere-Folotiya et al., 2014) is a phonics-based game which focusses on letter-sound knowledge to teach early literacy and spelling. English Practice (Pham et al., 2018) teaches users a broad range of English language skills and knowledge including grammar and vocabulary from many themes. Amer's (2014) Idiomobile game aims to teach idiomatic expressions and collocations to English language learners. The expressions were grouped into 11 thematic sets (including food, travel, and health) and were selected with the goal of teaching the most popular, useful, and frequently used English idioms and collocations. BW Vocabulary (Thongsri et al., 2019) and Books vs Brains@PolyU (Kohnke et al., 2021) both aim to teach vocabulary – in particular, word spelling, pronunciation, and meaning. However, while Kohnke and colleagues (2021) focussed on discipline-specific vocabulary, Thongsri and colleagues (2019) aimed to teach general vocabulary relevant across different majors/disciplines. Again, this provides support for the utility of mobile phone-based videogames as a potential educational tool for people from diverse linguistic and cultural backgrounds seeking to learn a range of language skills.

2.4.4.4.3 Game Implementation, Availability, and Platforms. Furthermore, there were patterns evident in terms of game implementation in the studies. All the games involved

independent study by language learners. Four of the games (Amer, 2014; Kohnke et al., 2021; Pham et al., 2018; Thongsri et al., 2019) appeared to focus on informal learning outside the classroom settings in unstructured activities. Students commonly experience stress from multiple sources of pressures (such as education, work, family, social, financial and time limitations and responsibilities). Given this stress, mobile phone-based CALL games offer an especially important benefit via their ability to be used anytime, anywhere, especially for short durations of play where the study is controlled by the learner.

Emphasis is often placed on the portability and ubiquitousness of mobile-based CALL and its benefits for self-directed learning and freeing-up teacher resources. Given this emphasis, it may be considered somewhat surprising that one of the games (Jere-Folotiya et al., 2014) was used exclusively inside the classroom. One factor potentially influencing this finding may be cultural differences. For example, in the case of GraphoGame studied in Zambia, it was noted that most students were underprivileged and accessed the internet through mobile phones rather than computers (Jere-Folotiya et al., 2014). In addition, results indicated that the groups where both students and teachers were exposed to the game had greater language improvements compared to when students alone were exposed to the game (Jere-Folotiya et al., 2014). This is a reminder that the benefits of mobile phone-based gaming, including their portability, connectivity and (potentially) lower cost and greater availability compared to other technologies is not limited solely to informal learning outside educational settings.

In addition, only two of the games found in the review – namely English Practice (Pham et al., 2018) and BW Vocabulary (Thongsri et al., 2019) – were reported by the authors as publicly or commercially available. This is surprising given the global popularity and usage of mobile apps among consumers. In 2021, there were more than 3.48 million apps available on Google Play Store and 2.2 million apps in Apple's App Store and more than 230 billion mobile app downloads annually worldwide (Statista, 2022a). Education apps (which includes language learning) represent the most popular category of mobile apps available on the Google Play Store, with more than

250,000 apps available in total and the highest number of paid apps available (AppBrain, 2022).

Although the exact number of language learning apps available commercially is unclear, a search of the leading app stores shows thousands of apps related to languages and language learning. Hence, the difference between the research and commercial data suggests that most games that are available commercially have not been evaluated in published academic research papers, while those tools that have been evaluated were designed by the researchers for the studies but are not widely or easily accessible to learners. More research is needed to evaluate the usability and effectiveness of CALL videogames. In addition, once evaluated, these mobile phone-based CALL videogames should be commercially available and accessible to language learners if possible. This review drives home the need for more research to be conducted into CALL videogames playable using mobile phones as well as the need for more publications in reputable global academic journals in the future.

In addition, all the videogames identified in this review were played solely on one device (mobile phones) in the studies. The most common platforms used were Android and Apple iOS. However, in a minority of cases the games were limited to just one type of mobile device or on platforms which have since been discontinued (such as BlackBerry). Among the papers reviewed, GraphoGame (Jere-Folotiya et al., 2014) was played using Nokia mobile phones, English Practice (Pham et al., 2018) used Android platforms, BW Vocabulary (Thongsri et al., 2019) was played on two platforms (Apple iOS or Android), and Idiomobile (Amer, 2014) was available on three mobile platforms (Apple, Android, and BlackBerry). Kohnke and colleagues (2021) did not specify in their paper which platform(s) their game utilised, only that it was a mobile phone-based application. Overall, Android was the most popular platform used in the papers reviewed, followed by Apple iOS, especially among the most recently published papers. This is consistent with data showing that in 2021 the Google Play Store is the leading app store worldwide, with the highest number of apps available and the most app downloads, while Apple's App Store is the second most popular (Statista, 2022a).

Furthermore, it is worth noting that while the BW Vocabulary game is commercially available in web-based platform as well as Android and iOS mobile-based applications, in the study by Thongsri and colleagues (2019) the game was only played by participants using the mobile platforms. CALL videogames have historically been dependent on platform-specific technologies. However, technological developments have meant that mobile devices increasingly have access to web-based technologies, enabling all devices to access web-based CALL videogames. This is an important step in the utilisation of CALL and future research should focus on the development and evaluation of multiplatform CALL videogames.

2.4.4.4 Evaluation of Use and Effectiveness in Language Learning. Firstly, the papers for all five mobile phone-based videogames evaluated the games regarding their effectiveness in language learning and/or its usage and usability. Three studies primarily evaluated the effectiveness of the mobile phone-based CALL videogames to improve language learning. In contrast, two studies mainly focussed on the evaluations of the usage of the games. However, there was some crossover between the two evaluation types.

For example, to evaluate the usability and usage of Idiomobile, Amer (2014) conducted a study involving four groups of university students learning English. The results indicated that students played Idiomobile an average of 28 times during the week-long intervention period. The highest levels of gameplay occurred in the initial few days of use, and there were fluctuations in patterns of gameplay during the intervention period. Multiple-choice quizzes were the most frequently played task in the game. Game usage was positively correlated with average scores on the quizzes in the videogame, with students who played Idiomobile more achieving higher scores in the language tasks in the game. Pretest TOEFL scores (language proficiency) and prior history of mobile phone usage were significantly related to game usage, such that people who were more familiar/experienced with mobile phones or who had better English skills before the game being more likely to play the videogame more often. Findings from the exit interviews suggested that players had an overall positive perception of the game. Players commented that they liked playing

the game, and enjoyed the challenge, sense of control, immediate feedback, interactivity, difficulty, repeated practice, and new idioms with each play. While language proficiency and mobile usage behaviour affected game usage, the author concluded that usage of Idiomobile was a better predictor of the language learners' scores on the language quizzes than their pre-existing language TOEFL scores.

Kohnke and colleagues (2021) examined the effectiveness of Books vs Brains@PolyU in increasing language skills with a focus on discipline-specific vocabulary and multiple difficulty levels. The findings of the study indicate that playing the mobile phone-based CALL videogame was associated with improved vocabulary learning, with each level and each discipline showing an increased number of proficient participants in the post-game tests. After one month of using the game, the number and percentage of participants who knew the vocabulary increased and the effect was more noticeable for words of intermediate level difficulty. Based on the results of the study, the authors concluded that mobile phone-based CALL applications provide a “feasible way to increase exposure to target language input and encourage L2 students to learn at anytime and anywhere” (Kohnke et al., 2021, p. 16).

Similarly, Thongsri and colleagues (2019) investigated the effectiveness of the BW Vocabulary game on vocabulary skills in EAL learners in China in a tertiary sample which explored differences between academic disciplines. The study aimed to also explore the relationship between academic discipline (STEM vs non-STEM), computer self-efficacy, and language learning performance with the game in a sample of 200 tertiary students. The results of the study indicated that the BW Vocabulary app was associated with improved language performance (the vocabulary score) for all participants in the post-intervention tests. Furthermore, the positive effect of the app on language learning score was significantly higher for STEM students than non-STEM students. Playing the game was also associated with higher levels of learning satisfaction in the posttest assessment. However, results showed the benefits of the game for learning satisfaction was greater for STEM than non-STEM students. In addition, the findings suggested that STEM students had a

higher computer self-efficacy than non-STEM students. Computer self-efficacy was shown to have a significant positive effect on both learning score and on learning satisfaction, and in both cases the effect was stronger for STEM than non-STEM students. The findings regarding computer self-efficacy in the study by Thongsri and colleagues (2019) indicate that STEM students have had more exposure, experience and skills using technology (such as mobile phones and CALL videogames). Results further showed STEM students feel more confident to use a mobile phone-based videogame such as BW Vocabulary, spend more time playing the game, are more skilled in the game and happier to use the game more often compared with non-STEM students.

To study the effect of the GraphoGame on language learning of students in Zambia, Jere-Folotiya and colleagues (2014) conducted a series of evaluations involving six groups (573 students and 68 teachers) in a randomised controlled trial. The game was played in 48 sessions over eight days separated into short bursts of game play lasting 7-9 minutes followed by a rest period of up to 10 minutes. It is worth noting that the playing session times were planned and controlled by teachers, rather than students themselves. The mean total duration of gameplay was 94 minutes over eight days. Data collected included gamelogs, baseline questionnaire, and a battery of local cognitive tests focussing on orthography, spelling, vocabulary, and mathematics. Results of the study indicated that the GraphoGame had a significant positive effect on spelling test results. More time spent playing the game (exposure time) was associated with better spelling scores in the posttest. The method found to be most effective for language learners was the group in which both students and teachers were exposed to the game. Overall, Jere-Folotiya and colleagues (2014) concluded that the GraphoGame is a useful and effective tool to improve language skills, especially spelling, letter-sound knowledge, and learning to read ciNyanja.

To evaluate language learners' patterns of use and engagement with the English Practice game, Pham and colleagues (2018) conducted an exploratory study using 'research in large through the app store' methodology. Data was collected from gamelogs and associated user information (including Google Firebase Analytics), with analyses based on 53,825 active users of the game

during a 3-month period in 2016. Results of the study indicated that users were more likely to play on weekdays rather than weekends, with the most popular days being Wednesday and Tuesday, and users tended to start playing around 8-9am with the peak time to play being 8-9pm. The average total duration of play across all users was 62 minutes. However, there was wide variation in engagement. Among users, 30% exited the app immediately and never went back after installation (bounce engagement), 24% played for less than 15 minutes total (shallow engagement), 14% played for more than 15 minutes but removed it within 7 days (deep engagement), and, in the highest level of engagement, 31% played for more than 15 minutes and kept using it for more than 7 days (complete engagement). Thus, it is interesting to note that just over half of users (54%) played the mobile phone-based game between zero- and 14-minutes total. The quiz section was the most popular part of the game, having the highest frequency of use and longest duration of gameplay. Users played grammar tasks for the least time. Deep and complete levels of engagement were highest for quizzes, followed by the flashcard tasks. Importantly, the study evaluated the game's use but did not evaluate the effect of the game on language skills. Despite this, the English Practice game showed a high degree of popularity among users across gender, age, and cultural backgrounds. Based on the findings of the study regarding patterns of player behaviour, Pham and colleagues (2018) recommended that future games focus on simple tasks (such as quizzes and flashcards) played in brief durations.

Overall, the studies identified provide evidence to indicate that mobile phone-based CALL videogames are associated with improved language skills for a variety of disciplines and contexts, and that participants are willing to use the games and perceive them as positive, valuable, and engaging. Furthermore, there were common themes discussed in papers regarding the benefits of the games identified in this review. For example, a common advantage related to increasing motivation - with learners having fun, becoming engaged and immersed in the game, so they want to play the game repeatedly. Benefits were also noted for repetition, which is vital for mastery of content and making the language learning process more automatic. Another common theme was

exposure to novel stimuli, which is important to increase familiarity and experience encountering and using a range of language skills and knowledge such as vocabulary. Other themes of advantages included self-directed study, a sense of user control, availability, flexibility, portability, and customised design.

However, despite these important benefits, there were also potential disadvantages of videogames noted in the studies. Disadvantages include technical issues affecting the device hardware and software such as poor storage memory, game lag, and audio problems which may affect the usability of mobile phone-based videogames (Amer, 2014). In addition, in the posttest interviews in study by Amer (2014), one participant reported feeling anxious playing the game related to test anxiety, and a second participant described feeling embarrassed when answering questions incorrectly and frustrated when they did not achieve a perfect score. Thus, although the evaluations found that most students have positive perception and experience while using mobile phone-based CALL videogames, some game features (such as time limitations, challenge, and scoring) may be associated with negative experiences in a small number of students. And, importantly, there were very few games currently available and accessible to students which have been evaluated in academic research.

2.4.4.4.5 Methodological Issues. There were several methodological issues identified in the studies. In terms of study design, only one game was evaluated in a randomised controlled trial. Specifically, Jere-Folotiya and colleagues (2014) conducted a series of evaluations including a randomised controlled trial with a pretest-posttest design. Participants included 573 students (aged 5-9 years old) and 68 teachers, who were randomly selected from 42 rural and urban government schools. Random allocation was used to assign participants to one of six groups, with the aim of comparing the control group with the five intervention groups and to investigate the most effective method of gameplay. In contrast, two studies used an uncontrolled, pretest-posttest multiple-groups design to evaluate the effectiveness of the game on language skills. Thongsri and colleagues (2019) compared two groups (students from STEM versus non-STEM degrees) while Kohnke and

colleagues (2021) evaluated the effect of interventions for students from four groups (nursing, business, design, and engineering).

In terms of methodology, the study by Pham and colleagues (2018) was particularly novel and interesting for its use of real player quantitative data provided by the gamelogs and Google. These methods differed from traditional data collection techniques for language learning studies such as participant questionnaires and interviews. Advantages of the novel method used include the ability to collect and analyse large quantities of detailed data regarding the demographics and specific gameplay behaviour (including scrolling actions and usage down to seconds) of a high number of users (tens of thousands of players) over a reasonably long duration of time (three months in this case) from people from a range of demographic groups located all around the world. In addition, despite the large quantities of complex data sets, it has the benefit of low use of resources by researchers due to automation of data analysis and low cost of access (under USD \$100 per year). However, as the data is obtained externally, there was no ability for an interviewer to probe for further information such as reasons and motivations behind their patterns of game usage. Importantly, the study by Pham and colleagues evaluated the game's use but did not evaluate the effect of the game on language skills (that is, its effectiveness).

There were also issues noted with the measures and reporting used in some of the studies. For example, the study by Kohnke and colleagues (2021) had methodological limitations including the lack of a control group, choice of measures, and issues with data analysis/reporting. As noted by Kohnke and colleagues (2021), the measure used in the pretest and posttest only asked participants whether they 'recognised' the target words or not (selecting yes or no). However, the measure did not test their actual knowledge of the word meanings. It is possible participants stated they recognised the word, but that they did not know the word's correct meaning or use. In addition, the level of statistical analyses reported in the study was limited. The results section, although lengthy and detailed, focussed solely on the 'average' (presumably mean) number and percentage of students who recognised the words, examining the raw differences at the individual word level and

within the groups. Other descriptive statistics (e.g., range) or inferential statistical tests (such as t-tests, p-values) were not reported. Thus, while the average words recognised increased from pretest to posttest, it was not stated if these changes were statistically significant. Therefore, while the study by Kohnke and colleagues (2021) provides evidence to suggest that mobile phone-based videogames have a positive effect on language learning, the conclusions are limited due to concerns with research methodology and poor reporting.

Two papers also noted problems related to participant attrition. In the study by Amer (2014) there was a high attrition rate, with 30% of participants not completing the study – although no explanation was provided by the authors. Similarly, the study by Jere-Folotiya and colleagues (2014) noted high participant attrition rates (46%) caused by student absences. The absenteeism in this study was reportedly due to time of year and weather (rainy season), which resulted in illnesses and affected the ability of students to travel to school (Jere-Folotiya et al., 2014). As a result, while the attrition in this case may be predominately caused by external factors unrelated to the intervention itself, high levels of attrition may result in lower than planned gameplay exposure. Furthermore, the attrition may affect findings regarding the effectiveness of the intervention on language skills, and impact the patterns of game usage described in these papers.

In addition, despite all five games providing evidence of the immediate effectiveness and usage of these tools in the short-term, investigation of extended duration game exposure and long-term benefits of mobile phone-based videogames as an educational tool was lacking. In the papers identified, evaluation of the games often involved very short durations of gameplay followed by testing of immediate, short-term effects only. For example, usage data indicated that duration of gameplay included an average of 62 minutes of gameplay in the study by Pham and colleagues (2018) and an average of 94 minutes of gameplay in Jere-Folotiya and colleagues (2014). In studies using a pretest posttest design, the duration of intervention period ranged from one week (Amer, 2014) to one month (Kohnke et al., 2021). The lack of evaluation and evidence for long-term benefits is common and consistent with the findings of other research regarding videogame-based

learning (e.g., Girard et al., 2013). However, the duration of studies is worth noting given the importance of repeated gameplay and exposure for developing automaticity, vital for language development (Van Moere, 2012; Webb, 2007). In addition, previous research indicates that repetition distributed over time in multiple brief sessions results in greater improvements than learning in fewer longer session (Andersen et al., 2015). Yet with their ability to be used anytime and anywhere, mobile phones are ideally suited to address this need. Furthermore, the results of the current review found evidence to indicate that users vary their gameplay behaviour over time and tend to play for relatively short periods of time. Thus, more frequent gameplay over wider periods of time and evaluation of long-term benefits are worthwhile aspect of investigation that should be considered in future research on mobile phone-based videogaming in language learning.

Therefore, methodological issues identified in these studies include lack of randomised controlled trials, choice of measures, limited data analyses, high attrition rate, and short duration of testing. As a result, while the papers identified provide evidence to suggest that mobile phone-based videogames have a positive effect on language learning, the strength of the conclusions may potentially be limited due to concerns with research methodology.

2.4.4.4.6 Publication Trends. There were also trends evident regarding the publication of the research. For example, although all papers identified were published in peer-reviewed journals that focus on CALL or educational technology, each of the five research articles were published in a different journal. Furthermore, all the papers were published in the last decade, and the majority (three of the five papers) were published since 2018. The paucity and recency of the publications is particularly interesting when considering that mobile phones have been in use for decades and the Apple iPhone was first released in 2007. However, patterns indicating an increase over time is consistent with data on mobile phone-based applications publicly showing that the number of apps available has increased exponentially in the last decade. For example, in Apple's App Store the number of apps has increased from 500 in at its launch in 2008 (Ricker, 2008), to over 500,000 in 2011 (Grothaus, 2011), to more than 2.2 million in 2021 (Statista, 2022a). Moreover, since 2016,

there has been a 63% increase in the number of downloads of mobile applications across all app stores (Statista, 2022a). This suggests that mobile phone-based videogames are an emerging and evolving tool with important and novel implications for language education in a time where students are increasingly digitally familiar and savvy learners, and most students typically have mobile phones.

2.4.4.5 Conclusion

This systematic review established comprehensive search criteria to conduct a review of research investigating what is presently available in mobile phone-based videogames for language learning. Only five games meeting the inclusion/exclusion criteria were identified in the current literature review. Methodological problems were noted which may reduce the validity of the conclusions regarding the games. Despite the overall low number of games identified and methodological limitations, findings of the research indicate positive and promising results regarding the potential use and effectiveness of mobile phone-based videogames as an educational tool for language learning. Aspects of game design and content, languages involved, game implementation, availability, and platforms were discussed. In addition, evaluation findings for use and effectiveness (including advantages and disadvantages), methodological issues, and publication patterns were examined. Core features and benefits noted include motivation, repeated exposure to novel stimuli, user control, immediate feedback, and portability. Importantly, with these features and benefits, mobile phone-based videogames appear to be well-placed to assist with the teaching of a range of language-related skills and knowledge. It is an accessible and adaptable tool to support users from diverse cultural backgrounds and first languages to learn different target languages and language skills. Hopefully, language learning teachers will consider being more open to using mobile phone-based games as an educational tool for students (both within classrooms and externally) alongside presently used resources moving forward.

In terms of limitations of this review, the scope of the literature review, number and source of databases studied, definitions and inclusion/exclusion criteria established (such as excluding

augmented reality and games on mobile devices other than mobile phones) may be considered too narrow or limited by some, potentially resulting in some available papers not being identified. In addition, with the paucity of games identified, it may be argued that this review suggests that insufficient evidence currently exists for the effectiveness of mobile phone-based videogames at improving language skills at this stage despite the trend indicating positive results. Given the limited number of games evaluated and methodological flaws discussed, future research could focus on the development of new mobile phone-based videogames in language education and studies evaluating changes in language skills among users. And once these studies have been conducted, this review highlights the need for more studies to be published in reputable global academic journals.

2.5 CALL Videogames as a Culturally Sensitive Pedagogy for Chinese EAL Nursing Students

2.5.1 Introduction

The demographics of the university classroom is changing. Over the past 20 years, the number of international students – also known as foreign students or overseas students – has nearly tripled from 1.95 million in 1997 to over 5.3 million in 2017 (UNESCO Institute for Statistics, 2020). Australia is at the forefront of international student migration issues, hosting the highest number of international students per capita (Babones, 2019). In 2019, there were 917,793 international students in Australia (Austrade, 2019). The number of international students enrolled in higher education in Australia has increased significantly in recent years – up 63% since 2015 and 11% in the last year alone (Department of Education and Training, 2019b). International students now comprise nearly one third (31%) of all students enrolled in Australian higher education (Department of Education and Training, 2019a). As Australia’s fourth highest export, international education is worth an estimated \$37.6 billion to the Australian economy and supports 250,000 jobs nationally (Department of Education and Training, 2019c). Thus, for Australia’s education system, international students represent a sizeable, growing, and economically valuable population. By far

the largest source of international students is China – accounting for 37% of international students in higher education in Australia (Department of Education and Training, 2019b).

This changing student population is reflected in nursing classrooms too. For the field of nursing education, international students represent an emerging and evolving area of importance which has significant implications for nursing educators. Mirroring the university population as a whole, Chinese students comprise the largest group of international nursing students in Australia (Wang & Greenwood, 2015). In the Australian healthcare system, international students represent a positive and vital part of the development of a diverse nursing workforce and culturally competent care for a culturally and linguistically diverse patient population.

However, in addition to the opportunities and benefits these students offer, international students may face important challenges in their education. A considerable amount of research has found evidence to indicate that linguistic, academic, social, psychological, and cultural factors (both resources and challenges) may have a significant impact on the performance of EAL nursing students (e.g., Crawford & Candlin, 2013; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Sanner & Wilson, 2008; Starr, 2009). In terms of language, research regarding EAL nursing students has identified significant challenges including inadequate listening and reading skills, problems understanding lecture content, difficulties communicating in clinical settings and, in particular, problems with low-frequency academic and technical vocabulary such as medical terminology (Crawford & Candlin, 2013; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Starr, 2009). The consequences of such linguistic difficulties in EAL nursing students include academic failure and removal from clinical placements (Jalili-Grenier & Chase, 1997; Müller, 2011a; San Miguel et al., 2006). While EAL nursing students need support for academic and clinical achievement, the effectiveness of current support programmes is limited by methodological problems and issues surrounding student attendance (Crawford & Candlin, 2013; Seibold et al., 2007).

Recently there has been increased research and awareness regarding cultural factors affecting international nursing students and the need to develop culturally sensitive and responsive teaching tools in nursing education (Wang, 2017; Wang et al., 2015; Wang & Greenwood, 2015). Of particular relevance and interest in this issue is a discussion paper recently published by Wang and Greenwood (2015) which examined the culture-related communication behaviours and learning styles of Chinese EAL nursing students at Australian universities. Some of the key cultural communication patterns and learning styles they identified among Chinese EAL nursing students include face-saving, quietness in class, respect towards teachers, saying 'yes', other-directed self, willpower, rote learning and memorisation, insider effect, collaborative learning, and diligence and self-determination in learning. The lack of research into Chinese EAL nursing students was highlighted, as well as the need for educators to increase awareness of Chinese students' culturally related communication behaviours and learning styles for teachers to adjust learning methods. The understanding of cultural factors was also recommended to develop culturally sensitive pedagogy and improve learning experiences and outcomes for Chinese EAL nursing students (Wang & Greenwood, 2015).

Before continuing with this discussion, a brief critique is necessary. As part of their paper, Wang and Greenwood (2015) described the cultural origins of communication and learning styles in the context of frameworks of collectivism versus individualism and high-context versus low-context cultures. However, use of the collectivism versus individualism and high-context versus low-context framework has been criticised by some scholars. In particular, the view has been criticised as being overly binary and ignoring the complexity of culture and individual experiences and personalities (e.g., Chan, 2020; Fouman, 2022; Herdin, 2012; Li et al., 2022; Moriizumi, 2011). Firstly, the criticisms of such binary frameworks discussed in the paper by Wang and Greenwood (2015) are acknowledged and are concerning. The researcher does not advocate or support such a perspective. Rather, the theoretical framework underpinning the research is the model of academic language proficiency (as explored in Chapter 1, section 1.3), and the research emphasises the

diversity, heterogeneity, and strengths of EAL nursing students. Thus, the aspect of the Wang and Greenwood (2015) paper discussed in this section is the importance of implementing a culturally-sensitive pedagogy which is dynamic and responsive to the student's learning style. A culturally sensitive pedagogy would likely be mutually beneficial for students, teachers, and institutions alike. However, a review of the research literature suggests there appears to be limited research into individual culturally sensitive teaching tools targeting the specific skill needs of international nursing students.

One potential tool for supporting EAL nursing students is computer assisted language learning (CALL) videogames. The term computer assisted language learning (CALL) refers to the use of computer-based technology to facilitate second language acquisition. Research has identified many benefits of CALL (including CALL accessed via mobile technology) such as its portability, flexibility, connectivity, spontaneity, availability, interactivity, and ease of use (e.g., Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). Previous research has found evidence of many positive effects of CALL on second language acquisition (e.g., Almekhlafi, 2006; Grgurović et al., 2013; Lai & Kritsonis, 2006; Liu et al., 2002; Zhao, 2013). In particular, research suggests that CALL encourages independence, flexibility, and self-direction. It also enables a degree of individualised learning and active engagement, reduces language learning anxiety, provides immediate feedback, improves motivation and enjoyment, allows repeated exposure while reducing instructional time, and develops computer literacy (Bloomfield et al., 2008; Lai & Kritsonis, 2006; Liu et al., 2002; Riasati et al., 2012).

Despite the potential benefits of CALL videogames for nursing students, nursing educators have been slow to implement this technology. There have been few videogames developed, as well as a lack of research conducted into this topic (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). Moreover, a review of the research literature has not identified any papers exploring CALL videogames specifically as a culturally sensitive learning tool for EAL nursing students.

2.5.2 Aims

The aim of this section is to discuss the potential benefits of CALL videogames (both computer-based and mobile-based games) as a culturally sensitive and responsive teaching tool for EAL nursing students, especially for developing language skills. Research has identified numerous cultural communication styles and learning behaviours in Chinese EAL nursing students (e.g., Wang & Greenwood, 2015). However, due to space limitations, this section of the literature review focus on three key areas: 1) willpower and diligence, 2) rote learning and memorisation, and 3) face-saving and quietness in class. Furthermore, it will explore a small portion of the potential benefits of CALL videogames including its customisability, portability, ubiquity, repeated exposure for automaticity, motivation, user-centredness, and private and autonomous learning. Importantly it will discuss how these factors relate to the cultural communication and learning styles of Chinese EAL nursing students. The goal of this particular section of the literature review is to discuss the potential benefits of CALL videogames as a culturally sensitive and responsive pedagogical tool. Using an eclectic approach, it aims to bring together ideas from nursing, linguistics, cultural studies, and information technology.

Although potentially relevant to other cultural and ethnic groups, this discussion will have a particular focus on Chinese EAL nursing students as this population comprises the largest group of international nursing students at Australian universities and is also the cultural group of EAL nursing students that has received the most focus in the recent research literature (e.g., Wang, 2017; Wang et al., 2015; Wang & Greenwood, 2015). It is also consistent with data regarding international students in Australia in general. Research shows that by far the largest source of international students is China, accounting for 37% of international students in higher education in Australia (Department of Education and Training, 2019b).

2.5.3 Discussion

2.5.3.1 Willpower and Diligence

Chinese EAL students are typically described as being extremely diligent and hardworking with high levels of willpower and self-discipline (Wang & Greenwood, 2015). These students tend to take their education seriously, study hard for long hours, and complete academic tasks with care as per instructions. However, a downside to this learning style is that they may be prone to ignoring their own enjoyment and mental wellbeing while studying. CALL videogames may be beneficial for EAL nursing students given the culturally-related learning behaviours such as willpower and diligence in two ways. Firstly, these tools may reinforce and increase motivation and fun. Secondly, CALL videogames may build on the students' willpower to study hard at all opportunities to optimise available study time, while reducing potential barriers competing stressors may pose for programmes of support.

For example, one of the key benefits of CALL videogames in nursing education is in improving motivation. In Chinese culture, self-discipline, persistence, and motivation in education are emphasised as being of considerable importance (Wang & Greenwood, 2015). Moreover, the act of moving to a foreign country for education and being a Chinese EAL nursing student requires motivation and a strong determination to succeed (Wang, 2017). While a certain amount of diligence and willpower are required to engage in English learning, research also indicates that playing CALL videogames increases levels of motivation.

CALL videogames have the advantage of being fun and enjoyable methods of learning, which increase engagement and immersion in the task (Müller, 2011b). They typically involve taking on perspectives of different characters (such as a student nurse) amid interesting settings and storylines, involving colourful and stimulating graphics, animations and sounds in a novel way not done with more traditional learning methods (such as reading book chapters). A recent literature review into computer-based videogames in nursing education emphasised an increase in motivation as one of the major benefits of this teaching tool (Pront et al., 2018). Although the exact

mechanisms of action are unclear, some of the motivating characteristics of videogames suggested by research include a narrative context, storylines, rules/goals, feedback, rewards, multisensory stimuli, challenging tasks and interactivity (Bellotti et al., 2010; Dondlinger, 2007; Garris et al., 2002; Granic et al., 2014; Lee & Peng, 2006). As a result, CALL videogames motivate and encourage students to repeatedly play the game, which is vital for developing automaticity and mastery of the content. Thus, one of the potential benefits of CALL videogames for Chinese EAL nursing students is that they may boost the students' own level of motivation and willpower for education, offering fun and enjoyment while learning and repeatedly practicing new information and skills (including language-related topics).

Another aspect of diligence and willpower is that Chinese EAL students work extremely hard at their studies amid pressures from multiple sources. Chinese culture values education as being of utmost importance. Students often attend classes for many hours during the day as well as study long hours outside the classroom. In addition, students may have external pressures such as employment, family responsibilities, and financial responsibilities (some of which may relate to being an international student). This may affect students' time, energy, and ability to study as well as, crucially, their ability to participate in additional programmes of support. Indeed, external factors such as financial, work, and family pressures have been identified in previous research as having a negative impact on the success of EAL nursing students and attendance in support interventions (Crawford & Candlin, 2013; Seibold et al., 2007; Starr, 2009). It is important for nursing educators and universities to be aware of and sympathetic to these culturally influenced learning behaviours and the competing stressors this group of students may experience. Teachers should develop and adapt learning methods to be sensitive to these strengths and needs including aiming to limit adding new stressors (such as time, travel, cost and effort) when implementing programmes of support.

With this in mind, CALL videogames have the potential to be a culturally sensitive pedagogy for Chinese EAL nursing students due to a number of their core features. For example, three of the

key advantages of CALL (especially CALL delivered through mobile devices) are its high levels of portability, ubiquity, and connectivity, such that it can be used anytime and anywhere (Chinnery, 2006; Godwin-Jones, 2011; Kukulska-Hulme & Shield, 2008; Miangah & Nezarat, 2012; Ogata & Yano, 2004; Viberg & Grönlund, 2012). Using CALL technology, EAL nursing students would not be required to physically attend extra classes at the university to engage in a programme of support. Instead, the programme can be completed independently at a place and time convenient to the student, accessed via a laptop, tablet, or smartphone. Hence, additional class time and travel time (and the associated expense) can be avoided. This could also help reduce issues related to poor attendance seen with previous support programmes for EAL nursing students (Seibold et al., 2007).

Combined with the benefits of the portability and connectivity of the devices, the students' own cultural learning behaviours of diligence and motivation are a positive resource which may encourage participation in support programmes. Students can choose and control factors such as where, when, how, and for how long they play the game in a way that best suits their own personal needs and circumstances. Devices such as computers and smartphones can be expensive to purchase initially. However, the ubiquitousness of the technology means that multiplatform CALL videogames are unlikely to widely exacerbate financial stress as students typically already have access to one or multiple such devices (including computers freely available for use on campus). In addition, although CALL applications can take considerable resources to develop by educators, the CALL applications themselves can be made available to students at low or even no cost.

Therefore, CALL videogames may be beneficial as a culturally sensitive tool by alleviating some of the challenges posed by competing stressors and responsibilities which may create barriers for participation in intervention programmes for EAL nursing students. At the same time, CALL games build on and reinforce the students' own positive resources of willpower, diligence, and motivation influenced by their cultural learning styles.

2.5.3.2 Rote Learning and Memorisation

One of the common stereotypes of the Chinese cultural learning is a focus on rote learning and memorisation (Wang & Greenwood, 2015). In the past it has been assumed that this involves passive rote learning to achieve only surface-level understanding. However, researchers now argue that the learning style of Chinese students involves memorisation through repetition, which enables a deeper understanding and high levels of academic achievement (Wang & Greenwood, 2015). Rather than being a hinderance (as it is often perceived), this cultural learning style of Chinese students should be viewed as a positive characteristic. This is especially relevant when combined with CALL videogames that teach nursing-related communication using customised responses to player input and the mastery of repetitious content, such as medical vocabulary.

Firstly, one of the primary advantages of CALL is its flexibility or customisability (e.g., Godwin-Jones, 2011; Miangah & Nezarat, 2012). CALL applications can be purposefully developed by the researcher to address a specific need or skill according to the individual needs of the language learner (including cultural communication and learning styles). Examples of this may be the need to improve medical terminology knowledge, medical abbreviations, skill at listening to an end-of-shift handover, and confusable medication names. The freedom of design in CALL means that specific topics/skills can be targeted, especially those that would benefit from memorisation and deeper understanding via repeated practice – a learning style already familiar to Chinese EAL nursing students.

Numerous researchers have recommended a focused, specialised, technical vocabulary for EAL nursing students, emphasising the model of academic language proficiency hypothesised by Cummins (1999) and the development of interventions to target this vocabulary in future research (Crawford & Candlin, 2013; Müller, 2011a; Salamonson et al., 2008; Starr, 2009). Studies investigating the needs of EAL nursing students have identified significant linguistic challenges especially regarding listening and reading skills, communication in clinical settings, and for academic and medical terminology (Crawford & Candlin, 2013; Malu & Figlear, 1998; Müller,

2011a; Olson, 2012; San Miguel et al., 2006; Starr, 2009). In particular, research has emphasised that medical/nursing terminology is one of the key areas with which international nursing students have trouble – affecting both EAL nursing students in general as well as Chinese EAL nursing students specifically. For example, in Wang’s (2017, p. 29) narrative inquiry into the learning experiences of Chinese EAL nursing students in Australia, specialist health terminology and jargon, especially that encountered in clinical placement settings, was voiced as a concern by multiple participants and was identified as “the most significant contributor to their language barrier”. Such language skills are particularly difficult for students to acquire because they are ‘low frequency’ (not regularly appearing each day in speech) yet require high levels of repeated practice to develop (Müller, 2011a). However, with the flexibility afforded by CALL and its advantage of enabling multisensory stimuli and interactions (e.g., audio, visual, haptic etc), custom-built applications could be designed focusing on the skills most important for EAL nursing students – such as listening and reading skills in EAL nursing students, with medical terminology being taught in a combined spoken and written format as recommended by Müller (2011a). Potentially, this pedagogical tool may improve students’ skills and confidence in a way that is not feasible in lectures. Hence, with high levels of adaptability, CALL applications are well-placed to be purposefully designed to focus on addressing the unique language needs of Chinese EAL nursing students – both in terms of what is taught as well as how its taught – in a culturally sensitive way.

Secondly, a unique and crucial advantage of CALL is its capacity for learning through repetition. Repetition, repeated exposure, and automaticity are some of the major potential outcomes of computer-based videogames in nursing education identified in a recent literature review (Pront et al., 2018). CALL’s ability to incorporate a conscious focus on repeated exposure to low-frequency specialised vocabulary is crucial to developing automaticity, increasing language processing speed, and reducing cognitive load (Müller, 2011a; Schmitt, 2008; Webb, 2007). Müller (2011a) argued that a high number of repeated exposures (estimated to be close to 10 exposures) are required for vocabulary acquisition. However, such repeated exposure is unlikely to occur

incidentally or even deliberately in traditional learning formats. Traditional formats such as lectures also unlikely to have to have the same impact on automaticity due to language-related challenges. For example, a study of EAL students in New Zealand showed that first-year EAL students estimated they had only “understood between 20 and 30 per cent of lecture content” (Johnson, 2008, p. 235).

In contrast, EAL nursing students could use CALL applications as many times as desired for increased exposure to the target skill. Further, learning can occur in a realistic but safe simulated environment with a CALL videogame, without the fear of real-life consequence of making a mistake on clinical placement. Using CALL, students would also have the advantage of immediate feedback on performance. In addition, students can choose how long they wish to play each time, and CALL games are suited to playing in repeated brief bursts of time. This is an additional benefit because research indicates that repeated practice conducted in multiple short sessions distributed across time has been shown to be more effective in improving performance than repetition conducted in longer single sessions (Andersen et al., 2015).

Thus, with a focus on repetition to achieve a deeper mastery of customised content, similarities and overlap arguably exists between the traditional learning style of Chinese students and CALL videogames. As such, CALL videogames may represent a more familiar teaching method to students than other learning methods in nursing education (such as open classroom discussions). As of June 2019, China had 854 million internet users, 99% of whom accessed the internet using mobile phones and the majority (65%) of whom were aged 10-39 years old (China Internet Network Information Center, 2019). China is also ranked first worldwide for mobile phone ownership (96% in 2018), well above the average globally (Deloitte, 2019). In terms of mobile games specifically, China has 491 million mobile game users in 2020, 60% of these users aged 18-34, and has the highest mobile game revenue worldwide (Statista, 2020). Among mobile phone users in China, 26% play mobile games daily while over 60% play at least once a week – well above the global average (Deloitte, 2019). Overall, China was the world’s largest videogame market

in 2018, with 626 million videogame players and \$24.8 billion USD in revenue (Snider, 2019). Thus, although students are unlikely to have used CALL videogames previously as a pedagogical tool inside the classroom, these figures suggest it is likely that Chinese students are familiar and experienced at using relevant technology. This includes using internet, laptops and smartphones as well as playing videogames outside the classroom in their own private time. This may be especially true for the current generation of younger students who are often considered to be “digital natives” (Black, 2010, p. 99) having grown up using this technology. Building from familiar tools may allow Chinese EAL nursing students to engage more, and to process and learn the content more efficiently and effectively. This is particularly relevant given the potential benefits of CALL videogames for learning crucial but often new and difficult skills for Chinese EAL nursing students such as low-frequency medical terminology.

Despite these potential benefits, it is worth noting that Wang and Greenwood (2015), advised caution when using games with Chinese EAL nursing students due to their lack of familiarity with games as an academic teaching method. While CALL videogames do not typically share the characteristics (such as public discussion and openly expressing opinions) that appear to be central to Wang and Greenwood’s (2015) caution in this matter, it is important to be aware of possible problems due to lack of previous experience with CALL videogames as a formal teaching method. Consequently, it may be prudent to follow Wang and Greenwood’s (2015) advice by introducing CALL videogames into the classroom with clear instructions and sufficient warning to students to allow time to prepare before playing the CALL games. However, despite these words of caution, CALL videogames are still arguably a culturally sensitive pedagogy which may have multiple vital benefits for EAL nursing students.

2.5.3.3 Face-Saving and Quietness in Class

Two of the most discussed cultural communication behaviours among Chinese EAL students are ‘face-saving’ and quietness in class (Wang & Greenwood, 2015). Face is a complex and difficult concept to translate. Oversimplified, it involves ideas of reputation of one’s self and family or peers,

and encompasses feelings such as dignity, harmony, pride, and prestige. Quietness in class is a related expression of this. Chinese EAL nursing students are typically less likely to discuss, give opinions, or ask questions in class due, at least in part, to not wanting to lose face. Hence, students remain quiet in class. Subsequently, students may be stigmatised and erroneously perceived as lacking opinions, critical thinking skills, or the knowledge to answer the questions correctly (Wang & Greenwood, 2015). Similarly, EAL nursing students often report difficulties related to anxiety, fear of failure, stereotyping, and discrimination (Crawford & Candlin, 2013; Sanner & Wilson, 2008; Starr, 2009). CALL may help to reduce the impact of such issues in several ways.

Firstly, CALL allows students to be anonymous while learning. Features which facilitate this anonymity include the virtual environment, use of usernames rather than real names, and avatars. For skills such as medical vocabulary with a correct/incorrect answer (and therefore a high perceived chance of being corrected in public), this anonymity is particularly helpful. CALL allows students to answer questions (with multiple repetitions of the target skill) informally in private away from their peers and teachers. Immediate feedback, including whether a player's answer is correct or incorrect, is then supplied automatically via technology rather than people with interpersonal relationships and cultural communication patterns to consider. Students do not need to be as concerned about saving face in a virtual world where their identity and answers to questions are evaluated privately by computers rather than by teachers in the presence of a classroom of their peers. In addition, CALL games often use (typically animated) characters and avatars. In computing, an avatar is a graphical representation of a user. Players can choose characters that look like them and wear the same uniform that they would use in clinical placement or conversely, they can choose characters that do not look like them (an alter ego with a different gender, ethnicity, hair colour etc). Either way, they can play the game as a character rather than as themselves. While not all CALL videogames include an avatar, the inclusion of this feature could potentially enhance the private and anonymous qualities of CALL videogames and could reduce the impact of face-saving and quietness in class among EAL nursing students.

Secondly, CALL applications are personally controlled by the user (the student), at the learner's own pace and ability level for informal, autonomous, and private self-directed learning (Cheng et al., 2010; Godwin-Jones, 2011; Kim & Kwon, 2012; Viberg & Grönlund, 2012). Students may use CALL outside the classroom in informal and familiar settings (such as in their own home using a laptop or mobile device), allowing students to learn and build their confidence in a private, non-threatening, and less stressful environment. As such, CALL may encourage independence, motivation, participation, and self-direction while reducing the effects of face-saving, quietness in class, anxiety, emotional stress, fear of failure, poor self-image, self-consciousness, and perceived discrimination or stereotyping by teachers or classmates.

Thirdly, CALL may reduce the impact of difficulties with formal learning environments popular in Western universities which may exacerbate communication patterns such as face-saving and quietness in class. Previous research has identified difficulties with the academic learning environment, such as difficulty understanding lecture content and lack of familiarity with the participatory learning style and examination formats among EAL nursing students (Malu & Figlear, 1998; Sanner & Wilson, 2008). CALL may represent an alternative delivery method to increase understanding of the topic or skill and improve learning outcomes while allowing students to study at their own location at their own pace. For CALL videogames using a question-answer format, this teaching tool may also help to familiarise students with examination formats such as multiple-choice questions while improving response times to verbal instruction as suggested by Müller (2012).

Furthermore, Sanner and Wilson (2008) emphasised that EAL nursing students often struggled with less rigid learning environments for their academic performance. However, clinical placements, and indeed clinical nursing work, are unlikely to conform to such rigid structures. Rather, EAL nursing students are often required to interact in spontaneous and flexible ways in clinical settings. Flexibility, interactivity, and spontaneity are some of the key benefits identified regarding CALL (e.g., Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). Thus, the

advantage of using CALL in private and informal environments may assist EAL nursing students by helping them become more familiar and comfortable with different learning styles and less structured environments, while building their confidence and experience with interacting quickly and spontaneously in both academic and clinical situations. As a result, students may be less likely to use communication behaviours such as face-saving and quietness in class when they later encounter these learning styles, increasing the chances of increased classroom participation and improved learning experiences and outcomes for Chinese EAL nursing students.

While there are many beneficial characteristics of CALL videogames as a culturally sensitive learning tool, that is not to say it is flawless and without challenges, especially with regards to face-saving. Yuan and colleagues (2012) stated that students have different levels of readiness for using self-directed learning and that self-directed learning can cause anxiety in some Chinese nursing students. In addition, CALL videogames have been noted to cause stress, anxiety, or embarrassment for a small number of students for reasons including incorrect answers and competition (Amer, 2014; Foss et al., 2013). However, CALL's flexibility and adopting certain strategies may help in this regard.

For example, to avoid causing a student to 'lose face', teachers should avoid discussing an identified student's scores or performance in the game in front of other students (either online or in the classroom). Doing so could affect future participation and student-teacher interactions. Instead, such conversations could be held in private (in the teacher's office, for example). If needing to give feedback about a student's participation in a CALL application, praise the effort and work in the game first before discreetly and carefully suggesting ways the student could modify their performance to allow students to save face.

In addition, for students used to teacher-directed classrooms, the more self-directed nature of CALL may be difficult. The instruction often given in CALL research is for students to 'play as often as they like for as long as they like'. Instead, to assist with the transition, teachers could (at least initially) give clearer and stricter directions for use. For example, students could be directed to

play the game for a set period of time – such as 15 minutes per day, every day for a week. Such instruction may help bridge the gap between teacher-directed and self-directed learning, while assisting with concerns related to face. It may also build on another cultural communication behaviour of Chinese students of respect for teachers. Hence, CALL applications may help with face-saving while retaining the respect of the teacher (for example, allowing repeated practice and errors without taking up the teacher's time, 'challenging' teachers or causing a loss of face) while also improving readiness, familiarity, and skills at self-directed learning.

Overall, CALL videogames may reduce the impact of communication behaviours related to face-saving and quietness in class by enabling students to learn an informal, private, anonymous, learner-directed environment. However, due to culturally related lack of familiarity with this type of self-directed learning, additional caution and steps should be taken into consideration when using CALL videogames with Chinese EAL nursing students to ease transition for students not used to this novel teaching method.

2.5.4 Conclusion

In conclusion, the student population in universities in Australia and globally has been undergoing significant diversification which is likely to continue. With the increasing international student population and the unique resources and challenges facing this group of students (as well as the educators who teach them), this is a topic of current substantive concern in Australia. International nursing students and CALD nurses are a valuable resource as part of culturally competent care in a multicultural country such as Australia in which large portions of society were either born overseas or speak a language other than English at home. Culturally sensitive teaching tools are needed to support this valuable and growing student population. Hence, the aim of this paper was to discuss the potential benefits of CALL videogames as a culturally sensitive teaching tool, with particular reference to teaching nursing related language skills and cultural communication behaviours and learning styles of Chinese EAL nursing students.

This discussion identified and explored a number of potential benefits of multiplatform CALL videogames as culturally sensitive and responsive pedagogy in this population. Firstly, with regard to the willpower and diligence of Chinese EAL nursing students, CALL videogames may build on and increase motivation and may also optimise the learning time available while reducing the potentially negative impact of external stressors on participation in support programmes via its benefits of portability and ubiquity. Secondly, this method may build on familiarity with repetition and memorisation styles of learning via the customisability of CALL videogames to specifically target areas Chinese EAL nursing students may find particularly difficult (such as low-frequency medical vocabulary). CALL features supporting this benefit include multisensory stimuli, immediate feedback, and repeated exposure to increase the chances of students developing automaticity and mastery of content. Thirdly, CALL videogames may reduce the need for face-saving and address quietness in class by enabling students to learn in an informal, private, and anonymous, learner-directed environment, while also supporting future participation in less familiar academic and clinical environments.

In the past, it has often been viewed as the student's sole responsibility to adapt to the teaching methods in the host country (Wang & Greenwood, 2015). Often, their cultural communication styles and behaviours are perceived as negative and detrimental to achieving success in Western universities. Conversely, it is also not about nursing educators feeling overwhelmed needing to change one's whole teaching method for a single group of students, as it is sometimes perceived. It is hoped that this paper will highlight the benefits that can be achieved for both students and teachers (and their institutions) adapting and adopting teaching methods (such as CALL) for the reciprocal benefit of all parties involved. Perhaps the most important message is to be aware of and sympathetic towards cultural communication and learning styles and taking a strengths-based approach, building on resources and being responsive to challenges.

In addition, more nursing educators should be supported and encouraged by their relevant institutions to consider using CALL applications in their classrooms. It is hoped that this paper will

encourage nursing educators and researchers alike to be more conscious of the cultural factors which may affect the learning experience of international nursing students.

2.6 Chapter 2 Conclusion

This chapter presented reviews of the previous literature relevant to international nursing students (including needs, strengths, and support programmes) as well as computer assisted learning in nursing education and language learning fields using computers or mobile phones. Firstly, common threads in the research reviewed on EAL nursing students included linguistic challenges (especially for specialised medical vocabulary), the impact of psychological, social, and cultural factors (particularly stigma and discrimination by educators and other students), and highlighting the need for more research into targeted support tools for EAL nursing students. Furthermore, the literature review identified the background, existing use (and noted lack of use), and advantages of CALL videogames in nursing education and language learning-related fields. Lastly, the potential benefit of a multiplatform CALL videogame as a culturally sensitive strengths-based pedagogical tool for international nursing students was discussed. Although rapidly evolving and expanding, the research conducted to date on CALL applications in nursing education is limited and has significant gaps in research. There is substantial space and need for research that investigates a multiplatform CALL videogame focusing on improving language skills in EAL nursing students.

Crucially, while CALL may provide a unique, culturally sensitive pedagogical tool in this population, a review of the research literature did not identify any previous studies specifically investigating either mobile phone-based CALL videogames or multiplatform CALL videogames for EAL nursing students. This represents an important gap in the research literature which provides support for the need for further research into the use of CALL for EAL nursing students.

Furthermore, studies often highlighted psychological factors (such as motivation, confidence, and test anxiety) among EAL nursing students, and studies have emphasised as CALL videogames as improving such psychological factors. However, it appears that no study has examined such psychological factors at baseline or in a pretest-posttest evaluation for EAL nursing students in the

context of a CALL videogame to improve language skills. In addition, of the four computer-based videogames for nursing education identified in the review, none contained detailed evaluation of gamelogs to understand the way students use and interact with the videogame.

The literature discussed in this chapter informed the development of the multiplatform CALL videogame application used for this research. The next chapter (chapter 3) discusses how the videogame was developed and constructed by the researcher. The discussion will explore background for technological choices (platforms, game engines, assets, and security) and game design choices (such as avatar, difficulty levels, narrative/authenticity, time limits and scoring). Game design phases and gameplay experience will also be described.

CHAPTER 3 DEVELOPMENT OF THE VIDEOGAME

3.1 Chapter Introduction

Chapter 2 provided a comprehensive examination of the previous research literature including international nursing students and educational videogames in nursing education and language learning. Research relating to issues faced by international nursing students were discussed. The review provided evidence of the benefits of a multiplatform CALL videogame as a pedagogical tool that is culturally sensitive and strengths-based for international nursing students. Through analysis of the literature, evidence was provided to support the significance of previous related interventions, as well as demonstrating the growing need of future CALL videogames that will incorporate these fundamentally important aspects for nursing-related language learning in international nursing students.

Following the review of the research literature, the present chapter discusses how the Medicina multiplatform videogame itself was designed, developed, and constructed by the researcher for the current study. Background and rationale for technological and game design choices will be discussed, as well as game design phases and considerations. Technological choices will be explored including the device platforms, game engines, assets, and security. Game design choices and features such as avatars, difficulty levels, narrative/authenticity, time limits, and scoring are examined. The learning tool ultimately developed and built by the researcher for this study was a multiplatform CALL videogame called Medicina, which could be played on both desktop/laptop devices using WebGL and on Android mobile devices such as smartphones.

3.2 Game Design Background

In order to design, develop, and build the educational videogame for this research, the study's rationale, aims, and research questions were first reviewed. The current study investigated the effectiveness, usage, and usability of a multiplatform CALL videogame to improve language skills in international nursing students. Research questions focussed on issues such as language skills, psychological factors, usage patterns among participants, game usability, and perceptions among

users. In order to address the research questions and aims, a customised multiplatform CALL videogame needed to be developed as part of this study.

Secondly, the literature was reviewed to explore existing games in the field, technical design aspects, and key features for potential inclusion in the application. As outlined in Chapter 2, a comprehensive review of the research literature identified no existing multiplatform CALL videogames in nursing education. Therefore, it was necessary for a new CALL videogame to be constructed for this study. Expanding the scope to single-platform videogames, a review of single-platform CALL videogames using mobile devices found five mobile videogames for language learning, but none of these focussed on nursing education language skills. Further literature review identified four single-platform games in nursing education (either CALL-related or not). These games were playable only using computer devices. Of these, one single-platform computer-based CALL videogame in nursing education, entitled *Medicina* (Müller, 2011b, 2012, 2013) is of particular relevance and interest to the present study. Thus, *Medicina* (Müller, 2011b, 2012, 2013) formed the underlying basis for the design of the multiplatform tool used in the current research.

However, it is important to note that while the design was influenced by Müller's (2011b, 2012, 2013) computer-only version, the game was redesigned and extended and the multiplatform videogame used in this study was developed and constructed by the researcher for the current research. Firstly, the delivery medium of the videogame was changed a multiplatform method. The original *Medicina* computer-based CALL game was developed by Müller (2011b, 2012, 2013) and focuses on teaching medication names to EAL nursing students. The game was designed to increase phonological awareness, improve listening skills, improve reaction times, and allow for multiple exposures to both written and spoken vocabulary, specifically for medication names (Müller, 2012). Importantly, however, the original *Medicina* computer game was a single-platform game accessible only on desktop or laptop devices. It was not playable on mobile devices.

In recent years there has been significant changes in mobile devices such as mobile phones (smartphones) and tablets. Notable changes include larger screens, introduction of touch screens,

improved audio-visual clarity, larger memory and data storage, higher data allowances from telecommunications providers, more powerful processors, faster connectivity and network speeds, and increased availability of applications (apps) (Godwin-Jones, 2017). Furthermore, whereas CALL videogames have historically been dependent on platform-specific technologies, mobile devices increasingly have access to web-based technologies. This enables students on any device to use the same application via access to web-based CALL videogames. In particular, the cross-platform game engine Unity (Unity Technologies) launched 'Unity 5' in 2015 (Robertson, 2015). Unity 5 supported multiplatform game development across 21 platforms (including Android mobile devices) and, crucially, introduced the ability to develop WebGL videogames via Unity for the first time, allowing developers to make games which can be played using web browsers with no plug-ins required (Robertson, 2015). Consequently, advancements in game engine technologies such as Unity became available to consumers which enabled multiplatform game development including both web-based WebGL and Android mobile platforms (Robertson, 2015). Thus, technological advancements were an important step regarding the development and utilisation of multiplatform CALL videogames and the ability to develop the multiplatform Medicina CALL videogame for the current research. Furthermore, the computer-only Medicina game was developed using Adobe Flash, which ceased operation in 2021. Consequently, it was no longer usable/operational with technological requirements of current systems/devices for either mobile platforms or via the web.

From a game design document standpoint, the task was to create a new pedagogical tool as similar as possible to Müller's (2011b, 2012, 2013) Medicina game whilst developing and constructing the new multiplatform game that was novel and extensive in design. Thus, while the design was influenced by Müller's (2011b, 2012, 2013) single-platform game, the videogame used in this study was developed and constructed by the researcher for the current research. The building process involved lengthy amounts of complex coding using multiple coding languages; the designing, rendering, and placement of multiple graphical assets, sprites, animations, and audio files; building of the game actions and interactions; attention to multiplatform-related issues such as

touch screens; and the construction of the gameplay, content, and features in a novel multiplatform game. It involved a new delivery medium (two platforms via WebGL and Android), new game assets (such as avatar graphics), new gameplay features (including three difficulty levels with time limitations), and new authentication procedures. The development of the game required new technologies (such as different game engine, file formats, software, coding languages, and databases), including the creation of the unique backend system stored in an SQL database and developed by the researcher using JSON, C# and PHP scripting language for this study. From these actions, the researcher built the two new versions of the game (WebGL and Android), the comprehensive backend system, gamelogs, and research management system necessary to run the game and study. The original game developed by Müller (2011b, 2012, 2013) was of extremely high quality and was an effective pedagogical tool for improving language skills in international nursing students. However, due to the technological changes which have occurred since that game's development and the new evaluations undertaken in this study, a new game needed to be built by the researcher for this study. Indeed, the aim was to create a game that was as similar as possible to the original in terms of design appearance, gameplay, and content while being delivered in a new multiplatform method with new evaluations.

3.3 Design Phases

The multiplatform CALL videogame evaluated in this research was called Medicina and was designed and developed by the researcher for this study. The development involved three primary phases.

3.3.1 Phase One - Preliminary Phase

In the first phase, the researcher and supervisory team were involved in preliminary discussions about the design of the videogame. The focus included developing the game in line with the research questions, research aims, game considerations (such as availability and longevity), and project constraints (such as time frame, finances, and access to resources). Comprehensive reviews of the literature were conducted to identify existing games and their features. The Medicina

videogame was chosen based on discussion with the supervisory team. Initial discussions also raised factors for later consideration such as potential game platforms and game engines.

3.3.2 Phase Two – Iterative Design Phase

The second phase involved the planning of specific technical components (such as game engine, platforms, assets, and screens) and game features. This phase involved considerable time, effort, research, training, and testing by the researcher. The task involved finding options that worked best for the research aims, aligned with the key considerations, and were based on discussion and expert advice from the supervisory team. For each component or feature, multiple options were researched, investigated, and attempted during this phase until the most suitable option was selected. Due to the intense complexity of the requirements, it was necessary for the researcher to undertake further training (such as educational tutorials) in the development of this tool. This additional learning was important for developing a videogame of good standard, capable of assisting with language skills in an engaging, strength-based way, as well as assessing participant progress during the intervention period.

Furthermore, the phase involved the main building and construction of the multiplatform Medicina videogame by the researcher in this study. It is difficult to describe the individual actions and nuances of the building process. However, at its core it involved lengthy amounts of complex coding using multiple coding languages; the designing, rendering, and placement of multiple graphical assets, sprites, animations, and audio files; building of the game actions and interactions; attention to multiplatform-related issues such as touch screens versus mouse; and the construction of the gameplay, content, and features in a novel multiplatform game. Using the Unity game engine, two versions of the game were created – WebGL and Android. A draft or ‘demo’ version of the videogame was developed by the researcher and discussed. Refinements were performed where needed. For example, three difficulty levels were added. The changes were then implemented.

3.3.3 Phase Three – Deployment Phase

Following many years of complex, intensive, challenging, and time-consuming efforts requiring considerable technical ability, the development of the multiplatform Medicina videogame was finalised by the researcher. The game was then deployed for evaluation as part of the current study. The WebGL version was playable online on laptop/desktop computers. The Android APK file was playable on Android mobile devices (such as smartphones and tablets) and was available for direct download to the mobile device. Both versions were accessed by the participants using the custom-built Research Management System website developed by the researcher for this study.

3.4 Design Considerations

To assist in the design and development of the multiplatform Medicina videogame in the current study, a list of desired features or considerations was outlined by the research team. This list was not intended to be prescriptive. Rather, it was prepared to provide some potential factors to take into consideration when making decisions about the design and development of the pedagogical intervention.

Design considerations include:

- Educational videogame features: The game should contain some common features of educational games identified in the literature review. For example, immediate feedback, scoring/rewards, time limits, narrative situations, a sense of challenge, constant engagement, and multisensory stimuli (such as visual and auditory).
- Financial costs: Users should not need to pay money to access the videogame. This includes paying a fee to download the game or having to purchase new devices/software to play the game (beyond their existing internet access and devices). On the development side, the researcher had no access to funding and used free or low-cost technologies where possible.
- Availability: The game should be available to students using a standard device (desktop, laptop, smartphone, or tablet), already owned by the student and using standard internet

connectivity (e.g., home, mobile, public Wi-Fi, library, on campus etc). It should also be available to as many students as possible on as many devices as possible.

- Ease of use: The game should not require advanced technical skills for users to access or play. Beyond the game itself, plugins or additional desktop applications should not need to be downloaded.

- Longevity: It is impossible to predict the future longevity of technology. However, where possible, the developer should select technology with popular/widespread usage and should avoid using technology whose cessation/closure is announced/imminent.

- Consistency: The multiplatform game should be consistent between platforms (e.g., web-based versus mobile). In addition, although not necessarily identical, the multiplatform version of Medicina developed in this study should be consistent with and similar to the original single-platform computer-based version (Müller, 2011b). The rationale of this consistency was to aid with comparison of results during data analysis and discussion, given the study's aims and significant original contribution to knowledge.

3.5 Technological Components

Technological choices such as the choice of platforms, choice of game engine, and development of game assets presented sizeable initial challenges. Factors adding to this challenge include the emergence of new technologies, the cessation of existing software, evolution of current technologies, and the practical constraints on the research (such as limited time, finances, and design considerations previously outlined). In the field of information technology, technologies evolve and change rapidly. In the decade between the original single-platform (Müller, 2011b) and the development of this new multiplatform game, significant technological changes occurred. Such changes significantly impacted the choice of technological components. For example, at the start of this research, the initial plan was for the development of a mobile-based game application to be designed based on the Medicina computer-based version. At the time of the early development phase of this research, CALL videogames were platform-specific, used on one native platform only.

The same was true for computer videogames and smartphone applications generally. This was due to the technology available at the time. However, since then, technological changes have led to the development of multiplatform videogames. Mobile devices increasingly have access to web-based technologies, enabling students on any device to use the same application via access to web-based CALL videogames. This section outlines the rationale behind technological choices in the current study

3.5.1 Choice of Platforms

3.5.1.1 Mobile-Based Platform

At the time of designing the game, there were four main mobile operating systems available for smartphones: Android, iOS, Windows, and Blackberry. Windows and Blackberry had less than 1% of market share each and were shut down soon thereafter. Hence, given the likely very small (if any) number of users, and the platforms being disbanded during the design phase, Windows and Blackberry did not meet the availability and longevity criteria. Consequently, Windows and Blackberry were both excluded as options for the mobile platform.

Thus, the two remaining mobile platform options were Android and Apple iPhone (iOS). Careful consideration was given regarding the choice of mobile platforms. Both were major platforms and were likely to be continuing, meeting the longevity criteria. However, Android was significantly more popular than Apple iOS and trends indicated that it was becoming increasingly more popular over time (Statista, 2022b). The most popular mobile operating system for smartphones was Android, which represented more than 60% of the market share in Australia at the time of development (Statista, 2022b). The second most popular operating system during the development phase was Apple iOS, used by just over a third of users (36%) (Statista, 2022b). In 2022, Android continued to be the most popular mobile operating platform in Australia (Statista, 2022b).

Although the current study was conducted in Australia, the sample population comprised international students. Thus, as part of the mobile platform selection process, research was

conducted to investigate smartphone mobile platform popularity among users from different countries. Data regarding mobile operating systems indicated that Android was by far the most popular platform worldwide. For example, around the time of design, Android reportedly had a market share of 77% worldwide versus 19% for iOS (Statcounter, 2022b). Similarly, in Asia (where it was anticipated that most of the international nursing students participating would be from) the split was 85% for Android compared with just 11% for iOS (Statcounter, 2022a). Expert advice was also sought from local nursing educators as part of the supervisory team. This discussion on local anecdotal mobile usage indicated that most international nursing students at Flinders University used Android smartphones rather than Apple iPhones. Therefore, global statistics, local factors, and the likely demographics of the study's sample were all explored in the selection of mobile platforms.

Initially, it was considered to make two mobile platforms to include both Android and iOS. However, to do so would not be feasible given the time and resource constraints. Furthermore, a serious and significant issue in the development of applications for both platforms is consistency – for both users and developers. On the users' side, there are differences in graphical user interface design, typography, button placement and design, navigation patterns, touch movement and touch grids, and swiping movements (Malik, 2020). For example, swiping left and swiping right results in different outcomes in iOS versus Android applications (Malik, 2020). Thus, if an application is designed for iOS, its appearance, movement, and function will be familiar and usable to users, but it will not be consistent with the Android app. In contrast, if built to be consistent across platforms, iOS users will find it unfamiliar and unnatural to use (Malik, 2020). Indeed, research indicates that users have significant negative experiences with cross-platform mobile apps (i.e., apps for both Android and iOS). An analysis by Hu (2017) of 68,000 ratings of 19 cross-platform mobile apps found that users of the two mobile platforms had distinctly different experiences and complaints about consistency. Results indicated that iOS users were significantly more likely to experience consistency-related issues such as 'crashing' apps, compatibility issues, and interface design issues

for 68% of the apps studied (Hu, 2017). Similarly, there is a considerable lack of consistency on the developers' end also (Hu, 2017; Kanivets, 2020).

In summary, taking into consideration the higher popularity/availability of Android, the consistency issues for cross-platform iOS and Android apps for the same game, and given time and resource constraints, the decision was made to use Android as the mobile platform.

3.5.1.2 Web-Based Platform

The original single-platform version of Medicina for computers (Müller, 2011b) was developed using 'Adobe Shockwave Flash'. Adobe Flash was a multimedia software platform used for the development of browser games, animations, desktop and web applications, displaying audio and video content on websites, and mobile games. Users were required to download a plugin for applications using Adobe Flash to be displayed. In the 2000's and at the time the computer-based Medicina game was designed, Adobe Flash was extremely popular, and its use was widespread. However, 'Adobe Shockwave Flash' suffered from limited accessibility (especially for mobile devices) and security issues (Fisher, 2022). It was discontinued by Adobe in January 2021 (Fisher, 2022). As a result, it was necessary to use a different technology when building the multiplatform version of the videogame for use in the current study.

Multiple technologies were considered for the web-based game for playing on desktop and laptop computers. Possible technologies and programming languages explored included WebGL, HTML5, Canvas, JavaScript, JSON, CSS, Three.js, and Unity desktop application (Unity Technologies). These options were trialled and assessed against the key design considerations. Additional reasons why products were not selected included development time, difficulty to learn and use, and possible lack of capability to meet the complex level of functionality and speed of processing required (especially given the game's intensive audio requirements). The Unity desktop option was dismissed as rather than being a web-based technology it required users to download and use a separate programme (the desktop application). Some options were considered outdated, having less widespread use to date, or at risk of being less likely to be maintained in the future due

to the popularity and integration of other products on the market. At the time of design, most web-based videogames centred around the use of HTML5 and WebGL-based technologies. Hence, the initial investigation into the use of these new technologies considered the use of JavaScript in conjunction with HTML5 and WebGL.

WebGL was chosen as the web-based platform. WebGL is a JavaScript-based Application Programming Interface (API). It is free, does not require installation of a plugin or application, and permits both native-platform and cross-platform game use. WebGL is capable of producing both 2D and 3D interactive graphics. At the time of designing the game, research indicated WebGL was the most popular API, and its use was increasing (Viscircle, 2023). It is also compatible with all main web browsers (such as Firefox, Chrome etc), content creation libraries and tools (including Blender), and game engine software (such as Unity and Unreal). Therefore, the decision was made to use WebGL as the web-based platform aspect of the multiplatform videogame for the current study.

3.5.2 Game Engine

Another technological component of the development process of the multiplatform CALL videogame was the choice of game engine. The term ‘game engine’ refers to a software development environment/programme designed for the creation of videogames. Multiple potential game engines were investigated including Unity (Unity Technologies), Unreal (Epic Games), CryEngine (Crytek), and Phaser (Photon Storm). Main factors of concern included the capability to create multiplatform games, the platforms available (e.g., iOS/Android), 3D and 2D game functionality, programming language, audio/graphics/animations availability and quality, computer requirements (e.g., processing speed), financial cost, and ease of use.

After multiple trials and careful consideration, the game engine selected for the development of the videogame in this study was Unity. Unity is a cross-platform game engine developed by Unity Technologies. The Unity game engine uses the C# scripting language. Whilst a scripting language is not technically a programming language, from this point on C# will be referred to as a

programming language for simplicity/familiarity. Unity is an easily available, user-friendly engine enabling the development of both 2D and 3D games with high quality audio, visual graphics, sprites, and animation. It also has drag-and-drop functionality. Unity permits multiplatform game development and supports a diverse range of platforms including PC, web-based, and mobile platforms (including touch screens). Importantly, using WebGL, Unity allows developers to make games which can be played using web browsers with no plug-ins required for players. Thus, it has the functionality to develop multiplatform games using WebGL and Android as needed for this study. This is accomplished due the way in which Unity game engine allows developers to create a game using the C# scripting language. The developer then decides to which platform the game is to be deployed, and subsequently “builds” the game to that specific platform. This means that a game developer is not required to create a game for an individual platform using that platform’s unique native programming language. Instead, Unity provides a developer with the convenience of being able to produce a game for the target platforms with the centralised use of Unity’s build in C# language. Another major advantage of Unity over other game engines is cost. While there is a professional license at a monthly cost, Unity is also available free of charge for small-scale games. In addition, Unity was most consistent with the researcher’s existing technical skill set and past experience with game development. In summary, taking into account platform-related, asset-related, technical, financial, ease-of-use, consistency, and design-related criteria, it was determined that the Unity game engine was the most appropriate game engine for developing the videogame for the current research.

Consequently, the multiplatform Medicina videogame was developed by the researcher using Unity with two versions of the game created – WebGL and Android. The WebGL version was playable online on laptop/desktop computers via the study’s website. The Android APK file was playable on Android mobile devices (such as smartphones and tablets) and was available for direct download to the mobile device.

3.5.3 *Game Assets*

The design of the Medicina videogame contains a very large number of assets encompassing many types. Assets used in the game included graphics/art files (such as avatars, characters, medication bottles, and hospital scene objects), audio files (including main vocal audio and background audio), text files, written medication names, and animation files. Most of these assets were created specifically for the single-platform version of the Medicina videogame (Müller, 2011b).

However, an unexpected, notable technological challenge experienced in the game development process was the conversion and transference of assets from the original Medicina videogame (Müller, 2011b) into the current game. The researcher was provided with original graphics from the previous Medicina videogame. However, these files could not be directly imported into the game engine to develop the current multiplatform application because the files used an unsupported, outdated file format. The previous computer-only Medicina game (Müller, 2011b) was developed using Adobe Flash, which since ceased operation. For use in the previous Adobe Flash-based game, the assets used a file format unique to Adobe Flash (e.g., SWF). However, these file formats (such as SWF) were not compatible or usable with the technological requirements of the current platforms (such as PNG for graphical images). Thus, the assets were in the wrong file format and incompatible with use for the new multiplatform CALL videogame.

The process of transcribing and redeveloping the asset files for use in the current game involved multiple steps. Firstly, the assets in the Adobe file format (such as SWF) needed to be transformed into a file format usable for the current game in order to be used on the new platform. However, when the files were converted into new file formats (such as PNG or MP4), some features were missing, altered, or of poor quality. For example, some animations were no longer animated, and in other cases the file would not convert at all. As a result, many of the converted game assets were deemed to not meet the requirements for use in the multiplatform Medicina videogame. For this reason, in many cases it was necessary to make changes to the assets in order for them to be incorporated. It was also essential to ensure that these game assets would be of reasonable quality

and fit for purpose in the multiplatform game, and to ensure these game assets would be consistent across all new platforms. It is important to note that this was not a fault with the original assets – they were of high quality in the computer-only game. Rather, it was a result of the technological changes and file conversion process.

To redevelop and create the new assets, a computer graphic design and rendering software was needed. One option was one of the many Adobe products such as Adobe Animate and Adobe Creative Cloud. However, the software was not a good fit for the study because of the cost and incompatibility with the game engine. For example, they were financially expensive, with Creative Cloud costing \$120AUD per month as a subscription fee at the time. Furthermore, it was considered these products were outdated, not as appropriate for long-term use with the game, and were not as easy to integrate into the Unity game engine compared with other options. Overall, these options were not selected as they did not meet the guidelines for cost, availability, longevity, and consistency.

Instead, Blender was determined to be the most appropriate software for this purpose. Blender is a free and open source software used in the creation of both 2D and 3D videogame assets. The software is comparatively easy to use and has the technical capacity and functionality to produce the assets needed for current study. For example, the creation of multiple avatars that would require not just a sprite-rendered image but also animation applied over the avatar. As Blender is a free open source software, it satisfied financial-related considerations. Furthermore, as Blender is an industry standard software there are many online tutorials which could be used to aid a developer in creating and finalising animations. Importantly, Blender is readily compatible with the Unity game engine and assets can be deployed across multiple platforms with high levels of consistency, which is vital for the development of the current videogame.

Thus, after careful research and explorations of multiple graphic and animation creation software, the decision was made to use Blender to redesign and redevelop the game assets. Using Blender, the researcher used the pre-existing game assets as a reference point to design and develop

brand new game assets such as avatars which would incorporate new animations for use in the multiplatform Medicina CALL videogame.

3.5.4 Authentication/Security.

Another technological aspect of the game development was that of authentication and security. Players were required to login to play the game using a unique username and password provided. The username supplied corresponded to their participant number while the password was a common colour followed by a short number (e.g., blue22), designed for ease of spelling and recall. By having participants login to the game using these security credentials, it was possible to link their playing across multiple playing sessions over time, between different platforms (WebGL versus Android), and connect the multiple data sources (e.g., pretest, posttest, and gamelogs) for the purposes of data analysis. This provided a very clear end-to-end security system that helped to maintain data accuracy, data security, and control of study procedures.

In Australia, universities provide students with an official student login and password for all their technology access (such as student system, email, and online course content). At Flinders University this official login is called the Flinders Authentication Name (FAN). However, the decision was made to use unofficial, study-specific logins rather than the official university wide system for several important reasons. Firstly, it enabled participants and their data to remain anonymous, de-identified, and separated from their university work. This was important for ethical reasons and allowed participants to answer questions and play the game anonymously. In addition, the inclusion of participants from multiple Australian universities, each with their own unique style of official logins and passwords, would have made using official logins highly difficult and complicated to access from a practical perspective. Thirdly, making a custom login allowed greater security and control over the study and intervention. For example, it ensured that only participants involved in the study were playing the game, increasing confidence in the accuracy of the gamelogs. The same login was used to access the game (both WebGL and Android versions), the pretest and posttest surveys, and the Research Management System Website.

3.5.5 Screens

Multiple screens were required in the game. In terms of start-up screens, there was a splash screen, as well as a login screen which asked participants to enter their username and password. As shown in Figure 3, a main menu screen led to three screens – ‘play’ (to enter the game), ‘scores’ (which showed the player’s best score), and ‘help’ (with instructions on how to play the game). In-game screens included the avatar selection (Figure 4), difficulty level selection, game countdown, game play (shown in Figure 5), and an end of round screen (shown in Figure 6). Storyboarding and planning of the screens was conducted in the second phase of development, and screens were built as part of the building phase (phase 3).

Figure 3

Screenshot of Main Menu Screen



Figure 4

Screenshot of Avatar Menu



Figure 5

Screenshot of Gameplay Screen



Figure 6

Screenshot of End of Round Screen



3.6 Game Design Components

3.6.1 Description of the Gameplay

The multiplatform Medicina videogame comprised a Game Graphical User Interface. At the first screen, users are required to enter their login details (username and password). Next, users are shown the avatar selection screen and must choose their avatar. Thirdly, players select the difficulty level. At the start of the game, a countdown screen appears, visually counting down from four seconds to one second to the commencement of the gameplay. The main game screen then appears.

In the gameplay, users listen to a verbal command to find a particular medication name (such as “Can you get me the thyroxine?”). On the screen are five medication bottles, each showing a different but easily confusable medication name. Users must select the correct medication name

(matching the verbal command) among each of the five written, labelled bottles. The user must make a selection within a set time limit, and immediate feedback is provided by a cartoon nurse (avatar). Points accumulate for correct answers. Not selecting an option, or choosing three incorrect answers, ends the game.

3.6.2 Gameplay Features

A key aspect of the design and development of the Medicina videogame was the inclusion of core videogame features consistent with previous games in nursing education, as outlined in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). It was important that the game met the criteria of being a videogame and contained many of the key components to confer the benefits of those features to participants. Thus, the multiplatform Medicina videogame was designed to incorporate many of the common features of educational videogames identified in the literature review such as avatars, immediate feedback, scoring/rewards, time limits, narrative, challenges/difficulty levels, repetition, realism, and multisensory stimuli. Further detail will be provided about some of the Medicina videogame's gameplay features individually.

3.6.2.1 Avatars

A common feature in CALL videogames is the use of characters and avatars (Peterson, 2005). In videogames, an avatar is a graphical representation of a user (Inal & Cagiltay, 2006). As a feature in CALL videogames, avatars enhance interaction in the virtual environment (Peterson, 2005). Avatars can come in many formats and styles such as cartoon animated characters or photorealistic avatars (Segaran et al., 2021). However, in CALL and computer-based videogames in nursing education (e.g., Müller, 2011b; Müller & Price, 2012), previous videogames have typically used avatars designed as animated cartoon-style characters. In addition, research regarding digital game-based learning has recommended cartoon-like character designs as improving positive emotional experiences among players over more realistic avatars (Segaran et al., 2021). Furthermore, disadvantages of realistic avatars include causing discomfort to participants such as the 'uncanny

valley' phenomenon (Segaran et al., 2021). Avatars can vary by characteristics such as gender, ethnicity, and appearance (such as hair colour/style). Players can choose characters that look like them or they can choose characters that do not look like them. Research indicates the use of avatars may have a positive effect including increasing motivation, self-esteem, engagement, realism, identification, and game loyalty/retention (Inal & Cagiltay, 2006; Kao & Harrell, 2018).

Two avatars were included in the multiplatform Medicina videogame developed by the researcher. For each avatar, the researcher had to produce graphic assets for each body position and facial expression and animate the movement (such as when providing feedback). These tasks involved significant time, skill, and labour. The avatars were animated-style characters, designed to represent student nurses in clinical placements. Both avatars were dressed in student nurse outfits with the Flinders University logo. The avatars were designed to create a sense of realism, authenticity, engagement, story narrative, and identification with the scenario while remaining anonymous. During gameplay, participants in this study were given a choice between two avatars (Figure 4).

3.6.2.2 Immediate Feedback

Immediate feedback is an important game component in videogames. It refers to feedback that is given contextually, instantly in the flow of learning, in response to a player's actions. Immediate feedback was incorporated as a key feature in the design of the multiplatform Medicina videogame. After players have given their input by choosing an answer, immediate feedback was given to reinforce knowledge by either correcting a mistake or affirming a correct answer. In this videogame, the immediate feedback was provided in multisensory format – with visual, spoken, and written feedback about the player's response. For example, this feedback included a visual emotional reaction by their chosen nursing student avatar, such as raising their arms up and smiling for correct answer or crying for an incorrect answer. In addition, the feedback involved a physical visual response shown on a patient character lying in a hospital bed, such as turning green and vomiting, accompanied by vomiting sound effect for an incorrect answer. Examples of these

immediate feedback are shown in Figure 7 and Figure 8. Feedback provided in the game allowed students to measure their current performance, modify their knowledge and strategies, and monitor their own progress.

Figure 7

Screenshot of Avatar and Patient Response to Correct Answer



Figure 8

Screenshot of Avatar and Patient Response to Incorrect Answer



3.6.2.3 Challenge/Difficulty Levels and Time Limitation

Further features incorporated in the design of the Medicina videogame included challenge/difficulty levels and time limitation. They are described together here due to their interconnected relationship in the design of the game. As part of the initial screens before gameplay, players are asked to choose their desired difficulty level. There were three difficulty levels available, each with different time limits: easy (16 seconds), medium (12 seconds), and hard (8 seconds). It is worth noting that the difference between the difficulty levels was solely the time limitation. Thus, the content of the

game (the medication names) did not vary by difficulty level. The time countdown commenced on loading of the page prior to the start of the question. The time limits were decided on based on multiple factors, including the question length, number, and length of response options, mean response times, and spacing between levels. The ability to choose and progress between difficulty levels was included to offer players a sense of control, challenge, and motivation, while encouraging students to become gradually faster with their listening and reading skills.

3.6.2.4 Narrative, Realism, and Authenticity

The narrative storyline of the videogame is that of a nursing student on a clinical placement who is asked by a senior nurse to get a medication for the patient in a hospital setting. The narrative, realism, and authenticity of the videogame are achieved in this game through the incorporation of multiple features. This includes the avatar (a nursing student character who is also wearing a clinical placement uniform with university logo), the graphics (such as medication bottles and hospital room-related appearance which provide visual illustration of a hospital setting), the verbal instructions from the senior nurse to find a medication, the physical feedback response from the patient (such as turning green and vomiting, accompanied by vomiting sound effect for an incorrect answer), the use of Australian accents, and the ongoing stream of distracting hospital-related background noise.

3.6.2.5 Scoring/Rewards

Players receive points for correct answers, with each correct answer awarded 250 points. During the game, points accumulate, and the current score is shown on the screen. At the end of the round, the total score is presented along with a feedback response from the avatar (e.g., happy facial expression). In addition, special recognition is given when players achieve their highest score.

3.6.2.6 Repetition

Another key feature of the gameplay was repetition. Using repeated exposure to both written and spoken medications, students can become familiar with the medication name itself and their word-parts. In addition, students learn to discriminate between similar confusable medication names and

word-parts. This repetition is vital for improving language skills including phonological awareness, knowledge about and familiarity with medication names, listening and reading skills, and automaticity (Müller, 2011a; Schmitt, 2008; Webb, 2007).

3.6.2.7 Multisensory Stimuli and Interactions

An important feature of the videogame in the current study is the inclusion of multisensory stimuli and interactions (e.g., audio, visual, haptic etc). For example, users receive input from multisensory stimuli such as audio with the verbal commands to find the target medication and visually through the colourful, animated graphics (such as the medication bottles and hospital room). In addition, players are represented in the environment through their visual character form (the avatar).

Furthermore, players use touch (whether through touch screen or mouse) to navigate the game and input their responses. Similarly, feedback is then given to players in both visual and auditory form, including the emotional reaction by their chosen avatar (such as raising arm up and smiling for correct answer or crying for incorrect answer), and response shown on an imaginary patient (such as turning green and vomiting, accompanied by vomiting sound effect for an incorrect answer). In addition, the game also incorporated a stream of hospital-related background noise (including ringing phones, tannoy announcements, and other noises). These sounds were included to improve realism, increase task difficulty, and provide distraction items. It also allowed students to practice phonological skills, listening skills, and selective attention skills in a task and setting with which international nursing students often report difficulties (Müller, 2012).

3.7 Chapter 3 Conclusion

In summary, this chapter discussed the design and development of the multiplatform CALL videogame called *Medicina*. The multiplatform videogame was developed and built by the researcher for the current research. The general process was discussed, including the phases of development and design considerations. The technological components of the videogame including choice of platforms, engine, assets, and authentication were explored. Discussion also included some of the challenges experienced, especially given the evolving nature of the relevant

technologies. Next, an overview of the gameplay and the choice of game features was provided. Elements such as avatars, difficulty levels, repetition, scoring, time limits, realism/narrative/authenticity, and multisensory stimuli were examined. The result was an evidence based multiplatform Medicina CALL videogame which aimed to improve language skills in international nursing students.

The fourth chapter outlines the research methodology separate to the development of this CALL videogame application. The study's design, sample and recruitment process, and choice of materials are discussed. In addition, data collection and data analysis procedures will be outlined. Ethical considerations and the methodological challenges created by the COVID-19 pandemic will also be explored.

CHAPTER 4 METHOD

4.1 Chapter Introduction

The previous chapter discussed the design and development of the multiplatform Medicina CALL videogame for the current study. The design phases, considerations, technological components, gameplay, and game design components were examined in-depth. Next, chapter 4 outlines the research method separate to the development of Medicina. The study's design, sample, recruitment process, materials, data collection procedures, and data analysis will be outlined. In particular, the selection, development, and implementation of materials such as the word recognition test, MSLQ-SF psychological measures questionnaire (MSLQ, Pintrich et al., 1991), game feedback questionnaire, System Usability Scale (Brooke, 2013), comprehensive gamelogs, and Research Management System are discussed. Ethical considerations will also be discussed including research ethics approval, voluntary consent, anonymity and confidentiality, and benefits/risks to participants. Methodological and research design challenges due to the COVID-19 pandemic are also described.

4.2 Study Design

To evaluate the effectiveness of the multiplatform Medicina videogame, the study used a quantitative, quasi-experimental, one-group pretest-posttest design. The objectives and aims of the research were important components of the selection of study design. The study involved the building of a new multiplatform videogame developed specifically for the research and the first evaluation of this novel application in this manner. Given the lack of previous literature and the paucity of published studies in this field more broadly, there was arguably an exploratory component of the research. The study explored Medicina and sought to examine its effectiveness, usage, usability, and perceptions of the game by international nursing students. As such, the quantitative, quasi-experimental, one-group pretest-posttest study design selected allowed for a nuanced account of the issue that provided further insights and depth of understanding. It sought to provide vital information which could then be used for further research including randomised controlled trials of the videogame in the future. Thus, exploring, illustrating, enhancing, and

clarifying findings and providing new insights were considered key considerations in the selection of study design.

A randomised controlled trial was also initially considered for this study as it is commonly regarded as the most methodologically rigorous tool to examine cause-effect relationships between an intervention and outcome (Hariton & Locascio, 2018). However, a randomised controlled trial was deemed not feasible in the present study on expert advice from the supervisory team due to significant practical constraints. Furthermore, a randomised controlled trial was not considered the most appropriate choice in view of the aims and exploratory nature of the research.

Therefore, practical and logistical factors, the study's aims, exploratory nature of the pilot research, the target population, and the educational context were some of the factors taken into consideration in determining the study's design. Based on these considerations, it was determined in concert with the supervisory panel that a single group pretest-posttest design would be the most appropriate method for this study to examine the research questions.

4.3 Procedure

The study used a quantitative, quasi-experimental, one-group pretest-posttest design to evaluate the effectiveness of the Medicina videogame. The data collection portion of the study had three phases: pretest period, a two-week intervention period, and posttest period. Data were obtained through written questionnaires and gamelogs. Phonological awareness was assessed using a word recognition test in the pretest and posttest periods. Other measures included demographic information, psychological measures (e.g., confidence, motivation), impact on language skills, game perceptions and usability (e.g., features liked, ease of use), and game usage (e.g., number of games played, scores).

4.4 Participants

Participants in this study included international students enrolled in a tertiary nursing course in Australia. Using convenience sampling, participants were sourced from Flinders University as well as external universities across Australia in a multicentre trial. Participants included all genders and

were aged 18 years and over. A total of 32 international nursing students took part in the study. All participants in this study were volunteers.

In total 48 external tertiary institutions in Australia were contacted for involvement in the study (see Table A1 in Appendix A). The final number of Australian universities agreeing to be involved in the multicentre trial was 12 universities with a Bachelor of Nursing programme. The multicentre sites spanned the country, representing one Australian territory and six out of six states in Australia. However, to respect the anonymity and confidentiality of participants (who may have potentially been the only participant from individual sites), participants were not asked information about their specific university or location (such as state) as part of the research materials. Hence, further details regarding the geographical location or enrolled university of participants is not known or presented. Information about courses undertaken regarding medical terminology as part of their degree, history of experience with clinical placements, or previous competencies passed (such as administering medication on placement) were not known.

The sample included 25 female participants (78%) and 7 male participants (22%). Participant ages ranged from 18 to 57 years, with a median of 25 years. Participants represented 13 different countries of origin, with the most common being China (31%) and South Korea (13%). There were 14 first languages represented, with the most common being Chinese languages (38%). The median duration of time spent in Australia was 3 years. All participants were studying a Bachelor of Nursing course with most participants (78%) in their second year or third year at the time of completing the pretest questionnaire. Participants reported low levels of prior experience with videogames overall.

4.5 Materials

4.5.1 Medicina Multiplatform Videogame

The educational intervention used in the study was the Medicina videogame. The multiplatform CALL videogame was built by the researcher for this study. The design and development of the

videogame, including the gameplay and game features, were discussed in detail in Chapter 3 of this dissertation.

4.5.2 Demographics Questionnaire

A demographics questionnaire containing 12 questions asked participants to provide information on their age, gender, country of origin, time spent in Australia, language background, education, and past videogame usage. Education topics included questions regarding course type, year level, and international student status. Past videogame usage questions focussed on average hours played per week, devices used, and level of experience. The written questionnaire was completed by participants on one occasion only, during the pretest period. Questions such as age, gender, and educational background are standard demographics questions commonly used in evaluation studies. Items regarding country of origin and language spoken were based on questions from Müller (2011b). In addition, variables regarding videogame usage history were adapted from questions used in previous videogame research (Phan et al., 2016). The questions aimed to confirm participants met the eligibility criteria for the study and provide information about the characteristics of the sample. In addition, the demographic variables were included to aid in analysis of the data by potentially providing explorations of associations between the demographic variables and primary variables of interest.

4.5.3 Word Recognition Test

A word recognition test was administered to participants twice during the study – during both the pretest and posttest trial phases. The test aimed to examine the participants' phonological awareness as an aspect of language skills. The word recognition test was designed by Müller (2011b) to measure phonological awareness and was used in previous research to assess the single-platform Medicina computer game. The questions were used verbatim with permission of the developer (Müller, 2011b), who was the principal supervisory on this research. Whereas the Medicina videogame contained real medication names, the word recognition test contained non-words which were not real medication names. However, each non-word item contained two word-parts which

were phonemes from real medication names. Variant items were then designed based on commonly confused phonemes. For example, the non-word cilopam (not a real medication) comprised two word-parts ‘cilo’ and ‘pam’ (taken from real medication names). Each word-part was then paired with a confusable phoneme. For example, ‘cilo’ and ‘pam’ were paired with ‘saro’ and ‘bam’ respectively, making four word options – cilopam, saropam, cilobam, and sarobam.

The participants were administered the same word recognition test in the pretest and posttest periods. The word recognition tests were administered online as part of the written questionnaires. Prior to starting the word recognition test, an audio check question provided participants with the opportunity to set up or adjust the audio settings to a comfortable level if necessary while also giving confirmation participants could hear the audio. The word recognition test comprised audio recordings of 30 items. Examples of the items include ‘cardibital’ and ‘cephazoline’. Participants were instructed to listen to the word and choose the correct medication name heard from written four options. Each of the 30 questions were presented individually to participants. The question was played only once per item and the audio started playing automatically after the page loaded. Each of the 30 words comprised two word-parts, such as ‘cilo’ and ‘pam’ for the item ‘cilopam’. Points were given for correct answers for each word-part, resulting in 60 pieces of data collected from 30 test words. The continuous variable had potential scores ranging from 0 to 60, with higher scores indicating higher levels of phonological awareness.

4.5.4 Psychological Measures Questionnaire (MSLQ-SF)

In addition to language skills, this study aimed to examine psychological factors in EAL nursing students. Previous research has indicated that psychological factors such as confidence, motivation, and test anxiety may be important to the outcomes of international nursing students (e.g., Crawford & Candlin, 2013; Malu & Figlear, 1998; Starr, 2009). Furthermore, research regarding CALL indicates these tools may have positive psychological benefits such as reducing anxiety and stress while increasing confidence and motivation (e.g., Dondlinger, 2007; Granic et al., 2014; Lee & Peng, 2006; Pront et al., 2018). However, a review of the research literature found no published

studies which examined such psychological factors at baseline or in a pretest-posttest evaluation for EAL nursing students in the context of a CALL videogame to improve language skills. Considering the paucity of research and novel nature of the videogame, the study investigated at an exploratory level the baseline context-specific psychological variables in the population and potential impact of *Medicina* on these variables.

Of particular importance in selecting the psychological measures questionnaire was the issue of state versus trait measurements. The distinction between trait and state measures are among the most significant and long-standing concepts in psychological and personality-related theories and research. As defined by Schmitt and Blum (2020):

Traits are characteristic patterns of thinking, feeling, and behaving that generalize across similar situations, differ systematically between individuals, and remain rather stable across time. States are characteristic patterns of thinking, feeling, and behaving in a concrete situation at a specific moment in time. Unlike traits, states vary across time as a function of the situation the person encounters. (p. 5206)

In the current research, the focus was on state measures of psychological factors rather than traits. In particular, the research was interested in issues like confidence and task value in regard to language skills and language learning (the concrete situation) in response to the CALL videogame in a (tertiary) educational context (the specific moment in time). Thus, the primary focus was not on the participants' broad levels of confidence in general life (e.g., general personality), or even about their education or degree overall, but rather around their nursing-related language skills in the context of the *Medicina* videogame.

Finding a measure suitable for the current research was challenging. While researching potential measures for this section, it became evident that existing measures have more predominantly focussed on trait concepts. This focus has been documented and supported in the research literature previously (e.g. Schmitt & Blum, 2020). Even existing measures that appeared to be state-based were typically still too broad. For example, they focussed on students' experiences or

approaches to their total academic situation globally (e.g., entire schooling career) rather than a specific topic or context as needed for the present study.

A search of the research literature was conducted to select the measure for the current study. Factors taken into consideration included the variables assessed, the population and setting, method of delivery, number and content of items and responses, validity, and reliability of the tests. The questionnaire found to be most appropriate for the current study was the Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich and colleagues (1991). The MSLQ is one of the most widely used questionnaires designed to measure academic motivation and learning strategies in university students (Wang et al., 2023). The MSLQ is a validated scale which has been tested across a wide variety of university topics or content areas (such as medical education, chemistry, statistics education) as well as diverse populations and cultures (Duncan & McKeachie, 2005). It is also a measure that explicitly permits changes to wording and choice of specific subscales to adapt it to the unique needs of individual studies (Pintrich et al., 1991). The MSLQ is in the public domain and permission to use the instrument is not required by the developers (Pintrich et al., 1991).

However, the MSLQ is a very long questionnaire. The full instrument contains 81 items, with the motivation section having 31 items. As a result, modifications are common among previous research using the MSLQ and multiple short-form versions have been developed and evaluated (e.g., Curione et al., 2022; Loose et al., 2023; Soemantri et al., 2018; Wang et al., 2023) including in a study of medical education students in Australia (Soemantri et al., 2018). Analysis of short-form versions of the MSLQ in previous research have demonstrated positive reliability and validity (Loose et al., 2023; Soemantri et al., 2018; Wang et al., 2023). For example, Loose and colleagues (2023, p. 14440) found that “in comparison to longer versions, the 6-item version came at little-to-no cost in terms of psychometric properties”. In the current study, the psychological measures section was just one part of a larger study. Multiple other measures would be used in addition to the MSLQ. Moreover, the study had a pretest and posttest design, meaning students would need to

answer the questions twice. Therefore, there were concerns that the MSLQ was too long for the present study and may lead to participant fatigue and recruitment difficulties. As a result, the decision was made to use a modified, shortened version of the MSLQ scale for the current study.

After careful review of the literature, the written psychological measures questionnaire was developed containing 10 items taken from the MSLQ. This was called a shortform MSLQ or MSLQ-SF. There were five subscales - intrinsic motivation, extrinsic motivation, task value, self-efficacy, and test anxiety. Each of the five subscales was measured with two items. These items were single-item measures of the main dimensions or themes the subscales assessed, as shown in Table 1.

Table 1

Psychological Measures Questionnaire (MSLQ-SF) Subscales, Dimensions, and Items.

Subscale	Dimension	Item
Intrinsic Motivation	Challenge	When learning a topic like medical terms, I prefer games that really challenge me so I can learn new things
Intrinsic Motivation	Mastery	The most satisfying thing for me in this game is trying to understand the content as thoroughly as possible
Extrinsic Motivation	Grade/score	The most important thing for me right now in this game is getting a good score
Extrinsic Motivation	Approval	I want to do well in this game because it is important to show my ability to my family, friends, employer, or others
Task Value	Interest	I am very interested in medical terms
Task Value	Usefulness	I think medical terms are useful for me to learn
Self-Efficacy	Learning	I'm confident I can understand the basic concepts related to medical terms
Self-Efficacy	Performance	I expect to do well in tasks related to medical terms
Test Anxiety	Cognitive	When I take tests I think of the consequences of failing
Test Anxiety	Affective	I have an uneasy, upset feeling when I take an exam

For example, the task value subscale contained an interest dimension ('I am very interested in medical terms') and a usefulness dimension ('I think medical terms are useful for me to learn'). The same questionnaire was given to participants during the pretest and posttest periods. Like the full MSLQ, responses were given on a 7-point Likert scale (from 1 'not at all true of me' to 7 'very true of me'). Items were scored as continuous variables, with higher scores indicating higher levels of the psychological factor.

4.5.5 Game Feedback Questionnaire

A game feedback questionnaire was administered to the participants during the posttest period and aimed to measure participants' perceptions and opinions about the game. The questionnaire contained 10 written questions with a mixture of response styles. To measure the impact of the game on language skills, three questions asked participants about the effects of the game on their familiarity, listening skill confidence, and ease of recognising medication names using individual 7-point Likert-style responses. In addition, six questions asked participants about their perceptions and thoughts on the games. For example, participants were asked what they liked about the game, opinions about the avatars, and suggestions for changes to improve the games. These six questions used open-ended text response boxes for more detailed feedback about the game. All questions in the game feedback questionnaire were based on items used by Müller (2013) in previous studies. The questions were used verbatim with permission of the developer (Müller, 2013), who was the principal supervisory on this research. Quotations from the qualitative questions would be used to provide additional information about perceptions of the game.

4.5.6 System Usability Scale

To further examine perceptions of Medicina and its subjective usability, participants completed the System Usability Scale (SUS). The SUS is a widely used short questionnaire developed by John Brooke in 1986 (Brooke, 1996, 2013). It was designed to measure the perceived usability of various engineering or computer systems such as websites, software, and computer games (Brooke, 1996, 2013). The SUS is freely available in the public domain and permission to use the instrument is not

required by the developers (Brooke, 1996). The SUS is a validated questionnaire and has a high level of reliability, with a Cronbach's Alpha of 0.92 (Bangor et al., 2008). In addition, the SUS is reliable in studies with small sample sizes, including in samples as small as 5 participants (Sauro, 2013; Tullis & Stetson, 2004). The scale is also known as "technology agnostic" (Bangor et al., 2008, p. 574) meaning it can be used to evaluate technological products across multiple platforms. This is particularly relevant for the evaluation of the multiplatform videogame in the current research. A recent systematic review found that the SUS is the most frequently used standardised questionnaire in studies evaluating the usability of serious games (Yáñez-Gómez et al., 2017). Despite its reliability and popularity, none of the four computer-based videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012) identified in the literature review appear to have evaluated the videogame using the SUS.

For the current study, the SUS was given to participants in the posttest period. The SUS was a written, quantitative measure comprising 10 items. Minor changes were made to the wording of the SUS based on previous research. Firstly, the word 'system' was changed to 'game' in all 10 questions based on the product (Medicina videogame) being evaluated in the current study. This change is consistent with other research using the SUS (Bangor et al., 2008; Brooke, 2013). Secondly, previous research has identified that a significant portion of non-native English speakers in particular were not able to understand the word 'cumbersome' used in the original version of the scale. Therefore, consistent with the recommendations and practices of other researchers, the word 'cumbersome' was replaced by the word 'awkward' ('I found the game very awkward to use') (Bangor et al., 2008; Finstad, 2006). In addition, as per the SUS guidelines (Brooke, 2013), half of the questions were negatively worded. Each question was rated on a Likert Scale with five response options ranging from 'strongly disagree' to 'strongly agree'. The continuous variable had potential scores ranging from 0 to 100, with higher scores indicating higher levels of subjective usability.

4.5.7 Questionnaires

A pretest questionnaire (Appendix D) and posttest questionnaire (Appendix E) were prepared by the researcher and were designed using Qualtrics. Qualtrics is a web-based research tool used for building and distributing research surveys as well as collecting and analysing data. Qualtrics was chosen for use in the current study because it enabled electronic distribution and completion of the questionnaire anywhere, anytime via multiple methods, and was supported by Flinders University. For example, using Qualtrics the questionnaires were embedded in a website and were accessible via both desktop and mobile devices. It also permitted both written and audio questions, which was vital for the word recognition test in which the participants were given an audio-based question and answered via written responses. In addition, the questionnaires can be built to enable a variety of response formats including single-item or multiple-item responses, Likert scales, and open-ended text boxes of multiple sizes. Furthermore, it was easily accessible and available through a Flinders University licence, and enabled the production of well-designed, professional surveys with Flinders University's branding. The researcher was also able to view the completed questionnaires online and export data to data analysis software such as SPSS. Thus, participants completed the pretest and posttest questionnaires via Qualtrics forms which were embedded in the Research Management System website.

4.5.8 Gamelogs

In addition to questionnaire-based data, the present study also incorporated gamelogs as a novel and vital method of data collection. The term 'gamelog' refers to the capturing and extracting of quantitative game data about player information, player game usage behaviours, and interactions with the game and its assets. Gamelogs were included to track participants' real-life, in-game behaviour in ways not readily possible using traditional research methods. For example, gamelogs may have benefits over traditional methods (such as participant-completed questionnaires), where accuracy of retrospective memory recall, social desirability bias, and participant fatigue may be concerns (D'Mello, 2021; Hartevelt & Drachen, 2015). The aim of the gamelogs was to provide

information about game usage by participants, for the purpose of discussion, and to explore potential associations between gamelogs and other measures.

Comprehensive gamelogs were designed and programmed by the researcher for use in this study. During gameplay, information from the actions, preferences, choices, timing, interactions with assets, and behaviour patterns of the player were logged against the user data (e.g., username) for the player. These data were then recorded/stored in the game database within the Research Management System. For example, an event may include user ID information (identifying the participant that records the event), a timestamp (recording the date/time the event occurred) as well as the event itself (such as playing a specific difficulty level). Data collected included scores (e.g., first score, highest score, total accumulated score), playing time (e.g., first time duration, highest time duration, total time played), number of sessions/times players accessed the game, avatar use, platform use, and difficulty level use (e.g., number of times participants played each difficulty level, first time played each difficulty). Overall, over 40 types of game behaviours and interactions were measured for each participant via the gamelogs. The gamelogs were developed using a combination of C# and PHP scripting language with the back-end stored in an SQL database. Gamelogs were initialised and continually updated while the participant was interacting with the game. This was achieved because of the interconnectivity between the game and the back-end system developed by the researcher. Gamelogs were collected during the entire trial period, with those relating specifically to gameplay produced during the intervention period.

A significant novel aspect of the study came from the incorporation of gamelog technology. Understanding who is playing a game and how they are playing it is of critical value for both the design/development and evaluation of CALL videogames. Arguably, the more researchers can know and understand about players' behaviours and preferences, the better they can design CALL videogames that are both engaging and enjoyable as well as being effective in improving language skills. Research about the nature and diversity of player behaviour and game experiences is still in its early stages and evolving. However, it is undoubtedly complex and multidimensional. Whilst

comprehensive gamelogs have not been traditionally used in the past, even within the field of CALL, they will become increasingly essential due to fact they are able to provide far greater and far more valuable insight with far more information from users' game experience than other previous methods - especially those that have typically relied on subjective recall. The information may therefore include aspects not previously considered or foreseen which can help lead to greater ability to understand the exact data points that intrinsically exist within the context of that videogame.

As discussed in the literature review, there have been some published studies of CALL videogames that explored gameplay behaviours such as frequency of gameplay without evaluating the tool's effectiveness (e.g., Pham et al., 2018). More commonly previous studies evaluated the effectiveness of CALL games but did not use gamelogs to explore game usage in detail (e.g., Thongsri et al., 2019). At the time of developing the research, this appeared to be the first study to examine both the impact of the game on linguistic skills as well as behavioural measures of participant gameplay usage in the one study and being able to link the data with other measures in the same sample through the use of comprehensive gamelogs. Thus, gamelogs may potentially derive important knowledge that impacts our understanding of videogame usage by international nursing students and factors affecting improvement of language skills after playing CALL videogames. If researchers can gain a better understanding of behaviour around gameplay, such knowledge can change the way CALL videogames are developed in the future broadly and make changes that improve future iterations of the Medicina videogame specifically. If it is better understood how users play CALL videogames (such as their engagement patterns, platform use, avatar use, difficulty level use, playtime length, etc), researchers can use this information to make improvements to CALL to lead to better language skills in the future.

Gamelog data are a direct rather than self-report measure of behaviour. It is an objective measure, rather than subjective, which uses real-time data captured at the time, instead of relying on delayed recall by participants themselves. There are several potential benefits of using gamelog data

in CALL research over other more traditional measures, such as self-report by participants via questionnaires. For example, technology-based direct measures like gamelog data may reduce or avoid the impact of recall bias and social desirability bias and may reduce participant fatigue (D’Mello, 2021; Harteveld & Drachen, 2015). In addition, while the logs are created continuously and automatically, the process also occurs unobtrusively in that players are not interrupted or aware of the data being recorded while they are playing. In doing so, the method does not interrupt game flow and reduces the impact of testing effects, where participants may change their behaviour as a consequence of knowing it is being measured (e.g., if they know avatar selection is being measured, participants may change their behaviour around avatar selection in response). Gamelogs require substantial effort, time, and specialised knowledge by the researcher to prepare and code. Hence, this difficulty and complexity may be a notable disadvantage initially to the use of gamelogs in research. However, once gamelogs have been set up, they do not require a lot of ongoing time and resources by the researcher (or participants). Instead, the gamelogs are recorded automatically and updated dynamically as the event occurs. In summary, the quantity and depth of information that can be obtained from gamelogs make it especially useful as a potential method of data collection in CALL research.

4.5.9 Research Management System

The procedures during the data collection phase of this study were conducted via a dedicated, custom-made website named the ‘Research Management System’. The Research Management System was designed and developed by the researcher. The system included a login page, pretest and posttest survey pages, game page (for playing and downloading the Medicina videogame), and a comprehensive back-end system. Participants logged into the website using the same login username and password provided for the study.

4.5.9.1 Research Management System Aims

The purpose of the Research Management System was to provide one central, easily accessible electronic location for all aspects of the study. This study contained multiple materials to be

accessed at different points over the three phases of the trial (pretest period, intervention period, and posttest period). Using the website, the pretest survey, WebGL game play, Android game download, and posttest survey were all accessed and completed in one place. This simplified and centralised the process for both the participants and researchers. It aimed to provide a platform that was safe, secure, and easy for participants to use.

In addition, the website helped to control the sequence of events in the study. Using the controlled game access via login and the back-end system, it was possible to ensure that participants completed tasks in the required order before accessing later tasks. The back-end system also assisted with the development and storage of the gamelogs. Furthermore, the study involved participants from multiple Australian universities and the procedures were to be completed remotely online. Thus, the website provided a location that could be accessed by participants from all learning institutions at any time and from anywhere.

4.5.9.2 Research Management System Design Background

In order to design, develop, and build the Research Management System for this study, the rationale, aims, research questions, and methodology were first reviewed. The study materials were numerous, diverse, and needed to be accessible via different platforms (desktop/laptop and mobile devices). Data collection methods included multiple written questionnaires (with visual and auditory components), playing of the game (accessed via multiple platforms), and comprehensive gamelogs. Therefore, to address the unique needs of the study and data collection methods, a Research Management System needed to be developed by the researcher.

4.5.9.3 Design Phases

The design and development of the Research Management System involved multiple phases. In the first 'preliminary' phase, the researcher and supervisory team were involved in preliminary discussions about the design of the Research Management System. The focus included developing the website in line with the data collection methods, research aims, key considerations, and project

constraints (such as time frame, finances, and access to resources). Literature searches were conducted to identify existing systems used in previous research and their features.

The second phase was the iterative design phase which involved the planning of specific technical components and website features and develop the system. This phase involved considerable time, effort, research, and testing by the researcher to identify and build the options that worked best for the study. For each component or feature, multiple options were researched, investigated, and attempted during this phase until the most suitable option was selected. This process was essential to ensure that this system met the standards and requirements necessary to work well for the study and support data collection. This phase also involved the main building and construction of the Research Management System. At its core, the building process involved lengthy amounts of complex coding using multiple coding languages; the designing, rendering, and placement of multiple graphical assets, buttons, text, and files; building of the website actions and interactions; attention to flow, control, and security issues; and the construction of the content and features in the Research Management System.

In the final phase, the Research Management System was finalised and deployed for use in the study. The front-end was accessed by the participants, while the back-end system (including gamelogs) was accessible only to the researcher (for the purposes of analysing the data).

4.5.9.4 Research Management System Design Considerations

To assist in the design and development of the Research Management System, a list of desired features or considerations was outlined by the research team. This list was not intended to be formal or prescriptive. Rather, it was prepared to provide some potential factors to take into consideration when making decisions about the design and development of the system. Design considerations include:

- Data collection: the system must enable access and completion of the methods of data collection employed in the study. This includes ability to complete written pretest and posttest surveys via Qualtrics, allowing players to download the Android version of the game, allowing

players to play the WebGL version of the game via the system, and enabling the collection of detailed gamelogs.

- Ease of use: the website should not require advanced technical skills for users to access or use. Beyond the game itself, plugins or additional desktop applications should not need to be downloaded to access the system.
- Website features: the system should contain some common features of websites familiar to users. For example, login/password, homepage, written content, assets, buttons, and links.
- Technological components: ability to use iframes, WebGL, back-end databases, and gamelog capabilities. For example, the system should enable the developer to design, build, continuously update, and store key back-end features and gamelogs.
- Hosting: permitting website development, maintenance, hosting, SSL certificates, QR codes and other core system features. The development, cost, and maintenance of hosting will all undertaken and paid for by researcher.
- Security and control: enable the developer to control access to the system and flow of users through the website to the correct trial phase at the correct stage in the correct order.
- Financial costs: users should not need to pay money to access the site. This includes paying a fee to download the game or having to purchase new devices/software to play the game (beyond their existing internet access and devices). On the development side, the researcher had no funding and used free or low-cost technologies where possible.
- Availability: the system should be available to students using a standard device (desktop, laptop, smartphone, or tablet), already owned by the student and using standard internet connectivity (e.g., home, mobile, public Wi-Fi, library, on campus etc). It should also be available to as many students as possible on as many devices as possible.
- Longevity: it is impossible to predict the future longevity of technology. However, where possible, the developer should select technology with popular/widespread usage and should avoid using technology for which cessation/closure is announced/imminent.

- Consistency: the features should be consistent between platforms (e.g., web, mobile).
- Reliability: the system should be reliable with a high level of uptime.

4.5.9.5 Research Management System Technological Components and Assets

One of the primary technological issues was the choice of website hosting provider. After careful review and consideration, AwardSpace was selected as the website hosting provider. AwardSpace is a well-known, popular, user-friendly, and secure hosting provider. Crucially, it has a high level of speed and reliability, with a 99.9% network uptime. It allows domain registration and SSL certificates. Furthermore, its technological capabilities include PHP, MySQL, app installers, and website building. Although AwardSpace has some free features, paid features were required for the current study. All plan costs, domain registration fees, and SSL certification fees were paid for by the researcher.

The website was custom-designed and built by the researcher in accordance with data collection methods and key design considerations. The gamelogs were coded in advance by the researcher and were triggered based on student interaction with website components and assets. Security could be divided into two key components. The first related to standard website security to protect data as well as all security issues related to student participation. The second security component required that the website design flowed from one trial phase (pretest, intervention, posttest) to the next. This helped ensure participants would be automatically taken to the correct page at the correct time. This system needed to be automatic.

Website assets included components created through HTML and JavaScript. Examples of assets and technological components include:

- Flinders University branding – official logos and branding were used by the researcher
- Buttons – chosen and implemented by the researcher
- Iframes – used to display pretest and posttest elements such as the survey run through

Qualtrics. As a result, Qualtrics-based pretest and posttest questionnaires were embedded in the website using iframes.

- Canvas – used to display the WebGL game in game section
- Android – participants downloaded the Android version via a button on game page.

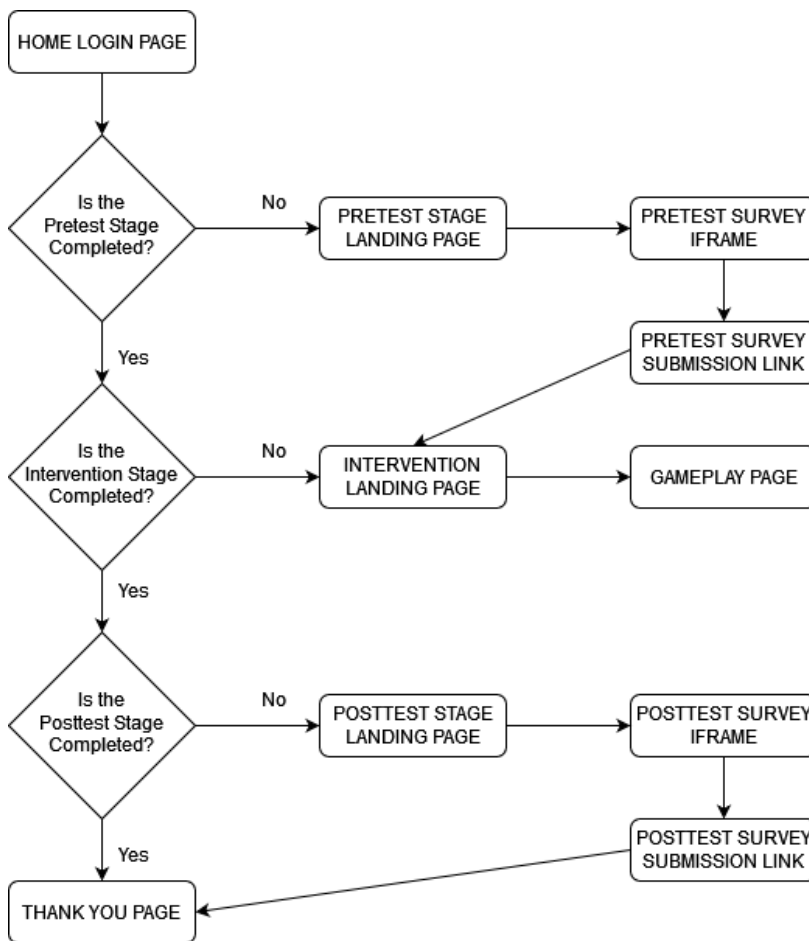
4.5.9.6 Screens and Flow

The system contained multiple screens and the flow of users through the screens was a vital aspect of the system. The first screen participants interacted with was the home screen, which enabled users to login to the system. After login was completed, the website back-end system through the SQL database was checked to determine the stage at which the student was at in the study. User credentials were matched to the participant's progress in the study. As such the website landing page after logging in would display the relevant information dependent on their current trial phase and completion of tasks. This information was used to guide the student to either continue the work they were currently working on or to tell the student to activate the next stage of the study.

Firstly, the students were directed to complete the pretest survey via the system. Secondly, the students were given access to the game page in the system which contained the WebGL and Android versions (download link) of the Medicina videogame. Once the participants began that two-week intervention period, the Research Management System allowed the student to continue to have access to the game if the student was playing the game through the website itself. Once the intervention period had ended, the participant was no longer able to access the gameplay and was directed to the posttest questionnaire. Figure 9 shows the screens, decision points, and flow of users through the Research Management System.

Figure 9

Research Management System Screens, Decision Points, and Flow.



4.6 Sampling and Recruitment

The sample was recruited by sending emails to international nursing students via the email lists at Australian universities and higher educational institutions which agreed to be involved. To protect the privacy of participants, the initial recruitment emails were sent via administrative staff at the university. The emails contained the recruitment flyer (Appendix F), letter of introduction (Appendix G), participant information sheet (Appendix H), and consent form (Appendix I). The emails asked international nursing students interested in the study to email the researcher if they wanted to participate. Interested students who contacted the researcher were then provided with the website address for the study and a unique login username and password.

The sampling and recruitment process of the study was significantly affected by the COVID-19 pandemic. After years planning the research, participant recruitment for the study commenced in

early 2020 at the same time the global COVID-19 outbreak began. The virus and resulting government, community, and educational institutional responses caused sudden, catastrophic changes which especially affected the target sample of international students. In response to the virus, federal and state governments in Australia enacted immediate strict border restrictions (Campbell & Vines, 2021). Most notably, on 20 March 2020, the Australian Government closed Australia's borders to all non-citizens and non-residents (Campbell & Vines, 2021). This meant that only Australian citizens and Australian residents could travel to Australia (Campbell & Vines, 2021). As well as federal-based border closures, individual state governments in Australia also enacted strict border closures affecting travel internationally and nationally between states (Storen & Corrigan, 2020). Consequently, international student arrivals in Australia came to an immediate and virtually complete halt. The decline occurred not just locally at Flinders University but state-wide and nationally, and affected all disciplines including nursing.

Analysis of official monthly migration datasets from the Australian Bureau of Statistics (2023) provides evidence of the severe, catastrophic impact of COVID on international student arrivals. In July 2020, just 30 international students arrived in Australia nationally, across all educational types (tertiary, secondary, etc), all states, and all disciplines (Australian Bureau of Statistics, 2023). This is a significant decrease from the 143,850 international students who arrived in the same month the year prior (July 2019), before the pandemic began. This represents a 99.98% reduction in international student arrivals Australia-wide. Similarly, in the six-month period from April 2020 to September 2020, only 140 international students studying at higher education institutions arrived in Australia, compared with 230,780 in the same period in 2019 (more than a 99.9% decrease). The reduction in international student arrivals in Australia due to the pandemic was neither small nor short-lived. In the 18 months from April 2020 to September 2021, a decrease of 99% or more occurred each month compared with pre-COVID levels and the mean monthly decrease in international student arrivals in Australia over this period was 99.6% (Australian Bureau of Statistics, 2023). These figures include all educational types across all states. However, certain

states and sectors were even more severely affected. For example, the data indicates that not a single international student studying an 'English Language Intensive Course for Overseas Students' (ELICOS) arrived in Australia in the one year from April 2020 to 2021 (Australian Bureau of Statistics, 2023). In addition, in South Australia (where the researcher was based), only 60 international students arrived in the 12 months from April 2020 to 2021 (Australian Bureau of Statistics, 2023). This is a reduction of 99.9% of international students arriving compared with before the pandemic in South Australia. Moreover, it is important to note that this figure of 60 international students in one year incorporates all academic institution types and all courses of study in the state. The precise number studying nursing education specifically is not provided in the official data. However, given the low total number overall, the number of international nursing students who arrived in South Australia is arguably likely to be very few students to none. Hence, official data from the Australian Bureau of Statistics (2023) illustrates the significant and lengthy decimation of international student arrivals in Australia as a result of the COVID-19 pandemic.

In response to the pandemic, educational institutions rapidly cancelled many existing support programmes for international students, reduced on campus activities, changed course delivery methods (to online and offshore) and introduced new regulations for research projects (Martin, 2020; Owens et al., 2022; Wells Advisory, 2021). Furthermore, the limited students who were present (typically second- or third-year students) may have been adversely affected by the pandemic, under more pressures, and less able to be involved in research. Substantial, progressive changes needed be made to the data collection and recruitment procedures as a result in response to the global pandemic and its impact on the sample population. These changes had a direct, significant impact on the research including study design, materials, recruitment procedures, delaying and prolonging data collection, and reducing sample size.

The initial plan for the study involved recruiting participants from a voluntary specialised professional language development programme designed to improve language skills among international nursing students at Flinders University. The programme was run by the principal

supervisor of this project. The focus of the support programme included international nursing students who wished to improve their language skills (especially nursing-specific medical terminology). As part of sampling, it was anticipated that participants may be lent mobile devices (e.g., tablets) with the game pre-installed. It was also anticipated that recruitment may be assisted by face to face discussion about the study by the teacher/researcher, as such methods of recruitment are generally considered more effective than email from unknown persons alone (Steinmetz et al., 2020). However, in response to the pandemic and departmental restructuring, this support programme was suddenly and unexpectedly ceased by the university just before data collection was set to begin. Consequently, this recruitment source was no longer available, and new methods of recruitment were needed.

The second plan involved expanding recruitment to all international nursing students within the College of Nursing and Health Sciences at Flinders University more broadly via email. This incorporated students from all years, skill levels, and degree types. Subsequently, recruitment was expanded to international nursing students enrolled in non-degree nursing pathway programmes, ELICOS, and offshore delivery at Flinders University. Unfortunately, no ELICOS students arrived nationally during the key pandemic periods in 2020 to 2021 (Australian Bureau of Statistics, 2023) and many institutions closed completely as a result.

The fourth attempt involved expanding recruitment to international nursing students studying at external universities in South Australia and nation-wide across Australia. This was followed by a fifth plan expanding recruitment to all ELICOS, Technical and Further Education (TAFE), and university colleges nationally that had a nursing-focused course (such as Bachelor, diploma, or certificate courses). Approval to recruit externally was granted from the Flinders University research ethics committee (SBREC). External institutions were contacted individually via email. Information was provided about the study and organisational permission was sought for the institution to distribute the recruitment flyers/materials to students. Every external university and tertiary institution in Australia meeting the criteria was contacted. The response from external

sources was overall positive and encouraging. The external institutions who explicitly declined provided reasons including that were no or few international nursing students enrolled, stretched resources due to budget pressures and programme changes/closures due to COVID, and increased fatigue/stress on international students due to the pandemic. A summary of the expanding internal (at Flinders University) and external recruitment methods is available in Table 2 and a summary of the multicentre site recruitment is outlined in Table A1 (Appendix A).

Table 2

Summary of Recruitment Methods

Step	Location	Course Type	Contact
1.	Internal	Specialised professional language development programme. Focus on first-year Bachelor students with interest in improving language skills	In person or email
2.	Internal	College-wide, undergraduate and postgraduate courses	Email
3.	Internal	Nursing-related pathway courses, ELICOS, or offshore courses	Email
4.	External	All Australian universities with a Bachelor of Nursing programme	Email
5.	External	All Australian ELICOS, TAFE, and university colleges (public or private) with nursing-related programmes (Bachelor, non-Bachelor)	Email

In total 48 external tertiary institutions in Australia were contacted for involvement in the study (see Table A1 in Appendix A). The final number of Australian universities agreeing to be involved in the multicentre trial was 12 universities with a Bachelor of Nursing programme, encompassing one Australian territory and all six states in Australia. It is important to clarify that in addition to the 12 universities who agreed to be involved, three TAFE/ELICOS institutions also agreed to be involved in the study (see Appendix A). However, the course types offered by the three TAFE/ELICOS institutions differed from the university centres (e.g., Diploma rather than Bachelor of Nursing), and no participants were ultimately recruited from these centres. Therefore, the three TAFE/ELICOS sites were not included in data analyses and were excluded from the total number of multicentre trial sites involved. Consequently, the final number of sites involved in this multicentre study was 12 Australian universities.

Further changes to recruitment were explored. This included expanding recruitment internationally or use of financial incentives. However, it was considered such changes would be unlikely to result in major increase in participants and may introduce threats to validity (such as due to accent differences and variations in medication names across different countries). Hence, these ideas were deemed not feasible after consultation with the supervisory team. The time devoted to recruitment was also significantly lengthened. However, the pandemic was prolonged and continuing with no clear end date in sight. Thus, due to time constraints of PhD candidature, further extension of the data collection period to seek additional participants was not possible.

In addition to expanding sampling population and sources, changes were also made to key documents in an effort to improve recruitment. For example, recruitment materials such as the letter of introduction and participant information sheet were modified. A new colourful and graphical recruitment flyer suitable for electronic distribution and incorporating a QR code was also designed. These changes were made to address the benefits and use of the videogame given the pandemic context and given the changes to include students from external educational institutions. It also addressed how students could participate as the study was conducted fully online, including when studying off-campus, by distance, or offshore. Ethical approval for these changes was obtained.

Furthermore, a part of the changes to sampling involved re-examining the data collection methods to see if any changes could be made to potentially improve recruitment. As a result, some study materials were changed to reduce the time involved for participants. These changes included the redesigning of the pretest and posttest questionnaires resulting in a reduction in length. The aim of these changes was to increase participant numbers and to reduce fatigue.

In summary, the COVID-19 pandemic had significant direct effects on the study resulting in sudden, unexpected, catastrophic impact to the study's population, recruitment and sampling, and data collection more broadly. Multiple changes were investigated and implemented to help mitigate the effect of COVID on the study.

4.7 Ethical Considerations

4.7.1 Ethics Approval

Ethical approval for the research was sought and granted from the Flinders University Social and Behavioural Research Ethics Committee (SBREC) (Appendix J). The ethics approval number was SBREC 6275, the project title was ‘The scope and speed of language learning using computer games’, and the chief investigator was Associate Professor Amanda Müller (the researcher’s principal supervisor). The application contained relevant documents including the recruitment flyer (Appendix F), letter of introduction (Appendix G), participant information sheet (Appendix H), consent form (Appendix I), and questionnaires (Appendices D and E). The ethics application included permission to obtain data by both the written questionnaires and gamelog data about game usage while playing the game. Multiple ethical modification applications were submitted and approved as changes were required, especially in response to challenges related to the COVID-19 pandemic.

The approval granted from the ethics committee included permission to recruit students from external Australian higher education institutions. In addition to approval from the SBREC, organisational approval was also granted by the Deputy Vice Chancellor (Students) at Flinders University for permission to recruit students from the university. Similarly, organisational approval was sought and granted within the College of Nursing and Health Sciences at Flinders University for contacting of nursing students within the college. As ethical approval had been granted by the Flinders University SBREC, approval was not required from each external institution’s individual ethics committees in line with reciprocal recognition of ethical approval processes in place. However, for external higher educational institutions, organisational approval was sought and obtained from the external institutions in accordance with their individual processes prior to recruitment.

4.7.2 Voluntary Consent

Participation in the research was voluntary. All participants were required to give written consent for participation in this study. To obtain voluntary consent, the researcher provided the letter of introduction (Appendix G), participant information sheet (Appendix H), and consent form (Appendix I). The consent form included affirmations that the individual had been provided with information about the study and freely consented to participate. Participants indicated willingness to be involved by contacting the researcher asking to join the study, signing the consent form, and completing the questionnaires. All participants completed the consent requirements and did so electronically. No paper copies were created. The electronic records were stored as per agreed university protocols. As part of voluntary consent, participants had the right to withdraw from the study at any stage or decline to answer questions at any time. No explanation was needed to decline/withdraw and enacting these rights would not result in negative repercussions to the participants. The right to withdraw was clearly communicated to participants in both the participant information sheet (Appendix H) and consent form (Appendix I).

4.7.3 Confidentiality and Anonymity

Participation in the study was anonymous and confidential. Participants did not provide sensitive information such as their name, address, contact details, or educational institution during completion of the questionnaire. Only limited personal details such as gender, age, language background, educational background was collected, but were analysed and reported in aggregate form across the study cohort. As some participants may have been the only students from their educational institution, data analyses were not reported based on location.

The questionnaires were completed using an anonymous participant identification number and login (outlined in section 3.5.4 in chapter 3) which was necessary in order to connect the data across the three trial phases for analyses. A document with participants' email addresses was used only for the purpose of assigning the identification number after recruitment, but was password-protected, only accessible by the researcher, and kept separately from all data. The participants'

responses to the questionnaire were non-identifiable data and no specific individual could be identified from the questionnaires or gamelog data. All data was stored, analysed, and reported in anonymous de-identified form.

Anonymity was further maintained via the one-to-one nature of the data collection. No individual's name or identity was reported in any publication arising out of the research or in this dissertation. Confidentiality was protected at all times with no discussion of the individual participants with other people. To protect participant confidentiality and anonymity, pseudonyms (such as 'P1', 'P2'...) were assigned and were used when providing quotations from participants in this study as part of the dissertation. Participants were informed about the anonymity and confidentiality of the study via the participant information sheet (Appendix H), and consent form (Appendix I) prior to participation.

4.7.4 Data Security

Within the National Health and Medical Research Council (NHMRC, 2019) 'Management of Data and Information in Research' guidelines, Section 3 outlines the responsibilities of the researcher in the management of data and information within a research project as part of the Australian Code for the Responsible Conduct of Research. These guidelines (NHMRC, 2019) outline the importance of the development of a data management plan and include the incorporation of physical aspects of network security. The researcher incorporated the guidelines relating to the development and maintenance of the research materials, research management system, and overall data collection. As such, the researcher considered the needs and requirements of both the short, medium, and long-term considerations that may exist with regard to the research management system. This included the maintenance of the webserver and website itself, as well as the physical storage of research data.

In accordance with the NHMRC (2019) code, the data were recorded in anonymous, de-identified form with data to be secure, accurate, accessible, and retained. Information about participant name, home address, or other sensitive or identifiable information was not obtained as part of the data collection. The authentication protocols used in the study meant that participant

login to the questionnaire and videogame involved unofficial, study-specific logins rather than the official university wide system (such as the Flinders Authentication Name). This was important for ethical reasons and allowed participants to answer questions and play the videogame in a way that was anonymous, de-identified, and fully separated from their university work. The data are accessed, stored, and backed-up by the single researcher only using password-protected storage means. For example, this procedure included password-protected documents on a password-protected personal university laptop, password-secured access to the SQL database, and university-based software via Okta (such as Qualtrics) secured with Multi-Factor Authentication (MFA). The data are being retained for a minimum of five years post-publication in accordance with the NHMRC (2019) guidelines.

4.7.5 Specific Risks or Benefits to Participants

There were no known specific risks to participants in this study. There was no financial cost to the participants for their participation in the study. Students did not receive extra credit. No monetary benefits or financial incentives were provided. However, individuals who volunteered to participate in this research study may have experienced improvement in their English language skills and improved familiarity with medication names.

4.8 Data Collection Phases

The data collection portion of the study had three phases: pretest period, intervention period, and posttest period.

4.8.1 Phase One: Pretest Period

In the first phase, the demographics questionnaire, word recognition test, and psychological measures questionnaire were administered to all participants in the pretest survey. Written voluntary consent was obtained at the start of the pretest questionnaire. The pretest survey was completed online via a Qualtrics form embedded in the Research Management System website and took approximately 10 minutes to complete.

4.8.2 Phase Two: Intervention Period

In the second phase, participants played Medicina over a two-week intervention period. As with the written questionnaires, the Medicina videogame was accessed initially via the website (Research Management System). Participants were free to play the game using either the WebGL version (using desktop or laptop device), or the Android version (via download to their mobile devices), or both platforms, as many times as they chose. Gamelogs were created during this phase. Participants continued to attend classes as normal. The time commitment varied in this period depending on the amount of time the participant chose to play the game but was estimated at up to three hours.

4.8.3 Phase Three: Posttest Period

In the final phase, the word recognition test, psychological measures questionnaire, game feedback questionnaire, and System Usability Scale were administered to all participants in the posttest survey. The posttest survey was completed online via a Qualtrics form embedded in the Research Management System website and took approximately 15 minutes to complete.

4.9 Data Analysis

4.9.1 Quantitative Data Analysis

Quantitative data were sourced from all three phases of the trial period. This includes data from the questionnaires in the pretest and posttest periods, as well as gamelog data from the gameplay intervention period. The data was first compiled in Qualtrics (for the survey data) and the Research Management System website back-end (for the gamelog data) before being converted into files for transfer into SPSS. The data were then directly transferred into SPSS (IBM corporation, for Windows).

Firstly, the multiple SPSS files (created by the different data points) were merged into one single SPSS file for analysis. Next, the data were checked to ensure no errors had occurred during the compilation and transfer of files. A significant amount of further configuration of data was performed by the researcher within SPSS to facilitate analysis including recoding of variables and computing of new variables (such as total scale scores). The data were checked and cleaned for

missing data, outliers, and normality. Descriptive statistical analyses were conducted including frequency distributions and measures of central tendency to describe the data. Inferential statistical analyses including paired samples t-tests and Wilcoxon Signed Rank tests were performed to explore statistical significance of relationships between variables and changes over the trial period.

4.9.2 Qualitative Data Analysis

The study contained a small number of qualitative questions in the feedback section of the posttest questionnaire. These were open-ended questions designed to elicit further information about participants' feelings and opinions about the game. Analysis and reporting of the qualitative data were performed using thematic analysis (Braun & Clarke, 2006).

Numerous qualitative methodologies exist within the broad spectrum of thematic analysis. Some approaches are highly specific methodologies (e.g., Gale et al., 2013; Vears & Gillam, 2022), while others are more flexible (Braun & Clarke, 2006; Clarke & Braun, 2013). For example, two specific-type methodologies are Inductive Content Analysis (ICA) (Vears & Gillam, 2022) and the Framework Method (Gale et al., 2013). The specific theoretical positions and comprehensive procedures involved in the ICA and Framework methods as a qualitative analysis methodology have been examined in detail by proponents of these methods of thematic analysis (e.g., Gale et al., 2013; Vears & Gillam, 2022).

However, arguably one of the most well-known methods of thematic analysis is the model outlined by Braun and Clarke (2006). Clarke and Braun (2013, p. 120) consider thematic analysis to be “a method for identifying and analysing patterns in qualitative data”. In contrast to the specific methodologies such as ICA and the Framework Method, Clarke & Braun (2013) argue that thematic analysis is considered a flexible analytical method rather than a complete methodology. Indeed, one of the key qualities and advantages of the thematic analysis method described by Clarke and Braun (2013) is its flexibility. The authors note that a flexible method of thematic analysis is beneficial because “the search for, and examination of, patterning across language does not require adherence to any particular theory of language, or explanatory meaning framework for human beings,

experiences or practices” (Clarke & Braun, 2013, p. 120). As a result of this flexibility, the data analysis procedures can be applied to a diverse range of contexts, experiences, theoretical frameworks, and research.

Overall, the diverse range of thematic analysis methods have similarities and differences, and the most suitable choice of method depends on the needs of the particular research. The current study involved the first evaluation of the novel Medicina multiplatform CALL videogame. Given the lack of previous literature and the paucity of published studies in this field more broadly, there was an exploratory component of the research. A nuanced understanding of the issue was sought that might provide further insights and depth of understanding. It was not known definitively in advance what specific themes would be raised in the qualitative feedback questionnaire. Thus, exploring, illustrating, enhancing, and clarifying findings and providing new insights were considered key considerations in the selection of qualitative data analysis method. Taking the research aims, research questions, and exploratory nature of the study into consideration, the decision was made to use the method of thematic analysis outlined by Braun and Clarke (2006).

The proponents of the different methods provide an examination of thematic analysis from different perspectives. However, despite these differences, at its core, thematic analysis is a well-defined form of qualitative analysis with similar characteristics no matter which specific model of thematic analysis is being employed. This similarity is most clearly seen in relation to the phases incorporated into thematic analysis. In particular, a significant feature of thematic analysis methods is the use of phases or steps.

According to (Braun & Clarke, 2006) thematic analysis can be broadly broken down in six phases. These six phases are: 1) familiarisation, 2) coding, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) writing up (Braun & Clarke, 2006). These steps of thematic analysis enables data obtained through qualitative methodology to be properly reviewed, analysed, and reported on in a way that helps to ensure that all data is acknowledged. In this method, a theme “captures something important about the data in relation to the research question,

and represents some level of patterned response or meaning within the data set” (Braun & Clarke, 2006, p. 82). There is no right or wrong method, or required prevalence, for determining what constitutes a theme using this method (Braun & Clarke, 2006).

Accordingly, the present study followed Braun and Clarke’s (2006) six phases of thematic analysis in order to analyse the qualitative data. The researcher spent a substantial period of time reading the responses to become familiar with the data, with the research questions kept in mind. A list of common themes was developed. The themes identified are examined in detail in the result and discussion chapters (chapters five and six). The overarching or broad categories/themes identified were used to substantiate or reinforce the study’s findings. In addition to exploring the themes that reverberated through the six steps, the presentation of the themes were support by direct quotes made by participants to illustrate the key themes and give a voice to participant perceptions of the Medicina multiplatform CALL videogame.

4.10 Chapter 4 Conclusion

This chapter outlined the methodology and methods used in this study. In particular, the chapter described the study’s design, participants, sampling, materials, data collection phases, ethical considerations, and data analysis procedures. Each of the materials used in the study were described, including the demographics questions, word recognition test, MSLQ psychological measures questionnaire, game feedback questionnaire, SUS, gamelogs, and Research Management System. In addition, methodological challenges encountered due to the COVID-19 pandemic were discussed. In particular, the impact of COVID-related changes in terms of sampling and recruitment methods were examined as well as the revised procedures which were implemented in response to these effects.

The next chapter (Chapter 5) focuses on the findings of the study. Firstly, the chapter presents the demographics of the participants and the characteristics of the sample. Secondly, the chapter discusses the results in relation to the research questions in this study.

CHAPTER 5 RESULTS

5.1 Chapter Introduction

The previous chapter (Chapter 4) described in detail the method used in the current study. In particular, the study's design, participants, sampling, materials, data collection phases, ethical considerations, and data analysis were examined. The fifth chapter presents the results of the study. Firstly, the chapter provides important information about the demographics of the participants and the characteristics of the sample. Secondly, the chapter presents the results in relation to each of the research questions in this study. These five research questions investigate language skills (including phonological awareness), psychological factors, game usage patterns, game usability, and general perceptions/feedback. It is important to note, however, that this chapter will focus only on presenting the results. Detailed discussion and an analysis of the meaning of the results, and comparison with the findings of other studies will not be provided in the current chapter, but rather will be examined in chapter 6 separately.

5.2 Data Preparation

5.2.1 *Missing Data*

Prior to data analyses, data checking and preparation was conducted via visual inspection and statistical procedures in SPSS. The results of these checks detected missing data across multiple variables and participants. Subsequently, the affected cases were examined individually. The majority of the missing data were limited to non-core demographic information rather than data important for the primary research questions in the study. Factors taken into consideration when exploring responses to the missing data included the small quantity and nature of the missing data, the apparent legitimacy of the missing values, the type of statistical tests to be conducted using the variables and the potential impact of substitution methods. Based on these factors, it was not considered appropriate to assign a value to the missing data or substitute the information with mean or median values for those variables. Hence, a decision was made to retain the missing data in the sample.

5.2.2 Outliers and Extreme Outliers

Further data checking and cleaning procedures were conducted to check for outlier and extreme outlier cases. The results of these checks detected outliers in two core variables: the MSLQ pretest total sum variable and the MSLQ posttest self-efficacy subscale variable. It is important to note that although there were three outlier cases detected in these two variables, the outliers found were not extreme outliers. Subsequently, the affected cases were examined individually to check if the outliers may potentially be the result of measurement errors or data entry errors. However, the values appeared to be entered correctly and were within potential ranges for those variables. After examination of the outliers, it was considered that the values appeared to be legitimate values and likely natural variation within the sample. In addition, consideration was given to the type of inferential tests to be conducted using these variables. In both cases, the variables would be tested using non-parametric tests. Nonparametric hypothesis tests are generally considered to be fairly robust to outliers, such that outliers will not necessarily violate their assumptions or distort results to the same degree as may occur in parametric tests. Taking into consideration the nature of the outliers (predominately not extreme outliers), the apparent legitimacy of the values (not errors and reflecting natural variation), and the use of non-parametric statistical analyses, a decision was made to retain the outliers in the sample.

5.3 Sample Population Demographics

An important aspect of research is to correctly identify the sample of interest (e.g., international nursing students), and a study's sample will ideally include individuals who reflect the intended population in terms of the core characteristics (Ponto, 2015). With this goal in mind, the current study not only included standard demographic questions such as age and gender, but also incorporated specific information relevant for the current sample such as cultural and linguistic diversity, educational history, and prior videogame experience. Hence, this section will present data regarding the characteristics of the sample.

In total 32 international nursing students participated in the study. As discussed in section 4.5.2 in chapter 4, participants completed a pretest survey that asked for general demographic information. To respect the anonymity and confidentiality of participants, participants were not asked information about their specific university or location (such as state), and details regarding the geographical location of students is not presented. Summaries of the data for participant demographic characteristics are shown in Table 3 and Table 4.

Table 3

Summary of Core Demographic Data

Item	Mean/Median/Mode	Response	N	%
Age	Mean 27.2	18-30	21	66%
	Median 25	31-57	10	34%
Gender		Female	25	78%
		Male	7	22%
		Other	0	0%
		Prefer not to say	0	0%
Country of Origin		China	10	31.3%
		South Korea	4	12.5%
		India	3	9.4%
		Nepal	3	9.4%
		Taiwan	2	6.3%
		Vietnam	2	6.3%
		Cameroon	1	3.1%
		Chile	1	3.1%
		Iran	1	3.1%
		Malaysia	1	3.1%
		Myanmar	1	3.1%
	Philippines	1	3.1%	
	Sri Lanka	1	3.1%	

Language Spoken	Chinese	6	18.8%	
	Mandarin	5	15.6%	
	Korean	4	12.5%	
	Hindi	3	9.4%	
	Nepalese/Nepali	3	9.4%	
	English	2	6.3%	
	Vietnamese	2	6.3%	
	Burmese	1	3.1%	
	French	1	3.1%	
	Mandarin and Cantonese	1	3.1%	
	Persian	1	3.1%	
	Sinhalese	1	3.1%	
	Tagalog	1	3.1%	
Time Spent in Australia	Mean 4 Years	0-4 Years	25	78%
	Median 3 Years	5-35 Years	7	22%
	Mode 3 Years			
Course Year Level	First year	7	21.9%	
	Second year	15	46.9%	
	Third year	10	31.3%	

Table 4

Summary of Demographic Data for Videogame Playing History

Item	Response	n	%
Number of Gaming Hours Played Per Week	0-1 hour	20	62.5%
	1-4 hours	7	21.9%
	5-9 hours	3	9.4%
	10-19 hours	1	3.1%
	20+ hours	1	3.1%
Type of Videogame Device Used	Mobile device	26	81.3%
	Desktop, laptop	12	37.5%
	Handheld device	1	3.1%

	Console device	0	0%
	None of the above	4	12.5%
Type of Videogame Player	Newbie/novice	12	37.5%
	Casual	20	62.5%
	Core/intermediate	0	0%
	Hardcore/expert	0	0%

5.3.1 Age

Information about each participant's age was obtained in the demographics section of the pretest questionnaire and measured on one occasion only. Participants were asked the question, "what is your age?" and responses were entered in a textbox. Data analysis revealed that the age of participants in the sample ranged from a minimum of 18 years old to a maximum of 57 years of age. Within this range, there was a wide variability of ages. There was a total of 17 different ages represented in the sample (number of unique ages). One participant elected not to answer this question. In terms of central tendency statistics, the mean age was 27.2 years and the median age was 25. The mode was split between five different ages which all had three responses. The majority of the sample was aged 18 to 30 years of age (inclusive), with a frequency of 21 participants or two-thirds (66%) of the sample being within this age bracket.

5.3.2 Gender

In the demographics section of the written pretest questionnaire, participants were asked about their gender. There were four possible response options – Male, Female, other, or prefer not to say. If selecting other, participants were directed to provide more information in a textbox to describe themselves. Results were split between two responses only – male and female. No participants chose to select the remaining two response options (other or prefer not to say) and all participants provided a response to the question. The results indicated most participants in the sample were female, totalling 25 participants (frequency) and representing a proportion of 78% of the sample. In contrast, just 7 participants (22%) were male.

5.3.3 Country of Origin

As the population of interest was international students, an important demographic characteristic of the sample was the participants' country of origin. Consistent with the other demographic questions, participants provided information about their country of origin in the pretest demographics questionnaire. This information was provided via a textbox format. One participant chose not to provide a response. Of the remaining 31 participants, descriptive statistical analysis indicated that participants were originally from a total of 13 different countries. The most common country among the sample was China. A frequency of 10 participants in total stated China was their country of origin, which represents a proportion of 31.3% of the sample. South Korea was the second most common country of origin, with a frequency of 4 participants (12.5% of the sample). Nepal and India were jointly the third most common countries of origin, with a frequency of 3 participants (9.4%) each. Other countries of origin represented in the sample were Vietnam, Taiwan, Cameroon, Chile, Iran, Malaysia, Myanmar, the Philippines, and Sri Lanka. Overall, the sample was quite diverse, and seven countries of origin were represented by only a single participant each.

5.3.4 Languages Spoken

Participants provided information about their language background in the pretest demographics questionnaire, with responses given via a textbox. One participant chose not to provide this information. Although most participants provided just one language in response to the language demographic question, participants were able to provide multiple languages in the textbox and one person provided more than one language when answering this question. Results indicated that participants' primary language background consisted of a total of 14 different languages. The most common language (representing 37.5% of the sample) consisted of either Mandarin, Cantonese, or just 'Chinese' (or a combination of multiple thereof), with a frequency of 12 participants stating this was their first language. Korean was the second most common language, spoken by 4 participants or 12.5% of the sample. Hindi and Nepalese/Nepali were the equal third most common languages mentioned, with a frequency of 3 participants and 9.4% proportion of participants each. Other

languages represented included Burmese, French, Persian, Sinhalese, Tagalog, and Vietnamese. Two participants stated their first language was English. It is important to note that while these participants reported English was their first language, these students were not born in Australia or in a country where English is the predominant language. They had also not lived in Australia their whole life – for example, one participant reported their length of stay in Australia as 13 months. Thus, although these participants reported a background that included English language, they were not excluded from the sample.

5.3.5 Time Spent in Australia

Another core demographic characteristic of the sample was the amount of time participants had spent in Australia prior to participating in the study. Participants provided information about the amount of time they had spent in Australia as part of the pretest demographics questionnaire. Responses were shared via a textbox. All participants provided a response for this question. Participants varied in how they presented this information. Some students gave the number of months, others listed the duration in years and a few participants even provided a brief written explanation for their answer. For the purposes of statistical analyses, the responses were converted into a numerical figure in years. Data analysis using descriptive statistics indicated that the time spent in Australia among participants in the sample ranged from a minimum of zero to a maximum of 35 years. There was a total of 14 different time durations represented in the sample (number of unique responses). In terms of central tendency, the mean duration was 4 years, the median duration was 3 years, and the mode was also 3 years. Most of the sample had spent 4 years or less in Australia, with 25 participants (a proportion of 78%) being within this timeframe. The most common duration among participants was 3 years, representing 22% of the sample. Only 3 participants had spent over 5 years in Australia. Although one participant stated they had spent 35 years in Australia, this was an extreme outlier which represented three times the duration of the next highest response. Note that two participants (representing a proportion of 6.3%) stated that they had spent no time in Australia at all and were studying offshore with an Australian university.

5.3.6 Course Type Studied

As part of the written pretest demographics questionnaire students were asked what type of nursing course they were studying. There were five possible response options: Certificate/Diploma, Bachelors, Honours, Masters, or other. If selecting 'other', participants were directed to provide more information in a textbox to self-describe the course in writing. Results indicated that all 25 participants who responded to this question stated that they were studying a Bachelor level nursing course.

Data was not available for this item for seven participants. The reason the data were missing is that the item was not included in the demographic questionnaire for the initial round of data collection where the sample was recruited from a specific programme within one university. However, due to COVID-19 pandemic and the difficulties the pandemic posed for the research, recruitment for the study was expanded to include participants from all nursing education courses at external tertiary education institutions nationally. As a result, a question about type of course studied was added to the demographics questionnaire which was provided to participants in the subsequent rounds of expanded data collection.

5.3.7 Course Year Level

In addition to course type, participants were asked what year level they were currently studying as part of the pretest demographics questionnaire. There were four possible response options: first year, second year, third year, and fourth year or higher. All participants provided a response to this question. Descriptive statistical analyses showed that participants stated that they were studying one of three different course years ranging from first year to third year. No students selected the 'fourth year or higher' option. The most common course year level among the sample was second year. A total of 15 participants were studying the second year of the Bachelor course, which represents nearly half (47%) of the sample. Third year was the second most common course year being studied by participants, with a frequency of 10 participants or 31.3% of the sample. First year was the least common educational course level of the three levels represented by the sample, with a frequency of

just 7 participants (22%). Therefore, the majority of the sample had been studying the course for two years or more, with over 78% of the sample studying at second or third year of the Bachelor of Nursing course.

5.3.8 Videogame History – Hours Per Week

To identify levels of previous experience and familiarity with videogames, participants answered a series of questions regarding videogame history and usage. In the pretest demographics questionnaire, participants were asked, “on average, how many hours per week do you spend playing videogames on any device?”. Participants could select from five possible options ranging from ‘less than one hour’ to ‘more than 20 hours’. Students were able to select one option only. Data analysis using descriptive statistics showed that all five of the response options were selected by at least one person. The most common videogame playing duration among the sample was ‘less than one hour’, which was the briefest duration among the response options. A total of 20 participants said they played videogames less than one hour per week, representing 62.5% of the sample. ‘One to four hours’ was the second most common playing duration among participants, with a frequency of 7 students or 22% of the sample. ‘Five to nine hours’ was the third most common time duration mentioned, consisting of 3 participants (representing 9.4% of the sample). Only one respondent each reported they played for higher duration options of ‘10 to 19 hours’ or ‘over 20 hours’. The overwhelming majority of the sample played for less than 4 hours per week, with 27 participants (84.4%) playing videogames for between zero and four hours per week.

5.3.9 Videogame History – Devices

The second aspect of videogame playing history obtained was the types of devices participants use when playing videogames. Participants were asked which devices they frequently used to play videogames and could select from five possible options: computer device (e.g., desktop, laptop), mobile device (e.g., Smartphone, tablet), console device (e.g., PlayStation, Xbox), handheld device (e.g., Gameboy, Nintendo DS), or ‘none of the above’. Participants were able to select multiple options from among the list of devices. Results reveal that 28 participants stated that they played

videogames using at least one device, representing 87.5% proportion of the sample. In contrast, just four participants stated that they used none of the devices – 12.5% of the study sample. The most popular videogame playing device among the sample was a mobile device such as a smartphone or tablet. In total, 26 people reported they frequently played videogames on mobile devices, which represents 81.3% (proportion) of the sample. A computer device (such as laptop or desktop computer) was the second most common videogame device used by participants, with a frequency of 12 participants (37.5% of the sample). Just one participant reported frequently using handheld videogame devices. However, the least common device used was consoles – which none of the participants reported using. Most participants provided just one device in response to the question. However, eight participants (25%) reported playing frequently using more than one device. In each of these eight cases, participants used both mobile and computing devices. Just one participant reported using three devices.

5.3.10 Videogame History – Player Type

In addition, participants provided information describing their videogame playing type in the pretest demographics questionnaire. To obtain this information, students were asked the question, “What type of videogame player do you consider yourself?”. There were four possible response options: ‘newbie/novice’, ‘casual’, ‘core/intermediate’ and ‘hardcore/expert’ (reflecting lowest to highest levels of experience types respectively). All participants provided a response to this item. Results indicated that all participants selected one of two videogame player types: newbie/novice or casual. No participants identified as either the core/intermediate or hardcore/expert player type. The most common videogame player type self-identified among the sample was ‘casual’, which was reported by 20 participants (62% of the sample). Newbie/novice was the second most common player type among participants, with a frequency of 12 participants and 38% of the sample. Thus, all participants in the sample considered themselves to be a causal gamer or less (casual or newbie).

5.3.11 Summary of Sample Characteristics

In summary, the current study contained a sample of 32 participants. The majority of participants were female (25 participants, 78%), with 7 male participants (22%). Ages of participants ranged from 18 to 57 years, with a mean of 27 years of age (median 25 years). Participants were international students representing 13 different countries of origin, with the most common country of origin being China (31%), followed by South Korea (13%), India (9%), and Nepal (9%). There were 14 first languages represented in the sample. The most common languages of origin were Chinese languages (38%), followed by Korean, Hindi, and Nepalese/Nepali. Most of the sample (78%) had spent 4 years or less in Australia, with a mean duration of 4 years and a median of 3 years. In terms of educational background, all students who provided this information were studying a nursing course at Bachelor level. Most students (78%) were in their second year or higher of their nursing education course, with 47% of the sample in their second year and 31% studying their third year. Participants reported low levels of prior experience with videogames overall. Most participants played for less than one hour per week on average (63%), and the vast majority played for between zero and 4 hours per week (84% in total). The most common devices frequently used to play videogames were mobile devices (such as smartphones) (81%) and computer devices (38%). However, 13% reported using none of the videogame devices frequently. All participants considered themselves either a novice/newbie (38%) or casual (62%) gamer – falling on the least experienced end of the player type spectrum. Overall, the prior videogame experience of the sample in this study could be described as low to modest, with most playing casually on mobile devices for less than an hour a week (if any) and perceiving themselves to be novice/casual players rather than intermediate or experienced gamers.

5.4 Research Question 1: Language Skills

5.4.1 Research Question and Aims

RQ1: Does the use of the Medicina multiplatform videogame improve language skills in EAL nursing students?

One of the aims of the current study was to examine the effect of the CALL videogame on language skills among the sample of interest. As such, the first research question investigates whether the use of the Medicina videogame improved linguistic skills in international nursing students measured in two ways. These measures included overall language skills for medication names (using three items) and phonological awareness (using word recognition test).

5.4.2 Normality Testing

Determining the distribution of the variable related to phonological awareness was important for choosing an appropriate statistical method for the first research question. To examine the normality of the variables, a Shapiro-Wilk test was performed for the word recognition test total scores for both the pretest and the posttest measures.

Firstly, a Shapiro-Wilk test of the pretest word recognition total scores was performed and did not show evidence of non-normality ($W(11) = 0.95$, $p = 0.67$). A visual examination of the histogram and the QQ plot for the pretest word recognition test sum scores was also conducted. This graphical analysis also did not show evidence of non-normality.

Similarly, a Shapiro-Wilk test of posttest word recognition test scores was conducted and did not show evidence of non-normality ($W(11) = 0.89$, $p = 0.16$). Furthermore, visual examination of the histogram and the QQ plot for the posttest word recognition test sum scores was performed. This graphical analysis also did not show evidence of non-normality.

Based on the outcome of the normality testing, the decision was made to use a parametric test. The mean with the standard deviation were used to summarise the variables for the word recognition test total sum scores for the pretest and posttest measures. Note that as the three items

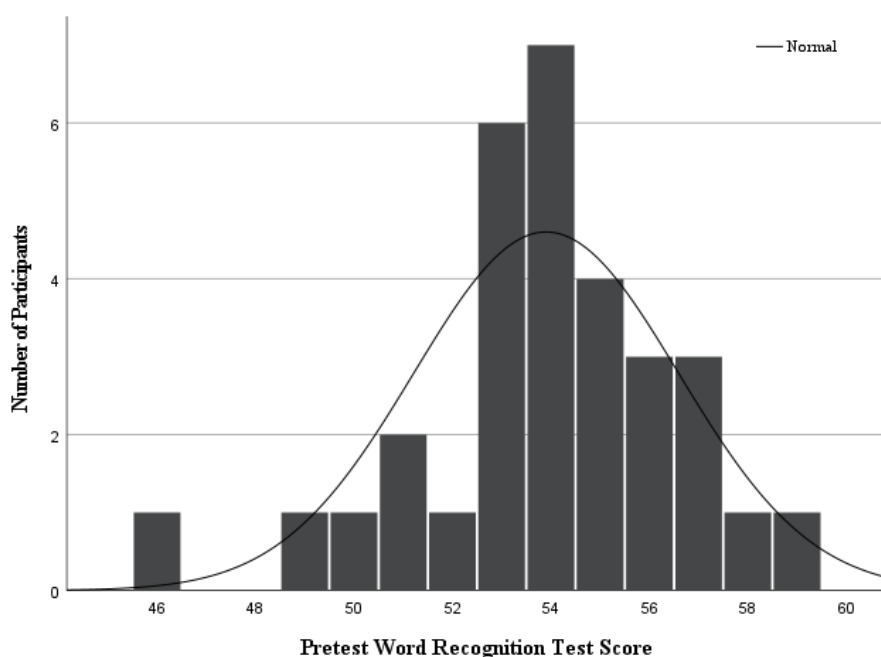
for general language skills used Likert questions, normality testing was not conducted for those three variables.

5.4.3 Phonological Awareness

Phonological awareness was measured using the word recognition test, which was administered to participants in both the pretest and posttest periods. Descriptive statistical analyses were conducted for total word recognition test scores at the pretest and posttest questionnaire. At the pretest, the mean word recognition test score was 53.90 (SD = 2.69), with scores ranging from 46 to 59 (see Figure 10). It is important to note that the maximum possible score for the word recognition test was 60. Higher scores on the test indicated higher levels of phonological awareness. Thus, results indicated that prior to playing the Medicina videogame, participants in the current study already displayed very high levels of phonological awareness. For the posttest scores, the mean word recognition test score was 55.09 (SD = 2.07), with scores ranging from 52 to 58. Thus, findings from the descriptive analyses showed that the mean word recognition test score was higher at posttest than at pretest.

Figure 10

Language Skills – Phonological Awareness at Pretest.



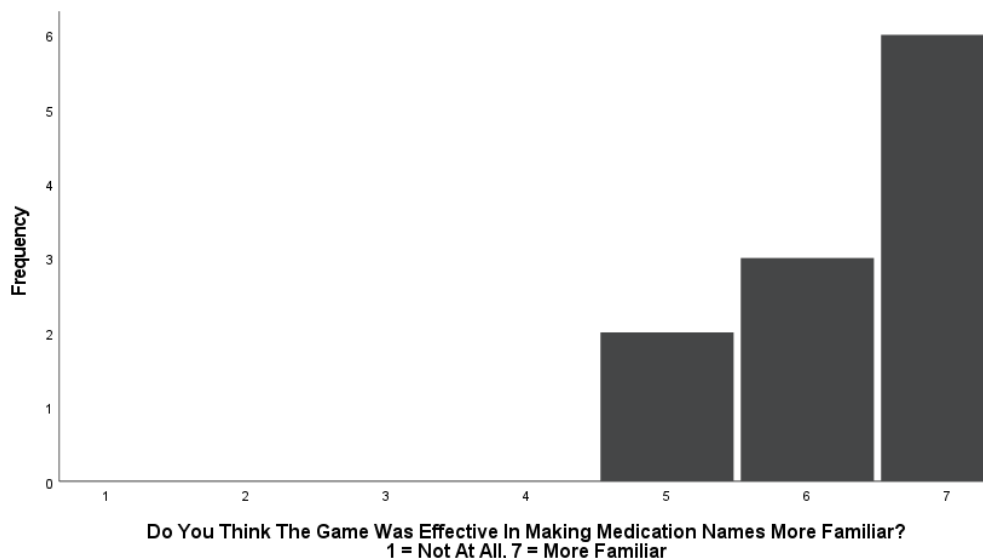
A paired-samples t-test was conducted to evaluate the impact of the Medicina videogame on international nursing students' phonological awareness as measured using word recognition test scores. The findings of the test indicated there was a non-statistically significant increase in word recognition test scores from Time 1 (M = 54.00, SD = 1.67) to Time 2 (M = 55.09, SD = 2.07), $t(10) = 1.54, p = 0.15$ (two-tailed). The mean increase in word recognition test scores was 1.09 with a 95% confidence interval ranging from -0.48 to 2.67. The effect size, as measured by Cohen's d , was $d = 0.47$, indicating a medium effect (that is, a moderate impact). Hence, the mean value for the posttest is 0.47 standard deviations from the value from the pretest.

5.4.4 Language Skills

As part of the posttest analysis, participants were asked three questions in the game feedback questionnaire regarding the impact of the videogame on their language skills related to medication names. Among participants who completed the posttest, all participants rated the Medicina videogame as being effective in making medication names more familiar (see Figure 11). The median effectiveness score was 7 out of 7. The mode was also 7 out of 7. All the participants rated a score of 5 or above for effectiveness in increasing familiarity with medication names.

Figure 11

Language Skills - Familiarity with Medication Names



Furthermore, participants were asked in posttest questionnaire “Do you feel more confident that you will understand spoken medication names?”. The median score given was 6 out of 7, indicating a strong positive effect of Medicina on participants’ confidence in understanding spoken medication names. All responding participants rated a score of 5 or above for effectiveness in increasing confidence with understanding medication names (Figure 12).

Figure 12

Language Skills - Confidence Understanding Spoken Medication Names

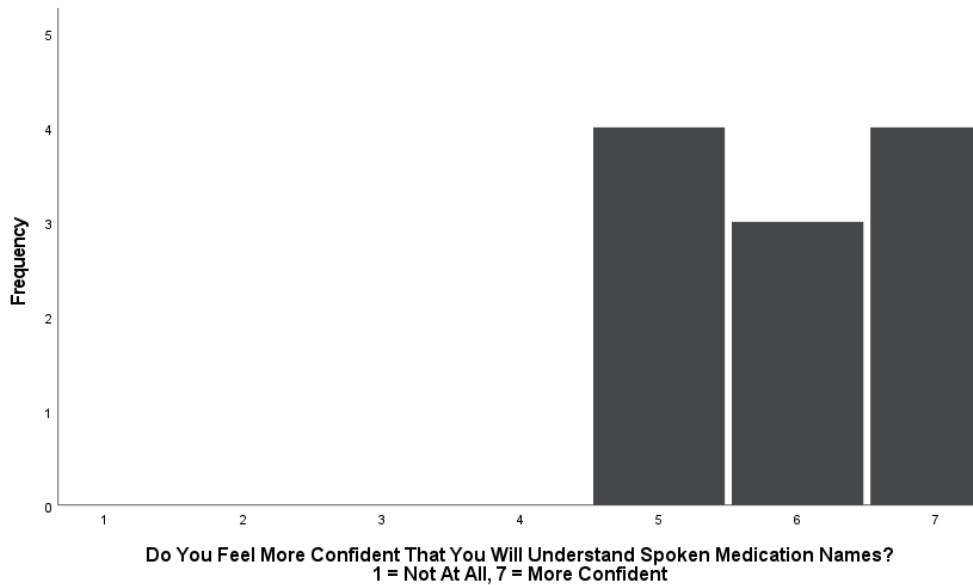
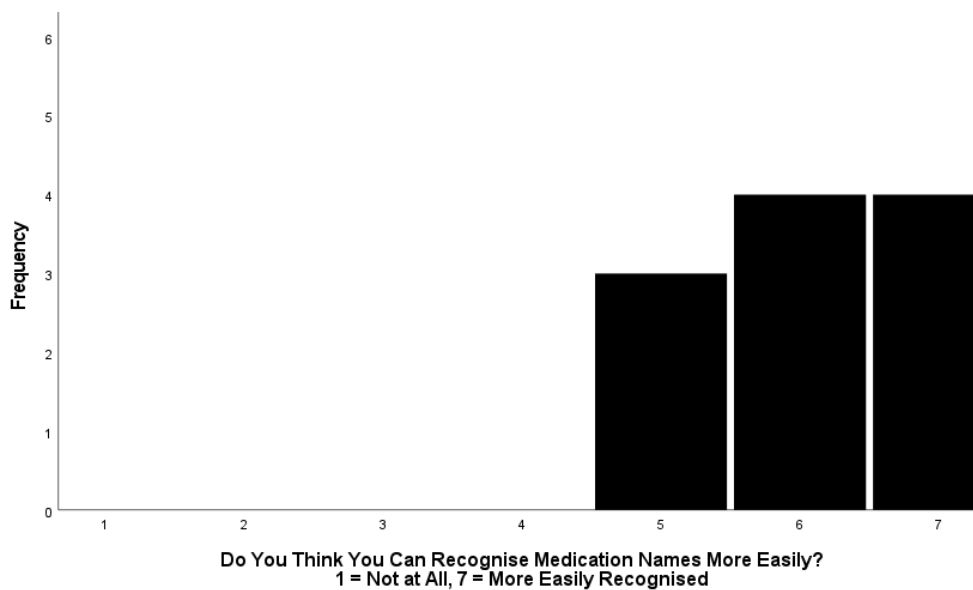


Figure 13

Language Skills - Recognising Medication Names



Lastly, participants were also asked, "Do you think you can recognise medication names more easily?". The median score was 6 out of 7. The mode was split evenly between 6 and 7, and all participants gave a rating of 5 or above (Figure 13). Thus, all responding participants reported a significant increase in their ability to recognise medication names more easily as a result of playing *Medicina*.

In summary, in the posttest questionnaire international nursing students reported that they felt that the *Medicina* videogame had a strong positive effect on their language skills. In particular, participants reported that *Medicina* had a highly positive impact on making medication names more familiar, their ability to recognise medication names, and confidence in understanding spoken medication names.

5.5 Research Question 2: Psychological Measures

5.5.1 Research Question and Aims

RQ2a: What are EAL nursing students' psychological feelings (such as task value, confidence, motivation, test anxiety) regarding learning medication names via a CALL videogame?

RQ2b: And what is the impact of the *Medicina* multiplatform videogame on such psychological-related factors in EAL nursing students?

Research question two aimed to investigate psychological feelings among international nursing students in the context of a CALL videogame teaching medical terminology (medication names). In particular, this study aimed to explore state-based psychological factors such as motivation, confidence, task value, and test anxiety among international nursing students before and after playing *Medicina*.

5.5.2 Normality Testing

Determining the distribution of the psychological variables was important for choosing an appropriate statistical method for the second research question. To examine the normality of the variables, a Shapiro-Wilk test was performed for each of the five MSLQ subscale sum scores

and for the total sum MSLQ score, with each tested for the pretest and the posttest measures separately. In total, a Shapiro-Wilk test was conducted for 12 variables for this research question.

Firstly, the total sum MSLQ scores were investigated for both time periods. A Shapiro-Wilk test of pretest total MSLQ score was performed and did not show evidence of non-normality ($W(11) = 0.95, p = 0.652$). A visual examination of the histogram and the QQ plot for the pretest total MSLQ score was also conducted. This graphical analysis also did not show evidence of non-normality.

Next, a Shapiro-Wilk test of posttest total MSLQ score was conducted and showed that the distribution of the posttest total MSLQ variable departed significantly from normality ($W(11) = 0.83, p = 0.022$). Furthermore, visual examination of the histogram and the QQ plot for the posttest total MSLQ score was performed. This graphical analysis also suggested the variable departed significantly from normality.

Therefore, there was a discrepancy between the outcomes of normality testing for the total MSLQ scores on the two time periods. Specifically, the pretest version of the variable did not show evidence of non-normality while the posttest version of the variable did find evidence that it may have departed significantly from normality. Based on this outcome, a non-parametric test was selected, and the median was used to summarise the variable when comparing the outcomes in total MSLQ scores for the pretest and posttest periods.

Secondly, the five MSLQ subscale sum score variables were tested individually for the pretest and posttest. The outcomes of the Shapiro-Wilk tests varied between subscales and testing phase. For pretest MSLQ subscale variables, a Shapiro-Wilk test of MSLQ subscale variables was performed and did not show evidence of non-normality for the pretest intrinsic motivation subscale ($W(11) = 0.89, p = 0.153$), pretest extrinsic motivation subscale ($W(11) = 0.89, p = 0.145$), pretest self-efficacy subscale ($W(11) = 0.90, p = 0.194$), and pretest test anxiety subscale ($W(11) = 0.89, p = 0.141$). A visual examination of the histogram and the QQ plot for these MSLQ variables was also conducted. This graphical analysis also did not show evidence of non-normality.

However, Shapiro-Wilk tests showed that the distribution of the pretest task value subscale ($W(11) = 0.85, p = 0.049$) departed significantly from normality. Furthermore, visual examination of the histogram and the QQ plot for these pretest MSLQ subscale variables was performed. This graphical analysis also suggested the variables departed significantly from normality.

For posttest MSLQ subscale variables, a Shapiro-Wilk test of MSLQ subscale variables was performed and did not show evidence of non-normality for the posttest intrinsic motivation subscale ($W(11) = 0.88, p = 0.112$), posttest extrinsic motivation subscale ($W(11) = 0.91, p = 0.245$), posttest self-efficacy subscale ($W(11) = 0.87, p = 0.083$), and posttest test anxiety subscale ($W(11) = 0.88, p = 0.098$). A visual examination of the histogram and the QQ plot for these posttest MSLQ variables was also conducted. This graphical analysis also did not show evidence of non-normality.

However, Shapiro-Wilk tests showed that the distribution of the posttest task value variable ($W(11) = 0.68, p = <0.001$) departed significantly from normality. Furthermore, visual examination of the histogram and the QQ plot for the posttest task value MSLQ variable was performed. This graphical analysis also suggested the variable departed significantly from normality.

In summary, there was variation noted in the outcomes of the normality testing for the MSLQ subscale variables. Of the five MSLQ subscales, four did not show evidence of non-normality in either time period. However, one MSLQ subscale (task value) showed evidence that the variables departed significantly from normality in both the pretest and posttest periods. Based on this outcome, and for the sake of consistency between the analyses in this research question, the decision was made to use a non-parametric test for both the MSLQ total and MSLQ subscale testing. Furthermore, median values and range were used to summarise the variables when comparing the outcomes in MSLQ scores for the pretest and posttest.

5.5.3 Baseline Psychological States

To investigate research question 2a, descriptive statistical analyses were conducted for five MSLQ subscales and the total MSLQ score at the pretest questionnaire. Each subscale had possible scores ranging from 0 to 14, and the total MSLQ score had a total score ranging from 0 to 70. The median

intrinsic motivation score at pretest was 11.55 out of 14 (SD = 2.34) and the mode was 12. For extrinsic motivation, the median pretest score was 9 (SD = 3.82) and the mode was 10. Participants reported a median self-efficacy (confidence) score of 10.50 (SD = 2.41) at pretest, with a mode of 11. The median task value subscale score at pretest was 12.75 (SD = 2.54) with a mode of 14 out of 14. It is important to note that the test anxiety subscale was calculated using negatively coded versions of the original variables, such that higher scores indicated lower levels of test anxiety. The median test anxiety score at pretest was 8.38 (SD = 3.21) with a mode of 8. The overall total pretest MSLQ score (combining all five subscales) was 50.33 (SD = 7.53). Overall, the results of descriptive statistical analyses indicated that participants in the current study had positive baseline levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value rating, test anxiety, and overall MSLQ score at pretest.

5.5.4 Posttest Psychological States

To explore research question 2b, inferential statistical analyses were conducted using the Wilcoxon Signed Rank Tests to examine change in the psychological measures after playing *Medicina* compared with the pretest. The results of the analyses are presented for each MSLQ variable separately.

A Wilcoxon Signed Rank Test revealed a non-statistically significant reduction intrinsic motivation at posttest after playing the videogame, $z = -1.27$, $p = 0.205$. The median score on the MSLQ intrinsic motivation subscale decreased from pretest (Md = 12) to posttest (Md = 11).

The median score on the MSLQ extrinsic motivation subscale increased from pretest (Md = 9) to posttest (Md = 10). However, a Wilcoxon Signed Rank Test revealed the increase in extrinsic motivation at posttest after playing *Medicina* was not statistically significant, $z = -0.96$, $p = 0.337$.

The median score on the MSLQ task value subscale increased from pretest (Md = 13) to posttest (Md = 14). However, a Wilcoxon Signed Rank Test revealed the increase in task value after playing the videogame was not statistically significant, $z = -0.60$, $p = 0.546$.

A Wilcoxon Signed Rank Test revealed the change in self-efficacy after playing the videogame was not statistically significant, $z = -0.16$, $p = 0.877$. The median score on the MSLQ self-efficacy subscale remained unchanged from pretest ($Md = 11$) to posttest ($Md = 11$).

Similarly, a Wilcoxon Signed Rank Test revealed the change in test anxiety after playing Medicina was not statistically significant, $z = 0.00$, $p = 1.00$. The median score on the MSLQ test anxiety subscale remained unchanged from pretest ($Md = 8$) to posttest ($Md = 8$).

For all psychological variables combined, the median score on the MSLQ total score increased from baseline ($Md = 50$) to posttest ($Md = 55$). However, a Wilcoxon Signed Rank Test indicated the increase in total MSLQ score after playing the videogame was not statistically significant, $z = -0.41$, $p = 0.683$.

5.6 Research Question 3: Game Usage

5.6.1 Research Question and Aims

RQ3: How do EAL nursing students use and interact with the Medicina multiplatform videogame?

One of the key aims of the study was to identify how many participants actually play the Medicina multiplatform videogame, and the precise nature and pattern of the game usage. To explore this issue, the study collected and analysed extensive quantitative gamelog data encapsulating dozens of event types. Primary themes regarding usage examined included overall engagement, duration played, scoring, avatar preference, device preference, and difficulty levels. The results for different aspect of game usage will be presented below.

5.6.2 Engagement and Number of Sessions

Descriptive analyses of the gamelogs showed that out of the 32 participants, 17 participants (53%) played the game at least once while 15 participants (47%) did not play the videogame. Among participants who played the game, the mean number of sessions played was 13.47 sessions ($SD = 14.63$), with a median of 10 and a mode of 15 sessions. There was significant variation in the number of sessions played by participants, with the highest number being 62 sessions.

In line with previous literature (Pham et al., 2018), overall engagement was categorised into different levels of engagement based on the length of time the participant played the videogame during the trial period. The first category was 'no engagement', meaning that the participant did not play the game at all. The second category was 'lighter engagement', which was categorised as a participant who played the videogame but did so for less than 15 minutes overall during the study. The third category was labelled 'deeper engagement'. This deeper engagement was categorised as a participant who played the videogame and did so for 15 minutes or more. Descriptive statistical analyses revealed that 15 participants (47%) were in the 'no engagement' category, 7 participants (22%) were in the lighter engagement category, and 10 participants (31%) had deeper engagement.

A Chi-Square Test of Independence was performed to assess the relationship between playing the videogame and posttest completion. There was a significant relationship between the two variables, $X^2(1, 32) = 9.61, p = 0.002$. Participants who played the Medicina videogame were more likely to complete the posttest questionnaire than participants who did not play the videogame. The effect size was large ($\phi = 0.6$).

5.6.3 Time/Duration of Gameplay

In terms of time spent playing, there were three primary measures: time played on first session, highest time played, and the total accumulative time spent playing the videogame. For the first session played, the mean time played among participants was 101 seconds (1.7 minutes) ($SD = 127.6$). However, there was considerable variation among the sample. The time of first session ranged from zero (indicating the participant logged out immediately) to 426 seconds (7.1 minutes) as the longest time for the first session. The time spent playing the longest session for each participant ranged from 19 seconds to 760 seconds (12.7 minutes). For the time spent playing the longest session, the mean longest session was 343 seconds (5.7 minutes) ($SD = 236.1$) and the median was 372 seconds (6.2 minutes). Analyses showed the mean overall total duration of gameplay (accumulative sum of all sessions) was 34.6 minutes ($SD = 44.2$). This is equivalent to a mean of 2.5 minutes per day over the 14-day intervention period. The mean time between the first

session and the last session played was 5.86 days (SD = 4.64). The highest total duration of gameplay recorded by a participant was 173 minutes (just under 3 hours). Among participants who played the videogame, one in four (24%) played Medicina for over an hour in total.

5.6.4 Scores

Participants were given a score for each correct answer during the game and scores were recorded in the gamelog. Each correct answer was awarded 250 points. Scores were calculated for the first session, the highest scoring session, and the total accumulative score. For the players' first game, the mean score was 2941 (SD = 4432.2). As participants were awarded 250 points per correct answer, the results indicated that participants answered a mean of 11.7 medication names correctly on their first session of gameplay. The lowest first session scores recorded was zero (no correct answers or logging out before answering a question), recorded for six participants. Meanwhile, the highest first session score achieved was 15,000 points, representing 60 medication names correct in the session. Among participants who achieved any score for their first session, 45% scored more than 4000 points (16 correct medication names).

For highest scores achieved in a single session, the mean recorded was 12,044 (48 correct answers) (SD = 8225.9), and the median was 12750 (51 correct answers). Highest scores achieved in one session ranged from 1250 (5 correct answers) to 27,000 (108 correct answers). Among participants who played the game, 41% achieved a highest score of 15,000 or more (60 correct answers) in a single session.

The total accumulative score for all sessions was also calculated. The mean total score was 65,882 points (SD = 81350). This represents a mean of 264 medication names answered correctly by participants playing the Medicina videogame. The median total score was 36,000 points, or 144 correct medication names. The lowest total score recorded for a participant who played the videogame was 1250 (5 correct answers). Overall, the highest total score achieved by a participant was 309,500 points, or 1,238 correct medication names.

5.6.5 Platform Usage

The Medicina videogame evaluated in the current study was a multiplatform type which could be played using both WebGL (desktop/laptop devices) and Android mobile devices. Data regarding participant device preference and patterns of usage were collected in the gamelogs. Among participants who played the game, the majority (81%) used only one platform type to play Medicina. In contrast, around one in five players (19%) played using both platform types on at least one session. Of the 13 players who used only one platform, just one player (8%) used solely the Android device. Instead, the remaining 12 single-platform users (92%) played using only the WebGL version. For participants who played the game, four participants (24%) played Medicina using the Android platform at least once. In contrast, 16 participants (94% of players) played Medicina using the WebGL platform at least once. As a proportion of total playing sessions, Android devices were used for 6% of sessions while WebGL (desktop/laptop devices) was used for 94% of sessions playing Medicina.

5.6.6 Avatar Usage

There were two avatars available in the Medicina videogame which were both designed in a cartoon-like, animated style (see Figure 4). Information about patterns in avatar usage were collected using gamelog data. The findings from gamelog data indicated that both avatars were used by the participants in the sample. Among participants playing the game, more than half (59%) used both avatars at least once. In contrast, 41% of participants consistently chose only one avatar rather than trying both. Examining the two avatars individually, each of the two avatars were used at least once by over 65% of participants. Overall, avatar 1 was chosen for 42% of game sessions, while avatar 2 was selected for 58% of all game sessions. Hence, the results indicated there was a fairly even split between the two avatars. However, exploration of the avatar usage patterns at the player level indicated that most participants tried both avatars at least once but then subsequently tended to stick to one avatar relatively consistently.

5.6.7 Difficulty Level Usage

The Medicina videogame incorporated three difficulty levels – easy, medium, and hard. Detailed gamelogs were obtained regarding difficulty selections and patterns. Core aspects analysed include the frequency and duration (time) of difficulty levels played as well as patterns of progression between difficulty levels. Note there were some missing data in this section due to a technical error affecting the first few participants.

The first gamelogs related to whether the participants played each of the three difficulty levels at any time. Of the 14 participants for whom difficulty gamelog data were available, medium was the difficulty level played at least once by the highest proportion of participants. In total, 93% (all players except one) played the medium difficulty level at least once. Hard was played at least once by 86% of participants, although 14% never played hard. Easy was played by the fewest participants who played the game, with 79% playing the easy level at least one time while 21% never played the easy level. Most participants (71%) played all three difficulty levels at least once. However, 14% played only two different difficulty levels (either easy/medium or medium/hard). A further 14% played only one difficulty level (medium or hard).

In terms of the number of sessions played at each difficulty level, medium was the most popular difficulty level, with hard level second, and easy level played for the fewest sessions. Medium difficulty was played for a mean of 5.71 sessions (SD = 12.07). The highest number of medium difficulty sessions recorded was 47 sessions. Hard difficulty was played for a mean of 5.14 sessions (SD = 4.24), with the highest number of hard sessions being 14 sessions. The least played difficulty level in terms of number of sessions was the easy difficulty, with a mean of 3.07 (SD = 3.32) and a maximum of 11 sessions. In terms of comparative proportion of sessions, medium difficulty was played in 41% of sessions, hard in 37%, and easy in 22% of sessions.

Descriptive statistical analyses for duration of gameplay showed that participants spent the highest duration of time playing the medium difficulty, followed by hard, and the least time playing the easy level. The mean time spent playing the game at medium difficulty was 1150 seconds (19

minutes) (SD = 2283 seconds). At medium level, the highest duration of gameplay recorded was 8661 seconds (144 minutes). The mean time spent playing the hard difficulty was 717 seconds (12 minutes) (SD = 813 seconds), with a maximum time of 2996 seconds (50 minutes). Easy was played for the least time overall, with a mean of 482 seconds (8 minutes) (SD = 559 seconds), and a highest time reported of 1942 seconds (32 minutes).

The pattern of progression between levels was also recorded in the gamelogs. For the first game played by participants, the most commonly chosen difficulty level was easy (64%). Medium level was the first played level for 29% of players. In contrast, hard was the first level chosen by just one player (7%). The pattern was essentially reversed for the final game played by participants. For the final game played, the most commonly chosen difficulty was hard level (57%). The second most popular level for the final game was medium level, which played as the final session for 43% of players. In contrast, no players chose the easy level as the final level played.

Participants progressed through the difficulty levels at different session intervals. Most of the participants (79%) had a unique pattern of movement between first difficulty levels that was not shared by any other participant. The only shared progression pattern (3 participants) involved starting at the easy difficulty level, moving straight to the second level on the second play, followed by changing to the hard difficulty on the third episode. That is, playing one session each moving from easy to medium to hard. Overall, easy level was played the earliest (mean = 1.64, median = 1), followed by medium (mean = 2.64, median = 2), and hard was on average played last (mean = 3.21, median = 3).

However, it is interesting to note that the progression between difficulty levels occurred very rapidly, with participants trying each difficulty level in quick succession on the first play. All participants who played all three difficulties (easy, medium, and hard) did so on their first day of playing. In fact, among participants who played all three difficulty levels, the mean time between the first difficulty level and the third difficulty played was just 11 minutes (SD = 4.38). The minimum (shortest) gap recorded was only 3 minutes between playing the first difficulty and the

third difficulty level. Furthermore, the maximum time recorded by a participant from the first to the third difficulty level was just 18 minutes.

5.7 Research Question 4: Usability

5.7.1 Research Question and Aims

RQ4: What is the usability of the Medicina multiplatform videogame?

The aim of the fourth research question was to investigate the usability of the Medicina videogame among a sample of international nursing students. The usability was measured in the posttest questionnaire using the System Usability Scale (SUS), a widely used standardised measure of usability for videogames and other technology systems.

5.7.2 Usability of Medicina

Descriptive statistical analyses were conducted and revealed the mean System Usability Scale (SUS) score was 76.25, with a median of 82.5, and a mode of 83. More than two thirds of respondents (70%) rated the system usability as 78 or above out of 100. It is important to note that the System Usability Scale is calculated and interpreted in a specific way. It is not a percentage but rather a score out of 100. Review of the research literature indicates that the average SUS score is 68 and scoring above 68 is considered above average. Further, SUS scores reflect ratings such as excellent, good, okay, poor, awful, or worst imaginable (Sauro, 2018). Hence, the SUS score found in the current study demonstrates that the usability of the Medicina videogame was above average and within the range considered as ‘excellent’ according to SUS interpretation guidelines (Sauro, 2018).

Furthermore, the SUS comprises ten individual questions measuring different aspects of usability. Each item was measured on a five-point Likert scale ranging from “Strongly Disagree” (score of 1) to “Strongly Agree” (score of 5). To gain a deeper understanding of usability of the Medicina videogame some of the scale items were analysed further. Results for the individual SUS items are summarised in Table 5.

Table 5*System Usability Scale Individual Item Results*

Item	Mode Ratings	Responders Agreeing N (%)
I think that I would like to use this game frequently	Agree	9 (90%)
I found the game unnecessarily complex	Disagree/Strongly Disagree	1 (10%)
I thought the game was easy to use	Agree	8 (80%)
I think that I would need the support of a technical person to be able to use this game	Disagree/Strongly Disagree	2 (20%)
I found the various elements of this game well designed (e.g. controls, avatar, levels, audio)	Strongly Agree	8 (80%)
I thought there was too much inconsistency in this game	Disagree	2 (20%)
I would imagine that most people would learn how to use this game very quickly	Strongly Agree	9 (90%)
I found the game very awkward to use	Strongly Disagree	1 (10%)
I felt very confident using the game	Strongly Agree	10 (100%)
I needed to learn a lot of things before I could get going with this game	Strongly Disagree	3 (30%)

Descriptive analyses were conducted and results for five of the items are presented below.

For item one “I think that I would like to use this game frequently”, the median reported score was 4, and the mode was also 4. The third item was “I thought the game was easy to use”. For ease of use, the median reported score (and also the mode) was 4 out of 5. The fifth item stated, “I found the various elements of this game well designed (e.g. controls, avatar, levels, audio)”. For this item, the median and mode were both 5 out of 5, indicating the individual game elements were perceived as well designed. Similarly, for the statements “I would imagine that most people would learn how to use this game very quickly” and “I felt very confident using the game” the median and mode were 5 out of 5 for both items. In summary, an item-level analysis of questions from the SUS found that participants had strongly positive perceptions of *Medicina*. In particular, participants felt that *Medicina* was easy to use and learn, felt confident using the videogame, and thought that the

elements of the videogame (such as levels, avatars, and controls) were well designed. Participants also stated that they would like to use the game frequently. Overall, the results of the SUS score and the individual SUS items indicate that the Medicina videogame has a positive level of usability among international nursing students.

5.8 Research Question 5: Perceptions of Medicina

RQ5: What are EAL nursing students' perceptions of the Medicina multiplatform videogame?

Participants were asked for feedback about the videogame in a series of six open-ended questions in the posttest questionnaire to explore their perceptions of Medicina. The most common themes identified included improving language skills, benefits for clinical placements, background noises, avatars, fun, confidence, challenge, scoring, feedback, and realism. Findings regarding player perceptions will be presented in this section based on common themes. To protect participant anonymity, pseudonyms (such as 'P1', 'P2'...) were assigned and will be used when providing quotations from participants in this study.

All participants in the study reported that the Medicina videogame had positive effects on their language skills, listening skills, and familiarity with medication names, and would help them in clinical placements. One comment stated "throughout this game, it helps me to improve that I can realise more clearly some ending sounds of medications without much confusion. Thank you" ('P1', participant pseudonym). Another stated "Through this game, I found that I became much more familiar with how to say the names of medications and much more confident, which will help me work more efficiently in my next placement" ('P4'). A third participant said the Medicina videogame "helps me to get familiar with the environment [sic] I'm going to face in the future, practised my listening skills, it's easier for me to understand the instructions given from other staff" ('P3'). A fourth student said that "The game helped me to be familiarised with the new medication terms" ('P6'). Similarly, another participant commented "Getting familiar with medication helps to gain more confident" ('P7'). Participants also felt that Medicina helps "sharpening the ears" ('P9'),

helps “establish cautiousness” (‘P5’), and was “handy for medical terms pronunciation and spelling” (‘P7’).

The ability to discern between different sounding medication names and the importance for reducing medication errors was also mentioned. For example, one student commented that the “game helps being aware of the some [sic] similar drug names and which may keep you from making mistakes in serious situations” (‘P9’). Students also spontaneously highlighted the benefit *Medicina* provides for exposure to the Australian accent. One participant commented “For someone who just arrived in Australia and not familiar with Australian accent, this game will provide a good opportunity to practise one’s listening skills” (‘P3’). Another participant stated to “Practice around 10 minutes every day so it can help to improve your listening skills about the medication names” (‘P2’). One participant suggested that the benefits for language skills was so good the game should be extended to other educational fields also: “Students from non medical [sic] or health and science background must play this game and others from the background should play at least once” (‘P7’). Thus, participants overwhelmingly reported that they felt the game had positive effects on their language skills. In particular, the feedback emphasised the videogame’s positive impact on listening skills, confidence, familiarity with medication names, reducing mistakes, performance in clinical placements, and the ability to discern between similar sounding medication names.

One of the most common features that participants liked about the videogame was the background sound effects. In fact, 44% of posttest responders spontaneously mentioned background sound effects unprompted as an aspect they thought was good about the game. In particular, participants felt that the background noises increased the challenge associated with the game, improved focus and listening skills, and created a sense of realism similar to the hospital environment. For example, one participant commented “The background noises were to mimic the busy situation in workplaces and help sharpening the ears. well done!” (‘P9’). Another student stated, “I really like the background noise of the game, it pushes me to focus on it and it mimics the real working environment, which is great” (‘P4’). However, two participants mentioned the

background noises in a negative context because the students felt the noises made the game too challenging. For example, one participant commented that the noise “distracts students from focusing on listening medication names and sometime [sic] causes misunderstanding of medication names as well” (‘P2’). Similarly, one participant felt that the easy level should have the background noises removed, as it was too difficult.

Avatars and the multisensory stimuli in *Medicina* were another common theme in the feedback from participants. More than two thirds (70%) of feedback questionnaire respondents had positive comments about the avatar characters and thought they should be kept in the game. Participants felt the avatar character “makes [the game] more interesting” (‘P7’) and “gives some attractions for players” (‘P2’), adding “I like the characters” (‘P6’). One participant felt the characters added realism and challenge, saying it provided “good visual distraction. In clinical environment, especially the Paediatric Department, there will be a lot of distractions. Clean background would make the game too easy compared to reality” (‘P5’). Another participant highlighted the interaction of the avatars, immediate multisensory feedback, motivation, narrative, and realism of *Medicina* in the nursing education context:

The characters in the game are cleverly designed with nurses, me and patients. If I get it right, the nurse gives me encouragement, which is very important. If I get it wrong, there could be very serious consequences for the patient. (‘P4’)

Furthermore, a common theme among the feedback was that the game was fun, interesting, enjoyable, and engaging. One participant commented, “It was interesting! ... I enjoyed it!” (‘P6’). Another participant commented, “have fun” (‘P5’). Furthermore, three participants reported without prompting that the *Medicina* videogame made them feel more confident. Overall, participants liked the challenge provided by the videogame and felt that the game motivated and engaged them. For example, one student commented that “The excellent thing is that this game makes student try hard for every attempts so that they can improve themselves. Thank you” (‘P2’). Another participant stated, “need lots of patience, because once you get wrong for three times you have to start all over

again. Not easy to do it again and again” (‘P1’). Multiple participants mentioned the need to focus, to “play while concentrated” (‘P9’) and to “try their best in every attempt” (‘P2’). The scoring system was also raised in the posttest feedback responses, with indications participants were motivated to achieve a good score. One participant suggested the scoring system should be changed so that lower times are awarded more points. In addition, participants liked the ability to choose from difficulty levels with “multiple options to choose from” (‘P5’). This was particularly well-illustrated in one participant’s comment that “Different levels are good, allows us to choose levels according to our listening ability and shows our improvement while playing” (‘P3’). This comment highlights the positive perception of the difficulty levels among participants and the benefits the difficulty levels may provide for player engagement and improving language skills.

Moreover, another crucial common theme in the game feedback was the realism of the videogame for nursing education and nursing practice. For example, participants commented that Medicina “mimics the real working environment” (‘P4’), “mimic the busy situation in workplaces” (‘P9’), and “make scenario like real hospital” (‘P8’). Similarly, one participant had a positive perception of the nurse avatar characters, graphics, multisensory stimuli, and background noise “compared to reality”, and likened these game features to being “in clinical environment, especially the Paediatric Department” where “there will be a lot of distractions” (‘P5’). Furthermore, one participant commented that Medicina “helps me to get familiar with the environment [sic] I’m going to face in the future” (‘P3’). Another participant noted “will help me work more efficiently in my next placement” (‘P4’). In addition, the realism of the impact of medication names for patient safety was noted by one participant who stated that Medicina “may keep you from making mistakes in serious situations” (‘P9’). Therefore, participants in the study had positive perceptions in the narrative and realism of Medicina in reflecting the clinical nursing environment and improving their performance in clinical practice.

The most common suggestion that participants had to improve the game was to add feedback steps related to the medication. For example, some participants wanted the game to show real

photos of the medication packet, give information about what the medication is used for after the response is selected, and show the nurse give the real-life medication packet to the patient. One participant commented, “Would be great if an image showing what the medication package look like, and what the medication is for as written on the package can appear after the player select an option” (‘P5’). Another participant (‘P1’) suggested that giving “Abbreviations for commonly used medications” would be helpful. In a sign that the study was conducted during the COVID-19 pandemic, one participant also spontaneously suggested that the game should include audio in which “mouths are covered with masks” (‘P1’).

Overall, findings from the qualitative feedback questions in the posttest indicated that participants had positive perceptions of the game, its features, and its effects on language skills and nursing education outcomes. Participants overwhelmingly reported that they felt the game had positive effects on their language skills. In particular, the feedback emphasised the videogame’s positive impact on listening skills, confidence, familiarity with medication names, medication errors, performance in clinical placements, familiarity to the Australian accent, and the ability to discern between similar sounding medication names and word-parts. In addition to benefits for language skills, participants had positive perceptions of the *Medicina* videogame and its features. Key positive features highlighted by participants included difficulty levels, time limitation, multisensory stimuli, immediate feedback, avatars and characters, background audio, fun and enjoyable gameplay, challenge, narrative, and realism. For example, participants liked the hospital-related background audio and felt this feature increased the challenge associated with the game, improved attention skills and listening skills, and created a sense of realism similar to the clinical nursing environment. Avatars and the multisensory stimuli in *Medicina* were another common theme in the feedback from participants. More than two thirds (70%) of feedback questionnaire respondents had positive comments about the avatar characters and participants highlighted the benefits of the avatars, immediate multisensory feedback, motivation, narrative, and realism of *Medicina* in the nursing education context. Furthermore, participants perceived *Medicina* to be fun,

interesting, enjoyable, and engaging. Overall, participants liked the challenge provided by the videogame and felt that Medicina motivated and engaged them while building confidence and competence in core nursing tasks and language skills. There was also a positive perception of the difficulty levels among participants and the benefits the difficulty levels may provide for player engagement and improving language skills. Moreover, another crucial common finding was the narrative and realism of the videogame for nursing education and practice, with participants commenting that Medicina mimics the hospital environment and nursing workplace. The findings of the feedback questionnaire also indicated that Medicina raised awareness about medication administration and the serious risks of medication errors for patient safety. Therefore, participants in the study had positive perceptions of the Medicina videogame for language skills, clinical nursing skills and knowledge, clinical placement performance, and psychological factors such as confidence, motivation, and engagement with learning.

5.9 Chapter 5 Conclusion

The current chapter presented the results of the study. As outlined in this chapter, the research findings provided preliminary support for the effectiveness, usage, and usability of the Medicina videogame in a study of international nursing students. Regarding overall language improvement, posttest measures indicated that participants felt that the Medicina videogame had a strong positive effect on their language skills including making medication names more familiar, improving their ability to recognise medication names, and increasing confidence in understanding spoken medication names. Findings regarding phonological awareness indicated a positive trend with median word recognition test scores higher at posttest than at pretest. However, despite the positive trend, the improvement in scores did not reach statistical significance.

Furthermore, the study also examined psychological measures to identify how international nursing students feel regarding learning medication names, before and after playing the CALL videogame. Firstly, results from the pretest showed that international nursing students had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall

MSLQ score at baseline before playing Medicina. Secondly, analyses showed that participants had higher levels of extrinsic motivation, task value, and overall MSLQ score at posttest compared with pretest. However, despite the positive trend, the changes did not reach the level of statistical significance.

Extensive gamelogs were obtained and identified how participants interact with the Medicina videogame. There was wide variation in gameplaying behaviour among participants. Overall, participants fell into one of three engagement categories: no engagement (47%), lighter engagement (22%), and deeper engagement (31%). Over the intervention period, participants who played the game played a mean of 13.47 sessions and a mean total time of 35 minutes. The mean total score was 65,882 which indicated a mean of 264 medication names answered correctly while playing Medicina.

Among participants who played the videogame, one in four (24%) played Medicina for over an hour in total. For the first session played, the mean playing duration was just under 2 minutes with a mean of 12 medication names answered correctly. The mean longest session was just under 6 minutes and highest scoring session involved a median of 51 medication names answered correctly. Among participants who played the game, 41% achieved a highest score of 15,000 or more (60 correct answers) in a single session

In terms of platform, there was a strong preference for the WebGL platform over the Android platform, and most participants consistently chose one device. Avatar preference was more balanced, and most participants played using both avatars at least once. Most participants played all three difficulties at least once. Medium was the preferred difficulty level overall, played by the highest proportion of players, the highest proportion of sessions, highest mean number of sessions, highest mean time, and most likely to be the final difficulty level played. Easy was the least popular difficulty level. Patterns of gameplay revealed participants most often started with the easy level first, before moving to medium and hard. The progression between difficulty levels occurred rapidly and in quick succession on the first play. All participants who played all three difficulties

did so on their first day of playing and the mean time between the first difficulty level and the third difficulty played was just 11 minutes (ranging from 3 to 18 minutes).

Results of the System Usability Scale indicated that participants rated the usability of the Medicina videogame as positive, above average, and overall excellent. Qualitative feedback questions in the posttest indicated that participants had positive perceptions of the game and its features. In particular, participants found the game to be fun, interesting, challenging, and beneficial for clinical placements. Game features with positive perceptions included difficulty levels, background noise, avatars, feedback, and Australian accents. All participants commented in the feedback questionnaire that the Medicina videogame supported their language skills. For example, participants felt the videogame improved listening skills, familiarity and knowledge of medication names, confidence, and the ability to discern between similar medication names and the awareness of word-parts.

Following on from the current chapter's presentation of the results, the next chapter will provide in-depth discussion of the research findings. In particular, the study results will be examined and explored, including comparisons with previous research literature and the study aims and research questions. Interesting and novel findings will also be discussed.

CHAPTER 6 DISCUSSION

6.1 Chapter Introduction

The current research aimed to develop a multiplatform CALL videogame named *Medicina* to improve language skills in international nursing students. Furthermore, the study aimed to evaluate the effectiveness, usage patterns, usability, and perceptions of the *Medicina* videogame in a trial involving international nursing students in Australia. Chapter 5 outlined the results of the study. Overall, findings indicated that *Medicina* was effective in improving language skills, had high levels of usage and usability, and was positively received among international nursing students. Accordingly, this chapter presents a detailed discussion of the findings related to the sample characteristics and research questions. Results will be discussed in the context of the study aims and comparison with previous research literature. Interesting and novel findings are also explored.

6.2 Sample Representativeness

The previous chapter outlined the results regarding the demographic characteristics of the sample. An important consideration is to examine if the study's sample is representative and reflective of the population of interest. External validity refers to the generalisability of the results; that is, the ability to generalise the findings of the research outside of the context of the current study. In this section, the characteristics of the current sample will be compared to the broader context to explore the representativeness and generalisability of the findings to the larger population of interest (international nursing students).

One sample characteristic finding is related to gender. The vast majority of the participants in the current study were female. In total, 78%, or almost four out of five participants, identified as female, while just 22% were male. Although skewed, this gender spread is overall consistent with the population of interest. Nursing is a field which has traditionally involved more females than males. Official data from the Australian Nursing and Midwifery Federation (2022) indicate that in 2022, 88% of employed nurses and midwives in Australia identify as female, while just 12% identify as male. In fact, arguably the proportion of males in the current sample (22%) was slightly

higher than expected given the historical gender imbalance in nursing. There are a few possible explanations for this finding in the current sample. Firstly, the number of male nurses in Australia is increasing in recent years. Data from new nursing registrants in South Australia demonstrates that the percentage of males registering as nurses has been increasing from 10% in 2014 to 14% in 2021 (Australian Nursing and Midwifery Federation, 2023). While the proportion change is small, it is relevant as it reflects an increase in male students studying nursing and subsequently entering the nursing workforce. Secondly, the finding may reflect gender patterns among international students more broadly. Across all disciplines nationally in Australia, data indicates there is a fairly even split among the genders of international students, with 49.6% female and 50.4% male (Universities Australia, 2020). This is substantially more equal than domestic students Australia-wide, where 58.6% are female, versus 41.3% male (Universities Australia, 2020). Hence, international students tend to have higher proportions of male students compared with domestic students in Australia. Therefore, given the tendency among international nursing students to have higher numbers of male students broadly across all disciplines, it is possible the difference in gender patterns is reflected in the international nursing student population.

One issue that is unlikely to explain the gender of participants in the study is that the topic relates to videogames. A common stereotype is that only males play videogames. However, research indicates this is not accurate. In fact, the gender ratio among videogame players is fairly balanced. For example, women accounted for 46.2% of the videogame players in China in 2019 (Statista, 2023). In summary, although the sample comprised more females than males, this finding indicates that the sample was representative of the cohort of international nursing students as the population of interest.

In terms of age, the findings showed the ages of participants ranged from 18 to 57 years, with a mean of 27 years of age (median 25 years). Two-thirds of the sample were aged 18 to 30 years. Although somewhat skewed, the age cohort in the sample is representative of the population of interest. The sample in the current study involved students in higher education studying nursing.

In Australia, most domestic students commence higher education at around 18-20 years of age (63%) (Universities Australia, 2020). Data from Flinders University (2020) (where the largest portion of students were enrolled) shows that 50% of students were aged 24 years or under and 18% were aged 25-29 years. However, there were students of a wide variety of ages, with a third of students (32%) aged 30 or over (Flinders University, 2020). This is consistent with the third of students aged over 30 in the current study. Furthermore, all participants in the study for whom course type was provided were studying a Bachelor of Nursing. Although students can complete the course over a wide variation of time, such as studying part-time, the course generally takes around 3 to 4 years full-time. In the current study, most participants were studying their second or third year of the course. Therefore, it makes sense that the majority of students were clustered around 18 to 30 years of age and that the sample was positively skewed. As such, the age of participants in the current study is reflective of the larger sample and is a marker of the external generalisability of the study.

The findings regarding age in the current study are also consistent with previous surveys of international students in Australia more broadly. For example, a study of over 600 international students in New South Wales reported that around four out of five respondents (81%) were aged 18 to 29 years ages, with a median of 25 years and a mode of 23 years (Ryan et al., 2016). Ages ranged from 18 to a maximum of 54 years of age. Accordingly, this previous research is very similar to the findings in the current study regarding age range and central tendency statistics.

However, the results related to length of time spent in Australia are not consistent with previous research regarding international nursing students nor in line with expectations. In the current sample, the mean duration participants had spent in Australia was 4 years, with a median and mode of 3 years. Furthermore, in terms of course year, the majority of the sample had been studying the course for two years or more – with 25 participants (over 78%) of the sample studying at second or third year. These findings were higher than expected and not consistent with typical Australian studies regarding international students. For example, in the study by Ryan and

colleagues (2016), 43% of the international students sampled in Australia had spent less than one year in Australia. In contrast, just 18% had spent 3 years or more in Australia. One potential explanation for participants having spent more time in Australia than found in previous research is the impact of the COVID pandemic. Due to border closures (Campbell & Vines, 2021), international students were not able to enter Australia. Hence, the pandemic likely significantly lowered the number and proportion of first-year students or those who had spent a year or less in Australia.

With regards to country of origin and language spoken, the largest group in the current sample was from China (31%) and spoke a Chinese language (38%). This finding is consistent with existing research which has shown that the largest source of international nursing students is China (Wang & Greenwood, 2015). It is also consistent with data regarding international students in Australia in general. Research shows that by far the largest source of international students is China, accounting for 37% of international students in higher education in Australia (Department of Education and Training, 2019b). In the current study, students from China represented 31.3% and the most common language consisted of either Mandarin, Cantonese, or just 'Chinese' (or a combination of multiple thereof), representing 37.5% of the sample. Thus, the sample in the current study was consistent with existing research and data regarding cultural and linguistic diversity and is representative of the cohort of interest.

6.3 Language Skills

The results showed positive trends indicating preliminary support for the effectiveness of the Medicina videogame for improving language skills. Regarding overall language improvement, posttest measures indicated that participants felt Medicina had a strong positive effect on their language skills. In particular, playing Medicina made medication names more familiar to participants, improved their ability to recognise medication names, and increased their confidence in understanding spoken medication names. Findings regarding phonological awareness indicated a positive trend with median word recognition test scores higher at posttest than at pretest. However,

despite the positive trend, the difference did not reach the level of statistical significance, possibly because the study was underpowered (Sullivan & Feinn, 2021).

The pattern of findings regarding effectiveness of *Medicina* on language skills identified in the current study were broadly similar to the results of the computer-based videogames in nursing studies evaluated in the research literature. For example, in both the *CHERMUG* games (e.g., Boyle, 2012) and *Medication Game* by Foss and colleagues (2014), the findings showed that while performance was higher at posttest and there was a trend indicating the videogames improved the target skills, the results did not reach the level of statistical significance. To evaluate the efficacy of the *Medication Game*, Foss and colleagues (2014) conducted a randomised controlled trial over four weeks with nursing students at two Norwegian universities. Students were randomly assigned to a control group (traditional lectures and task-solving classes) or a gamer group (along with routine classes, they played the game as often as desired). While the successful pass rate for the course was higher for the gamer group, the difference was not statistically significant. However, Foss and colleagues (2014) concluded that despite the lack of statistical significance, playing the game frequently had a positive influence on examination results, indicating the effectiveness of videogames for teaching specialized skills in nursing education. Hence, these findings are overall consistent with the results of the current study.

However, comparison of the results of the current study to previous research regarding phonological awareness is more complex. The current study included testing of the effect of the multiplatform *Medicina* videogame on phonological awareness using a word recognition test. Inferential statistical analyses provided evidence to indicate that while phonological awareness was indeed higher after participants played the multiplatform *Medicina* videogame, the results did not reach the level of being statistically significant. This finding is not fully consistent with the previous evaluation of the single-platform (computer-only) *Medicina* game which preceded the one in the current study. Müller (2011b) evaluated the efficacy of *Medicina* with 25 international nursing students enrolled in a graduate nursing degree at Flinders University. A pretest-posttest design trial

was conducted using quantitative and qualitative methods. The same word recognition test was used for both the pretest and posttest to assess phonological awareness. During the intervention period, participants played *Medicina* via computer as many times as they desired (Müller & Mathews, 2013). Results indicated an increase in word form recognition, with posttest scores significantly higher than pretest scores (Müller, 2011b). Thus, *Medicina* was found to be effective in increasing phonological awareness to improve the ability of international nursing students to identify medication names.

Detailed comparison of the current study's findings with the evaluation by Müller (2011b) suggests that a potential explanation for this discrepancy may be differences in the samples in terms of the phonological awareness skills of participants at baseline. Despite using the exact same word recognition test in both samples (i.e., the previous version testing and the current testing of this study), the results of the two samples had vastly different word recognition test scores at pretest. At the pretest, the mean word recognition test score in the current study was 53.90, with the highest recorded score being 59. It is important to note that the maximum possible score for the word recognition test was 60, and higher scores indicated higher levels of phonological awareness. In contrast, in the study by Müller (2011b) the mean phonological awareness score at baseline was 36, increasing to a mean of 40 at posttest. Thus, comparison indicates that prior to playing the videogame, participants in the current study already displayed substantially higher levels of phonological awareness, sometimes nearly perfect scores, than seen in previous studies of international nursing students using the exact same measure.

This may be a result of a ceiling effect, or at least a situation where fewer gains are made at the higher levels of a skill, and this can affect the statistical outcomes of a study simply because the effect of the independent variable on the dependent variable is weakened. The finding may also indicate regression toward the mean (Davis, 1976; Furrow, 2019). In pretest-posttest designs, regression toward the mean happens when comparing paired measurements among more extreme (high or low) levels in one time period, and this tends to be closer to the middle in the other time

period (Davis, 1976). Similar to a ceiling effect, when already scoring so close to the maximum score at baseline (such as 59 out of 60), there is little room for improvement. Hence, students with high test scores at pretest will either remain the same or sometimes score closer to the middle upon retesting, which results in an apparent negative relationship between the initial score and the second score (Davis, 1976; Furrow, 2019). This can lead to erroneous conclusions regarding treatment effects (Davis, 1976).

The unusually high baseline phonological awareness skills compared with previous research and potentially associated regression toward the mean (Davis, 1976) is likely reflective of the differences in sample characteristics due to the COVID pandemic. It is worth noting that in the present study *Medicina* was originally planned to be primarily evaluated using first-year students. It was thought that these students would likely have less experience with the Australian accent, less familiarity with medical terminology such as medication names, and lower levels of nursing-related English academic language proficiency overall. Hence, it was thought that these students may benefit the most from using *Medicina*. However, due to the COVID pandemic the sample demographics were markedly different than expected in certain aspects. Most students (78%) were in their second year or higher of their nursing education course and the mean time in Australia was four years. Only a small minority were first-year nursing students or had recently arrived. Thus, these students had passed multiple semesters of their nursing course at Bachelor level, and had been in Australia for nearly half a decade. Accordingly, participants in the current sample likely already had greater familiarity with the Australian accent and medical terminology, higher levels of academic language proficiency, and higher phonological awareness skills at baseline compared with participants in previous studies. This is also likely in the context that many participants chose to play on the hard difficulty level. Given the level of proficiency prior to entering the study, the results showing that playing *Medicina* improved what was already advanced language skills are perhaps more surprising and promising. It might be assumed that improvement in language skills would not occur in advanced learners, such as in the current sample. Despite this, the participants in

this study showed improved language skills in the posttest after playing Medicina. This finding highlights the need for support programmes targeting language skills among international nursing students from all skill levels and backgrounds, including among advanced students.

As well as the quantitative measures, participants gave qualitative feedback in the posttest survey which often referred to the Medicina videogame as improving their language skills, listening skills, and knowledge of medication names. There were no comments that contradicted or negated the hypothesis among the responses. Rather, many useful comments were gathered that enriched and supported the evidence gained from the quantitative data regarding phonological awareness. In addition, findings from the qualitative feedback questionnaire illustrate that Medicina increased awareness among students about mishearing medication names. For example, participants stated that playing Medicina helped “boost confidence and establish cautiousness” (‘P5’) and “the game helps being aware of some similar drug names and which may keep you from making mistakes in serious situations” (‘P9’). Qualitative feedback supporting the positive perceptions and benefits of Medicina for improving language skills is discussed in more detail in section 6.7 of chapter 6. Therefore, it is likely that an effect of the Medicina videogame is increased awareness about phonological differences and the importance of differentiating between phonemes to avoid making medication-related errors as a nurse. Consequently, it is plausible that participants paid more attention to actively listening to and learning medication names, and they may have been encouraged to develop their language skills through these changes. This is a positive impact of playing the game which is consistent with previous research (e.g., Müller, 2012) and may be considered an additional beneficial element of Medicina.

In summary, research question one asked, “Does the use of the Medicina multiplatform videogame improve language skills in EAL nursing students?”. Results showed Medicina had a positive effect on language skills including increasing familiarity with medication names, improving the ease of recognising medication names, increasing confidence in understanding spoken medication names, and a non-significant increase in phonological awareness. Thus,

answering research question one, the study's findings indicated that the Medicina multiplatform videogame does improve language skills among international nursing students.

6.4 Psychological Measures

The study examined psychological measures to understand how international nursing students feel regarding learning medication names via a videogame. Previous research has argued that international nursing students may experience difficulties such as low confidence and test anxiety, and that these psychological factors can contribute to poor outcomes among international nursing students. However, a review of the research literature did not identify any studies specifically measuring state-based psychological factors in the context of learning medication names/medical terminology. In addition, substantial research has discussed the benefits of educational videogames as leading to improvements in psychological factors such motivation, self-efficacy, and anxiety (e.g., Dondlinger, 2007; Granic et al., 2014; Lee & Peng, 2006). However, none of the previous studies identified as evaluating computer-based videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012) measured psychological constructs among nursing students prior to playing the videogame. This includes the two CALL videogames identified which focussed on international nursing students and medical terminology (Müller, 2011b; Müller & Price, 2012). Therefore, the study aimed to explore state-based psychological factors (such as motivation, confidence, task value, and test anxiety) among international nursing students before and after playing Medicina.

Firstly, results from the pretest showed that the participant had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall MSLQ score at pretest. Secondly, analyses showed that participants had higher levels of extrinsic motivation, task value, and overall MSLQ score at posttest compared with pretest. However, despite the positive trend, the changes did not reach the level of statistical significance.

The current study was the first to investigate the baseline psychological measures in international nursing students in the context of learning medication names via a videogame and

explore the impact of a CALL videogame on psychological factors using a pretest-posttest measure. This makes comparison with existing research literature challenging. However, a deeper discussion of the results can be conducted. Using a short-form MSLQ, five subscales of psychological factors were measured: intrinsic motivation, extrinsic motivation, self-efficacy (confidence), task value, and test anxiety. A total score combining all five subscales for an overall psychological measures scale was also created and assessed. The findings of each of these will be discussed individually.

The MSLQ measures two types of motivation – intrinsic and extrinsic. In terms of extrinsic motivation, the results indicated that the absolute values for extrinsic motivation were high at both the pretest and posttest time periods. This finding indicates that participants displayed high levels of extrinsic motivation overall. That is, participants were highly motivated by external factors such as wanting to achieve a good score and to show their ability to other people (such as family and friends). In addition, while extrinsic motivation scores were high at both measurements, the mean level of extrinsic motivation was higher at posttest than at pretest. Thus, the result indicated that there was a positive trend in which Medicina was associated with an outcome of higher extrinsic motivation. However, despite the positive trend, the result was not statistically significant. This finding closely aligns with the results of other psychological measures in the study such as task value and overall MSLQ. There are several potential explanations for this finding. Firstly, it is possible that the videogame did significantly increase extrinsic motivation but that findings reflect measurement issues. That is, the questionnaire did not measure extrinsic motivation appropriately given the use of the substantially shortened MSLQ questionnaire (required for logistical reasons). Secondly, the results may be due to regression toward the mean (Davis, 1976), especially given the very high scores recorded at baseline. Lastly, another potential explanation is that Medicina does significantly improve extrinsic motivation, but that the study had insufficient power to detect it due to the sample size (type II error) (Sullivan & Feinn, 2021).

Like extrinsic motivation, the results indicated that the absolute values for intrinsic motivation were high at both the pretest and posttest time periods. This finding indicates that participants

displayed high levels of intrinsic motivation overall. Hence, participants were highly motivated by internal factors such as wanting to feel challenged and wanting to understand medication names as thoroughly as possible (mastery). However, contrary to findings of the other psychological measures, the mean level of intrinsic motivation showed a very small, not statistically significant decrease at posttest. Firstly, it is possible that Medicina had little effect on intrinsic motivation among participants. Secondly, it is possible that the questionnaire did not measure intrinsic motivation adequately, given the use of the only two questions in this subscale as part of the shortened MSLQ questionnaire. Thirdly, the findings may be due to the study being underpowered or regression toward the mean (Davis, 1976; Sullivan & Feinn, 2021).

One finding notable for discussion was the impact of Medicina on confidence levels (also termed self-efficacy). Confidence was measured in two ways in the study. Firstly, it was measured using the multi-item MSLQ at repeated measures (pretest and posttest). Secondly, confidence was also assessed in a single item measure in the posttest-only feedback questionnaire. In terms of the absolute level of confidence, both measures demonstrated high levels of confidence in participants in both the pretest and in the posttest. This suggests that the participants felt confident understanding spoken medication names and performing in tasks relating to medication names. The findings from the posttest-only measure demonstrated that participants reported feeling much more confident understanding spoken medication names after playing Medicina. However, the MSLQ self-efficacy subscale did not show a statistically significant difference. This is possibly due to being underpowered (type II error) or regression toward the mean (Davis, 1976; Sullivan & Feinn, 2021). The variation in findings between the two scales regarding change in confidence may reflect the use of two different measures of confidence with variation in the questions being asked to participants. Nonetheless, the use of multiple measures of confidence is arguably a strength of the study.

Another construct measured in the study was task value. The absolute levels of task value at both pretest and posttest time periods was high. In fact, in a scale with a highest score of 14, the

median task value score was 13 at pretest (mode of 14) and a median of 14 at posttest. This finding indicates that participants strongly believe that learning medical terms (medication names) is a topic which is highly valuable and important to learn. The findings also showed that the mean level of task value was higher at the posttest than at the pretest. Thus, the result indicated that there was a positive trend in which higher task values were evident after playing *Medicina*. However, the difference did not reach statistical significance, likely due to the very high scores at baseline and regression towards the mean (Davis, 1976).

With regards to test anxiety, the results found neutral to somewhat positive test anxiety scores with a median score of 8 out of 14. Hence, the findings indicate international nursing students in this sample did not feel particularly anxious about taking exams nor were fearful of failing. Furthermore, the findings showed no change in levels of test anxiety in the posttest questionnaire compared with pretest levels. Thus, this result indicated that the videogame did not lead to changes in levels of test anxiety in international nursing students. Firstly, it is possible that *Medicina* did not affect test anxiety among participants. Secondly, it is possible that the questionnaire did not adequately measure test anxiety in the shortened MSLQ questionnaire (MSLQ-SF). Thirdly, the findings may be due to the study being underpowered (Sullivan & Feinn, 2021).

Lastly, the study combined all five subscales to form an overall psychological measures MSLQ score. With regards to overall MSLQ score, the findings of the study showed that the participants had a positive psychological measure at baseline as well as after playing the videogame. Secondly, the results suggested that the absolute score was higher at posttest than at pretest, indicating a positive trend for overall psychological states being higher (more positive) after playing the *Medicina* videogame. However, the results did not reach statistical significance, possibly due insufficient power or regression towards the mean (Davis, 1976). Consistent with the respective subscales, potential explanations include measurement issues with the short-form MSLQ, insufficient power due to sample size (type II error) (Sullivan & Feinn, 2021), regression towards the mean (Davis, 1976), and the sample characteristics.

Feedback from participants in the posttest feedback questionnaire provides further evidence and context regarding the impact of the Medicina videogame on psychological constructs. Of participants who responded to the qualitative feedback questions, 37.5% commented without prompting that the videogame improved their confidence regarding medication names. For example, participants stated that Medicina caused them to become “much more confident” (‘P4’), “helps to gain more confident [sic]” (‘P7’), and that the videogame helped to “boost confidence” (‘P5’). Participants in the feedback questionnaire also mentioned the videogame increasing intrinsic motivation (such as sense of challenge and mastery). For example, one participant stated, “the excellent thing is that this game makes student [sic] try hard for every attempts so that they can improve themselves” (‘P2’). Similarly, another student commented that players “need lots of patience, because once you get wrong for three times you have to start all over again. Not easy to do it again and again” (‘P1’). Qualitative feedback supporting the positive perceptions and benefits of Medicina in terms of psychological factors such as motivation and confidence is discussed in more detail in section 6.7 of chapter 6. Hence, the relationship between psychological factors and the videogame was further supported by the qualitative participant feedback from the posttest questionnaire.

In summary, the results of the psychological state measures indicated participants had high levels of intrinsic motivation, extrinsic motivation, task value, and self-efficacy related to learning medication names via the videogame, as well as low levels of test anxiety. These psychological states remained highly positive at baseline. Non-significant increases were found in extrinsic motivation, task value, and total MSLQ scores. The evidence of positive psychological effects was further supported by quotations in the qualitative feedback questionnaire as well as the single item confidence measure showing Medicina increased confidence in understanding spoken medication names.

A review of the research literature indicates that the present study is the first to assess multiple psychological state factors using the MSLQ or a pretest-posttest measure more broadly in

CALL videogames in nursing education. While this adds to the novel and significant original contribution to knowledge of the study, it also means that direct comparisons between the findings in the present study and that of the pre-existing research literature is limited. Of the four computer-based videogames in nursing education identified in the literature review (Pront et al., 2018), none evaluated psychological measures in both pretest and posttest like the current study. However, there are comparisons which can be made in terms of posttest only assessments. In particular, Müller (2011b) evaluated the efficacy of the single-platform computer-based *Medicina* with 25 international nursing students. Participants were asked at posttest only about their confidence and results indicated that participants displayed a high level of absolute confidence as a result of playing the game and this was triangulated to the qualitative comments section.

Furthermore, the trends are similar to the results for the *Brevissima* computer-based CALL videogame which aimed to teach medical abbreviations to international nursing students (Müller & Price, 2012). Müller and Price (2012) used a qualitative survey to evaluate perceptions of *Brevissima* in a sample of 11 international nursing students. In a posttest-only feedback questionnaire, participants' opinions of the gameplay were positive, with many users mentioning positive effects of the game and specific features on confidence and motivation. More than one third of participants spontaneously mentioned game scores during feedback without prompting and mentioned the scoring system in the videogame providing a source of motivation and self-assessment. It is important to note that the study did not provide quantitative analysis of the single-platform videogame *Brevissima* or evaluation at both pretest and posttest for psychological factors such as motivation and confidence (Müller & Price, 2012). Despite this, the positive feedback on psychological impacts is similar to the absolute high levels of confidence at posttest and positive trends for psychological measures noted in the current study.

Some of the previous studies on single-platform computer-based videogames in nursing education also discussed psychological effects of the videogames but do not appear to have measured them as part of the study. For example, Foss and colleagues' (2013) *Medication Game*

aimed to educate nursing students for simple mathematical and medication calculation skills as well as standard medical units and expressions. The authors discussed the potential impact and benefits of the game to test anxiety, self-efficacy and motivation among students. To evaluate the efficacy of the Medication Game, Foss et al. (2014) conducted a randomised controlled trial over four and a half weeks with students in a baccalaureate nursing course on medication calculation at two Norwegian universities. Data were collected via examination results after the intervention period, gaming metadata, and a questionnaire. The authors provided repeated discussion of test anxiety, motivation, and self-efficacy, and the benefits provided by the game in these psychological areas in the evaluation papers. Despite this discussion, Foss and colleagues do not appear to have measured these directly as part of the evaluations. However, the authors did note the importance and value of measuring these psychological effects in future research.

Similarly, the literature review conducted identified substantial previous research regarding international nursing students which highlighted the issue and impact of test anxiety, fear of failure, and lack of familiarity with the test formats used in academic settings in Western countries among this population (e.g., Crawford & Candlin, 2013; Malu & Figlear, 1998). The results of the present study indicated that participants in this sample did not appear to suffer from test anxiety including a general fear of failing tests. This is contrary to the findings of previous research regarding international nursing students (e.g., Crawford & Candlin, 2013; Malu & Figlear, 1998). A potential explanation for this discrepancy is the unique characteristics of the sample due to COVID. This may include the high duration of time in the country, advanced level of study (leading to more experience and familiarity with tests), and atypically high level of language skills at baseline.

Although this is the first study to measure test anxiety in this specific population and context, the finding is consistent with research regarding test anxiety from the broader research literature. Test anxiety is a type of state anxiety, rather than trait anxiety (Martin & Naziruddin, 2020). The distinction between trait and state measures are among the most significant and long-standing concepts in psychological and personality-related theories and research. As defined by Schmitt and

Blum (2020, p. 5206), “states are characteristic patterns of thinking, feeling, and behaving in a concrete situation at a specific moment in time. Unlike traits, states vary across time as a function of the situation the person encounters”. In the current study, the focus was on state measures of psychological factors rather than traits. Research indicates that test anxiety is affected by situational factors such as the perceived consequences of the test such as having a high-stake or low-stake setting or outcome (Clark et al., 2018; De Jonge et al., 2024; Martin & Naziruddin, 2020; Sommer & Arendasy, 2015; Von der Embse et al., 2018). In particular, previous research has found that tests with a perceived high-stakes nature or consequences are related to higher test anxiety than low-stakes testing (Sommer & Arendasy, 2015; Von der Embse et al., 2018). In the current study, the testing consequences and context were low-stakes. The performance of participants was anonymous and did not impact their grades or their educational outcomes. That is, the neutral to slightly positive levels of test anxiety reported may relate to the testing not being linked to grades and was low-stakes. Hence, this situational context may thus provide an explanation for the low median test anxiety (a state-based measure) identified, and is consistent with previous research.

It is interesting to compare the results of the current study with previous research especially for the psychological impact on motivation. Motivation is considered one of the major advantages of videogames in nursing education and was emphasized by authors of the four reviewed games. For example, Foss et al. (2014, p. 346) argued that the positive effects of the Medication game may include “increased motivation and active learning reinforced by instruments of entertainment.” Similarly, the single-platform Medicina was described as a “fun game” (Müller, 2013, p. 292) that increased motivation “through a diversification of delivery methods” (p. 162), leading to increased confidence to engage in clinical placements and classes. In addition, Müller and Price (2012) highlighted key features of the Brevissima game that promote motivation in nursing students. For example, student interaction is achieved through constant spatial movement and touch selections, engagement with multisensory stimuli, as well as time limitations. In addition, the feedback and scoring system provides reward for effort in a genuine and continuous way.

Research outside the nursing education context for videogames in general also have previously indicated that videogames can increase motivation (e.g., Dondlinger, 2007; Granic et al., 2014; Lee & Peng, 2006). In a review of educational videogames, Dondlinger (2007, pp. 22-23) concluded “all find that motivation to play is a significant characteristic of educational videogames.” Exactly how or why players are motivated through videogames is unclear, but it seems that these distinct design elements are key: narrative context, rules, goals, rewards, multisensory cues, and interactivity, immersion (Bellotti et al., 2010; Lee & Peng, 2006). The opportunity to apply subject matter in a new context (Rieber, 1996) and transference are also important. Furthermore, Garris and colleagues (2002) reviewed videogame learning and discussed fantasy, rules/goals, sensory stimuli, challenge, mystery, and control as key videogame characteristics that trigger intrinsic motivation and self-directed repeated gameplaying as part of the game cycle.

Hence, the previous reviews theorise that videogames may be a useful educational tool in nursing education to increase motivation. This is consistent with the many of the positive trends seen in the current study. However, this appears to be the first study to assess psychological measures using both qualitative feedback and a quantitative pretest-posttest measure to detect levels at both time periods (and change over time) before and after using a CALL videogame in nursing education. The results of the current study highlight the significance and value of more detailed assessments in the future.

A second issue is that of how motivation is conceptualised and assessed as a construct. The previous studies identified in the literature on computer-based games in nursing education appear to have described motivation as a singular construct. However, in psychological theory motivation is typically conceptualised as incorporating two elements: intrinsic and extrinsic motivation. Indeed, the MSLQ, which is one of the most commonly used measures of psychological constructs in learning environments measures intrinsic and extrinsic motivation as two separate subscales. In the current study, the results indicated highly positive levels of both intrinsic and extrinsic motivation at

both measurement periods. However, in comparing levels before and after using *Medicina*, there was a different pattern seen for the two measures, with mean extrinsic motivation increasing at posttest but mean intrinsic motivation slightly decreased. Given the novel nature of the finding, the unique sample characteristics due to COVID, more research is needed to investigate this issue further.

In summary, research question two asked, “What are EAL nursing students’ psychological feelings (such as task value, confidence, motivation, test anxiety) regarding learning medication names via a CALL videogame?” and “What is the impact of the *Medicina* multiplatform videogame on such psychological-related factors in EAL nursing students?”. Results showed that participants had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall MSLQ score at baseline and at posttest. Non-significant improvements in extrinsic motivation, task value, and overall MSLQ were also found at posttest. Thus, answering research question two, international nursing students had positive psychological feelings regarding learning medication names via the videogame both before and after playing *Medicina*. International nursing students strongly believed that medication names were valuable and important to learn, and felt motivated and confident to do so using *Medicina*.

Lastly, as part of the discussion of these findings, it is relevant to acknowledge some potential limitations. This study assessed psychological factors using a self-report questionnaire. Self-report measures are known to be associated with potential sources of bias which may threaten the validity of the findings (e.g., Althubaiti, 2016; Betts Razavi, 2001; Pekrun, 2020; Teich et al., 2024). Examples include social desirability bias, memory/recall errors, and problematic response styles (such as acquiescence, extremity, or central tendency responses) (Althubaiti, 2016; Betts Razavi, 2001; Pekrun, 2020; Teich et al., 2024). Despite these issues, self-report measures are widely employed in research, especially for measuring psychological variables related to learning that involve gaining insights into internal factors which are difficult to achieve via external objective measures (Pekrun, 2020; Teich et al., 2024). As noted by Pekrun (2020, p. 191), “self-report is

indispensable for any more fine-grained assessment of mental processes, including students' motivation, emotions, cognitive strategies, and metacognition during learning." Accordingly, self-report was deemed a relevant and necessary method taking into consideration the context and goal of this research question. Furthermore, while self-report measures were used in some parts of this study, it was not the only method employed. For example, to measure game usage behaviours, comprehensive gamelogs were used. Technology-based direct measures like gamelog data may reduce or avoid the impact of recall bias and social desirability bias associated with self-report methods (D'Mello, 2021; Hartevelde & Drachen, 2015). The next section will discuss the findings related to game usage obtained using gamelogs.

6.5 Game Usage

Extensive gamelogs were obtained and identified how participants interact with the Medicina videogame. The results showed there was wide variation in gameplaying behaviour among participants. Overall, participants fell into one of three engagement categories being no engagement, lighter engagement, and deeper engagement. Over the intervention period, participants who played the game played a mean of 13.47 sessions and a mean total time of 35 minutes. The mean total score was 65,882 which indicated a mean of 264 medication names answered correctly by participants playing the Medicina videogame. As such, the gamelogs indicated participants who engaged with the game had high levels of exposure to a sizeable volume of medication names through playing the Medicina videogame. In terms of platform, there was a strong preference for the WebGL platform over the Android platform, and most participants consistently chose one device. Avatar preference was more balanced, and most participants played using both avatars at least once. Most participants played all three difficulties at least once. Medium was the preferred difficulty level overall, played by the highest proportion of players, the highest proportion of sessions, highest mean number of sessions, highest mean time, and most likely to be the final difficulty level played. Easy was the least popular difficulty level. Patterns of gameplay revealed participants most often started with the easy level first, before moving to medium and hard, and that

the progression between difficulty levels happened rapidly on the first day within a mean of 11 minutes (albeit there are a number of rounds in this fast-paced game which are completed within those 11 minutes). Progression between difficulty levels likely occurred as an aspect of scoping out the game, rather than as a consequence of mastering each level before gradually progressing to the subsequent level. The following section will provide discussion of some of these novel findings.

6.5.1 Game Engagement Patterns

Among the events analysed, the study investigated patterns around the frequency and duration of usage of the Medicina videogame. Gamelogs were used to objectively explore this pattern of usage. The results indicate that participants varied a great deal in their patterns of usage. Overall, there was a trend that people tend to fall into one of three broad categories: never played, played a little, and played a lot. Firstly, some students completed the pretest questionnaire but despite having access to the game and directed to play, never played the game even once. This was termed ‘no engagement’. Secondly, some students played the game a small number of times (usually in the immediate aftermath of completing the questionnaire) but then did not play much or at all over the full intervention period. This was referred to as ‘lighter engagement’. Lastly, there was a group of participants who played many times, over many different sessions during the trial period and achieved high scores. Participants who interacted in this manner were referred to as having ‘deeper engagement’. Based on this categorisation, the findings demonstrated 47% of participants showed no engagement, 22% met the lighter engagement category, and 31% demonstrated deeper engagement.

During the current study, participants who played the Medicina videogame played a mean of 13.47 sessions with a mean total playing time of 35 minutes. Among participants who played the videogame, one in four (24%) played Medicina for over an hour in total. The mean total score was 65,882 which indicated a mean of 264 medication names (one name per round) answered correctly while playing Medicina. The gamelogs also investigated patterns regarding the first sessions participants played and their highest scoring session. For the first session played, the mean playing

duration was just under 2 minutes with a mean of 12 medication names answered correctly. The mean longest session was just under 6 minutes and highest scoring session involved a median of 51 medication names answered correctly. Among participants who played the game, 41% achieved a highest score of 15,000 or more (60 correct answers) in a single session. The pattern and frequency of game usage is possibly due to the players' motivation and enjoyment, as well as to external factors such as students not downloading or playing the game due to unrelated responsibilities (being busy with employment, study, or family roles) during the intervention period.

The results demonstrated in the current study are unique and novel. The previous evaluations of similar computer-based CALL videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012) did not include a comprehensive, multifaceted analysis of game usage frequency as performed in the current study. Similarly, most studies of mobile-based CALL videogames (outside of nursing education) did not investigate game usage frequency. One previous study was identified which provided information about CALL game usage (Pham et al., 2018). However, that study involved a single-platform mobile phone-based app and did not focus on nursing students. To evaluate patterns of use for the English Practice game, Pham and colleagues (2018) conducted an exploratory study using data collected from gamelogs and associated app-store user information (using inbuilt Google Firebase Analytics) during a 3-month period. Results of the study by Pham and colleagues (2018) indicated that on average language learners used the app for about 5 minutes each session and averaged 10 uses before uninstalling it.

In contrast, findings in the current study showed the mean overall total duration of gameplay (accumulative sum of all sessions) was 35 minutes and the mean number of sessions played was 13.47 sessions. It is worth noting that when playing *Medicina*, students are getting rapid fire medication names appearing every 12 seconds on medium level (or less time if they select a medication name sooner or were playing at hard difficulty). It is also an intensive gameplay with little room for hesitation or mishearing before players lose and have to restart a new game session starting at zero points again. In this context, the game usage data is particularly impressive. The

finding indicates positive levels of engagement and high levels of exposure to medication names. Repeated exposure is crucial to improving language skills for specialised vocabulary, developing automaticity, increasing language processing speed, and reducing cognitive load (Müller, 2011a; Schmitt, 2008; Webb, 2007). Interestingly, the highest total duration of gameplay recorded by a participant for the Medicina videogame in the current study was 173 minutes (just under 3 hours) and 24% of participants who played the game did so for over 1 hour in total. Hence, descriptive analyses showed that the duration of gameplay and number of sessions played was higher among students who played the Medicina videogame in the current study than previous research such as the English Practice game.

However, similar to the study by Pham and colleagues (2018), there was wide variability in game usage. Whereas the current study categorised players into three engagement patterns, the study by Pham and colleagues used four categories. In that study, results showed 30% exited the app immediately and never went back after installation (bounce engagement), 24% played for less than 15 minutes total (shallow engagement), 14% played for more than 15 minutes but removed it within 7 days (deep engagement), and, in the highest level of engagement, 31% played for more than 15 minutes and kept using it for more than 7 days (complete engagement). Hence, a third of users never played the app and over half of users (54%) played the mobile phone-based game between zero- and 14-minutes total over a three-month period. Therefore, the results of the current study in terms of patterns of usage frequency of the game are consistent with research on mobile app usage in general.

Direct comparison of the proportions between the two studies is challenging due to measurement differences. The study by Pham and colleagues (2018) included four categories versus three in the current research and incorporate slightly different meanings and measures of engagement. However, broadly speaking, there were a similar proportion of participants in the highest engagement category, being 31% in both studies. In addition, the proportion of players who played the game but played for less than 15 minutes (called 'lighter engagement' in this study) was

similar in both studies – 22% in this study versus 24% in the study by Pham and colleagues (2018). In both studies, more than half of participants played the game to some degree. The proportion of participants in the lowest category of engagement was higher in the current study (47% ‘no engagement’) than reported by Pham and colleagues (30% ‘bounce engagement’). However, it should be noted that in this study the category included participants who never downloaded or installed the game, whereas in the study by Pham and colleagues (2018) the lowest category was reported to involve players who downloaded and installed the game to their phone and opened the game, but then immediately exited the app (‘bounce engagement’). This may account for some of the differences in proportions. However, the findings are unique and significant, with the present study being the first to provide detailed, objective gamelog analysis of a CALL videogame among international nursing students or nursing education more broadly.

Furthermore, by not excluding participants who did not finish the posttest, this study was able to obtain a more complete, accurate, unbiased picture of participant game usage. Attrition is a well-known methodological problem in longitudinal studies generally, such that “attrition rates from 30 to 70% are often reported (Gustavson et al., 2012, p. 1). Similarly, in nursing education research, participant attrition is a common issue in previous studies of support programmes for international nursing students. For example, in the study by Seibold and colleagues (2007) out of the 20 international nursing students in Australia enrolled in the face-to-face support programme, only nine attended the intervention and completed the posttest evaluation (Seibold et al., 2007). Furthermore, in higher education broadly, online courses typically have high levels of non-completion (including a markedly higher rate than face-to-face learning), with some statistics reporting a drop-out of 70-99% (Delnoij et al., 2020; Shaikh & Asif, 2022).

This study was a multiphase quasi-experimental trial involving three phases of participation over a two-week period. In this case, ‘non-completers’ refers to participants who started the study (completed phase one) but either did not play the game in phase two and/or did not complete the posttest questionnaire in phase three. In the case of CALL videogames in language learning,

previous research has shown that a common and typical aspect of gaming behaviour is that engagement levels differ and a sizeable proportion of players will never play the game (Pham et al., 2018). In the current study, results of inferential statistical analyses demonstrated that there was a significant relationship between playing the game and completion of the posttest, and the effect size was large. Overwhelmingly, the participants in the current study who completed the posttest were those who engaged with the game. Hence, if only participants who completed the posttest were included in the study, the findings regarding game engagement and game usage behaviours (as well as other measures) would likely have been vastly different and presented an inaccurate, potentially biased picture of game usage. In the unique context of the current study, the information that could be obtained and the understanding that could be gained from non-completers was of substantial value. Thus, it was a strength of the current study that non-completers were included in the research and analyses. As a result, the study provided many novel insights and significant original contribution to knowledge.

6.5.2 Platform Usage

One of the novel aspects of this study was the analysis platform usage patterns based on the objective gamelog data. The Medicina videogame developed and evaluated in the current game was accessible on two platforms: the WebGL version (for use on laptop/desktop computers via the web) and the Android mobile version (available via an Android APK file and playable on Android devices such as smartphones and tablets). Both platform versions of the application were available to all participants and participants were free to choose to play the game using whichever platform they preferred. The results of the gamelogs in the current study found evidence to indicate that the WebGL version of the game played on desktop and laptop computers was overwhelmingly the most popular platform among participants.

Among participants who played the game, the majority (81%) used only one platform type to play Medicina. Of the players who used only one platform, just one player used solely the Android device, with the remaining 92% using only the WebGL platform. The WebGL version was played

at least once by 94% of players. In contrast, just four participants (24%) played Medicina using the Android platform at least once. As a proportion of total playing sessions, Android devices were used for 6% of sessions while WebGL was used for 94% of sessions playing Medicina. In summary, while both platforms were played to some extent, the findings indicate that the WebGL platform version was the most popular.

This finding about device/platform usage and preference is very interesting and significant. The current study was the first to study a multiplatform CALL videogame in nursing education. Until now, serious game interventions in both language learning and nursing education have studied computer-based videogames and mobile-based videogames separately in different studies (and using different interventions and assessments). A review of the research literature indicates that this is the first study to examine detailed gamelogs for two platforms for the same game at the same time and to subsequently analyse and compare the usage patterns among the different platforms. This finding highlights the value of studying a videogame available on multiple platforms in a single study. It is understandable that the platforms have only been studied separately in past research. Historically, they were studied separately in part because of the differences in technology. However, the results of the present study demonstrate the importance and value of studying the technologies together in the way conducted in this current research. This represents a significant original contribution to knowledge.

Previous research has emphasised the advantages of mobile-based CALL videogames (e.g., Chinnery, 2006; Godwin-Jones, 2011; Kukulska-Hulme & Shield, 2008; Miangah & Nezarat, 2012; Ogata & Yano, 2004; Viberg & Grönlund, 2012). In particular, the purported advantages of CALL using mobile devices over traditional computer-based CALL methods have included flexibility, portability, connectivity, spontaneity, availability, interactivity, user-friendliness, permanency, accessibility, immediacy, and situating of language learning activities into everyday life (Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). Hence, it is often arguably implied or assumed that CALL videogames using mobile devices will be more popular and used more

frequently than traditional desktop or laptop devices. This is potentially due to the heavily discussed benefits of ubiquity and portability of mobile devices, meaning they are able to be used anytime and anywhere. It is also possibly an assumption based on the research from predominantly entertainment-focussed games which finds that mobile platforms are the most popular platform (Statista, 2021b, 2022c). It is potentially assumed that user preferences and usage patterns for entertainment games and serious educational games is the same. However, the findings of the current study challenge and contradict this view.

Results of the study showed that while both platforms were used, most participants played on the desktop rather than the mobile app. There are many potential explanations or reasons for this finding. Firstly, it could be influenced by the fact that the study recruitment was conducted during the COVID-19 pandemic. As a result of the pandemic, universities changed classes to be done online with either no or significantly fewer in person classes. There was also significantly reduced use of public transport, socialising, and group lunchbreaks. Overall during the pandemic, people were significantly less likely to even be in the situations where mobile games are typically described as being great for playing 'anywhere anytime'. They were more likely to be at home with a laptop or desktop computer, especially when people were in lockdown, not attending classes in person, not using public transport, not in cafes, and no longer waiting to see friends. Also, increased attention and concern was given over hygiene related to mobile phones as a source of infection/risk of getting infected. For students in a health discipline such as nursing education, this may have been a small but added consideration discouraging phone use. Therefore, there was significantly less emphasis and less relevance on portability, which has previously been perceived as a major reason for the value of mobile-based CALL applications. Therefore, in the context of COVID, it is possible students used the Android app less compared with their desktop/laptop because they were mostly at home, doing less commuting, with most classes online not in person. Hence, the findings regarding platform use identified in the current study may reflect changes that occurred during the COVID-19 pandemic and the impact the outbreak had on student mobility and learning.

Furthermore, the choice of platform may reflect the primary purpose/context of the Medicina videogame. Specifically, the fact that it is a videogame used for learning and education rather than entertainment. Data regarding the gaming industry overall across all genres indicates that the most popular platform and the most profitable platform for videogames is the mobile platform (Statista, 2021b, 2022c). For example, in terms of revenue, data indicates that mobile was the top-ranking platform in 2022, responsible for \$92.2 billion USD in annual revenue (Statista, 2022c). In contrast, browser PC games (to which the WebGL version of the multiplatform Medicina videogame would belong) are the fourth most profitable platform, earning just 2.3 billion USD annually (Statista, 2022c). However, these figures are across all genres and would likely primarily represent games for entertainment rather than educational purposes. It is possible that this pattern of device popularity is not true for serious games for professional educational purposes such as the Medicina videogame, as opposed to purely entertainment-based games. One potential reason for this is that students may see serious CALL videogames as part of their study, and as a result these students may prefer using the game at the same time as doing their classwork on their desktop/laptop computer. Thus, this finding would suggest that students may use serious games in a different way than the way they use entertainment games. In particular, students may perceive serious games as part of (rather than separate to) their main study work. For students who do most of their study on desktop/laptop devices, they may therefore be playing the videogame on their laptop/desktop while doing classwork.

Since the current study is the first study to investigate platform usage preferences in multiplatform videogames in language learning or nursing education, it makes comparison with previous research difficult. However, expanding the literature review to other fields, the finding is consistent with the results of research regarding platform usage in other educational tools outside of CALL videogames. For example, a study by Delaviz and Ramsay (2018) investigated device preference for short instructional videos in an engineering course at the University of Toronto in Canada from 2016 to 2018. The educational videos were available across all device platforms via

YouTube and an online learning system website. The study found that 95% of video views were performed using personal computers (laptops/desktops), whereas just 5% used either tablet or smartphone mobile devices. In fact, smartphones were the device least commonly used by students, accounting for less than 2% of views. Interestingly, the findings by Delaviz and Ramsay (2018) are not consistent with data about YouTube device preferences in general, where 63% of YouTube viewing time overall is conducted using mobile phones compared to just 12% using desktop (Statista, 2021a). Thus, the finding of the current study is consistent with the results of studies investigating platform preference in other educational tools (such as online videos rather than CALL videogames). This pattern suggests that students may prefer to engage with educational applications using personal computer devices rather than mobile devices.

In addition, it is possible that gameplay may have been affected because it was part of a study rather than normal videogame usage. In order to use the mobile version of the Medicina videogame, students in the study were required to download the app from the website to their phone and login to play the game. This was essential to control access to the game and to be able to get the data for the gamelogs which were vital for the study analyses. Needing to download the game is also consistent with the procedure of previous studies. It also did not seem to affect the use of the desktop game, which suggests the requirement for students to login is unlikely to be the primary cause of this finding. However, it is still important to mention this issue as a possible (although unlikely) explanation for the result.

One factor which does not explain the finding is the demographics of this sample related to past videogame playing history and device preference. As part of the pretest demographics questionnaire, participants provided information about their previous experience and usage of videogames. Results showed that most popular videogame playing device among the sample was a mobile device such as a smartphone or tablet. In total, 26 participants (81%) reported they frequently played videogames on mobile devices. In contrast, a computer device (such as laptop or desktop computer) was played frequently by 38% of participants. Thus, it is interesting to note that

the pattern of platform usage identified in the current study is significantly different to the device usage participants reported regarding their previous videogame playing history.

However, another potential explanation for this finding is that factors related to the specific gameplay features and skills may be important. Firstly, this game requires intensive listening skills. Students must not only listen to the verbal medication names, but they must also deal with hearing the distraction sounds in the background at the same time. This requires not only a high level of listening skills, but also considerable selective attention skills and high cognitive load, with multiple audio sources involved. Most casual games do not involve such intensive listening skills and audio. Instead, they predominantly involve visual processing. In entertainment-based games, when there is sound, it is mostly 'sound effects', not the primary focus of the game. Playing this game in a loud environment or where people may need to 'keep an ear out' for other noises, such as on public transport, may mean this game is not well-suited to playing in mobile form in public. It is worth noting that when playing *Medicina*, students are getting rapid fire medication names appearing every 12 seconds on medium level (or less time if they select a medication name sooner or were playing at hard difficulty). It is also an intensive gameplay with little room for hesitation or mishearing before players lose and have to restart a new game session starting at zero points again. Thus, it is possible that the results are due to the specific features of the *Medicina* videogame's audio requiring intense listening skills. In contrast, casual mobile-based games often require less sustained attention, a focus on mostly visual rather than audio stimuli, and the ability for players to look away from the screen often. Therefore, the central involvement of audio and listening skills may have an impact on the finding regarding platform use.

Aside from sensory-related features, other factors related to the type of game features may also be significant. Secondly, the game involves people playing for set durations, where your scores accumulate. Although the medication names are presented randomly each gameplay, if the user stops playing, the user must start a new round next session, meaning they lose that winning streak. In contrast, in most casual games, users can save their progress, instantly log out and log back into

same point, meaning users can pick up exactly where they left off. This could potentially affect students playing on mobile more than WebGL versions because it is possible they may play for shorter durations and need to stop more suddenly if they are playing in public (e.g., on public transport). This would therefore affect the ‘reward’ aspect of the game. Thirdly, the screen size may be an issue. Students must read the names of the medications on the bottle. It is possible that for some, it was much easier to read these names quickly and clearly on the large desktop/laptop screen compared to mobile.

Fourthly, cognitive load may be a factor. Medicina is a videogame that requires high cognitive load and the use of multiple high-level skills (listening, reading), senses (auditory, visual, haptic/touch/movement), significant selective attention, and concentration. This game may simply not be good to play in public, such as on public transport, where there are a lot of distractions (people, noises, visual). For example, if playing on public transport, there are lots of people around, jostling movements (which may affect picking the correct bottle), and the need to be alert to place in order to not miss alighting at the correct stop (which means listening to audio announcement on train or looking away from screen – may lose). Moreover, in the Medicina videogame there is both foreground and background audio stimuli. In this case, there is audio specifically used as background noise to be interpreted by students as background data. This could be understood as essential to the students learning experience. This audio-based game mechanic would be considered as essential to students learning experience. It also adds to the cognitive load of the videogame. In the qualitative feedback questionnaire, multiple participants commented unprompted on the challenging nature of the game, the impact of the background sound effects, and need to focus and concentrate while playing the game. Hence, the issue of cognitive load and audio-intensive features raises potential challenges to the usage of videogames in addition to the possible benefits of mobile games (such as portability and availability).

Thus, the previous research emphasised CALL videogames using mobile-based devices as having advantages over traditional computer-based devices, especially due to their ubiquity and

portability (e.g., Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). However, the results of the current study regarding platform usage patterns for the Medicina videogame may challenge these assumptions. In particular, the results may indicate that the functioning of the educational, audio-intensive multisensory videogames requiring high attention and cognitive load may not be best suited to mobile devices. This especially in relation to the way in which mobile games are thought to be used in public places such as on public transport. Indeed, the advantages of mobile-based videogames may not take into consideration aspects related to a CALL videogame such as to improve complex language skills in international nursing students. Hence, this finding represents a significant original contribution to knowledge.

In addition to the factors discussed previously, the finding may also be affected by the geographical location of the sample. The current study was conducted in Australia. While a very small number could potentially have been located offshore, the vast majority were based in Australia. This is significant because data shows that in Australia most people use desktop/laptop computers more than mobile devices. In fact, 60% of internet traffic in Australia is via desktop while 36% uses mobile phones (with the small percentage remaining using tablet) (Statcounter, 2022c). This pattern of platform use is in fact opposite to worldwide trend, in which 60% is mobile versus 38% desktop (Statcounter, 2022d). Therefore, another possible explanation for the results is the choice of sample used in the current study, which was conducted using participants predominately based in Australia, who are more likely than other samples to use desktop devices over mobile devices.

Other potential reasons were also explored but are unlikely. For example, the mobile version was Android not Apple, meaning it required students to have an Android device. One participant said they only had an Apple iOS phone so while they very strongly wanted to use the app it was not possible given the app was Android only. Unfortunately, information regarding the device availability among the remainder of the sample was not known as it was not an item included in the questionnaire. However, in Australia where the sample was conducted, research shows that Android

is vastly more popular than Apple iOS (Statista, 2022b). This is also consistent with international statistics showing that in 2021 the Google Play Store is the leading app store worldwide, with the highest number of apps available and the most app downloads, while Apple's App Store is the second most popular (Statista, 2022d). Therefore, given the popularity of Android over Apple mobile devices both in Australia and worldwide, the choice to use the Android platform was not likely to be primary reason for the lower levels of mobile app usage compared with the web-based/desktop usage. In addition, cost was considered unlikely to be a factor in platform usage preference. Firstly, there was no direct cost involved in playing the game such as a fee for downloading the game. Secondly, on campus universities provide free wi-fi access (such as Eduroam) for both laptop and mobile device usage. Thirdly, as discussed previously, 36% of internet traffic in Australia occurs through mobile devices Statcounter, 2022c). Therefore, concerns about cost would likely affect both web and mobile access to some degree and would be unlikely to explain the pattern observed in platform usage preference, where only 6% of sessions played by participants occurred via the mobile platform. Further research is needed to explore motivations and reasons for platform usage in multiplatform CALL videogames in nursing education.

6.5.3 Avatar Usage

There were two avatars available in the Medicina videogame which were both designed in a cartoon-like, animated style (see Figure 4 and section 3.6.2.1 in chapter 3). Information about patterns in avatar usage were collected using gamelog data. The findings from gamelog data indicated that both avatars were used by the participants in the sample. Among participants playing the game, more than half (59%) used both avatars at least once. In contrast, 41% of participants consistently chose only one avatar rather than trying both. Examining the two avatars individually, each of the two avatars were used at least once by over 65% of participants. Overall, avatar 1 was chosen for 42% of game sessions, while avatar 2 was selected for 58% of all game sessions. Hence, the results indicated there was a fairly even split between the two avatars. However, exploration of

the avatar usage patterns at the player level indicated that most participants tried both avatars at least once but then subsequently tended to stick to one avatar relatively consistently.

In addition to the quantitative data, feedback from participants in the posttest questionnaire provides further evidence and context regarding avatar usage in the videogame. Medicina's avatars and the multisensory stimuli featuring the avatars were a common theme in the feedback from participants. More than two thirds (70%) of feedback questionnaire respondents had positive comments about the avatar characters and liked their inclusion in the game. Participants reported that they "like the characters" ('P6') and felt the avatar character "makes [the game] more interesting" ('P7') and "gives some attractions for players" ('P2'). While describing their positive opinion of the avatars in the game, one participant emphasised the benefit the avatars added for realism, saying the avatars provided "good visual distraction. In clinical environment, especially the Paediatric Department, there will be a lot of distractions. Clean background would make the game too easy compared to reality" ('P5'). Another participant highlighted the interaction of the avatars, immediate multisensory feedback, motivation, narrative, and realism of Medicina in the nursing education context:

The characters in the game are cleverly designed with nurses, me and patients. If I get it right, the nurse gives me encouragement, which is very important. If I get it wrong, there could be very serious consequences for the patient. ('P4')

Therefore, findings from the feedback questionnaire indicated that avatars were positively perceived by participants, and that avatars potentially had an effect on interactivity, motivation, enjoyment, and engagement. Furthermore, the comments from participants provide indicate that avatars may add a sense of realism and identification with the characters and narrative of the videogame in the nursing education context.

In videogames, an avatar is a graphical representation of a user which aim to enhance interaction in the virtual environment (Inal & Cagiltay, 2006; Peterson, 2005). Research indicates that avatars may have a positive effect including increasing motivation, self-esteem, engagement,

realism, identification, and game loyalty/retention (Inal & Cagiltay, 2006; Kao & Harrell, 2018). Avatars can come in many formats and styles such as cartoon animated characters or photorealistic avatars (Segaran et al., 2021). However, in CALL and computer-based videogames in nursing education, previous videogames have typically used avatars designed as animated cartoon-style characters (e.g., Müller, 2011b; Müller & Price, 2012). In addition, research regarding digital game-based learning has recommended cartoon-like character designs as improving positive emotional experiences among players over highly realistic avatars (Segaran et al., 2021). The present study is similar to previous research of computer-based videogames in nursing education as the design of the two avatars was heavily based on the assets developed by Müller (2011b; Müller & Price, 2012).

None of the computer-based videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012) or mobile-based CALL videogames in language learning (e.g., Amer, 2014; Jere-Folotiya et al., 2014; Kohnke et al., 2021; Pham et al., 2018; Thongsri et al., 2019) identified in the research literature collected gamelogs and reported evaluations of avatar usage patterns. As such, comparison of the findings of the current study with existing evaluated studies is limited. Hence, this is a novel contribution of the current study.

However, in terms of the qualitative feedback comments from participants regarding avatar use, the trends in the current study are similar to the results for the Brevissima computer-based CALL videogame which aimed to teach medical abbreviations to international nursing students (Müller & Price, 2012). Müller and Price (2012) used a qualitative survey to evaluate perceptions of Brevissima in a sample of 11 international nursing students. In a posttest-only feedback questionnaire, participants' opinions of the avatars were positive, with many users mentioning positive effects of the avatars on confidence and motivation. The authors labelled the avatars as a "focal point for the emotion and realism of the learning experience" (Müller & Price, 2012, p. 159). In addition, it was noted that while avatars increased realism, they also acted to reduce the emotional pressure associated with more traditional learning methods (such as exams). Mediating

the students' responses to the educational materials. It is important to note that the study did not provide quantitative analysis of avatar usage for the single-platform videogame *Brevissima* (Müller & Price, 2012). Despite this, the positive feedback on avatar use is similar to the qualitative feedback at posttest identified in the current study.

Research from outside the nursing education field may provide further context and potential explanation for the findings identified in the current research. For example, one potential influence on choice of avatar may be the gender of participants. Research has found that most people choose avatars of the same gender and that this trend is particularly true for female players (Martey et al., 2014). For example, research shows that more than 77% of men and 93% of women choose same-gendered avatars (Martey et al., 2014). Gender is especially relevant for the current study as most of the participants were female (78%). In the current game, there were two avatars. The participants could choose which of these two to use as their avatar in the game. In the current study, both avatars had a cartoon-like animated appearance and were of a similar style. This may be one potential reason for the findings showing both avatars were used at least once by more than 65% of participants, and most participants (59%) switch between the two avatars over the gameplay period. However, as a proportion of sessions, one avatar was used slightly more than the second avatar (58% vs 42% of sessions). Although both avatars had a cartoon-like animated appearance of a similar style, one (Avatar 2, see Figure 4) arguably looked slightly more 'typically female' appearance than the other (such as a shoulder-length hairstyle). It is possible that the choice of avatar therefore reflects the gender of participants as well as the importance of realism, authenticity, and identification with the narrative in this study. It is important to note that previous research regarding gender and avatar choice have typically been done on MMORPG (massive multiplayer games), especially those with fantasy types of characters (such as elves) for entertainment purposes (Martey et al., 2014). The current study is different as the study involves a serious game for educational purposes, which makes the findings of the study even more relevant and interesting.

Numerous psychological and social factors may influence a participant's avatar selection process and usage patterns (Szolin et al., 2022). Szolin and colleagues (2022) conducted a systematic review of avatar use in serious and entertainment games in relation to game disorders. Examining the game user and avatar relationship in video games, psychological and social factors were explored, including roles of self-perception, self-concept, and self-identity (Szolin et al., 2022). The authors argue that avatar choice and avatar customisation are influenced by the way in which a user perceives themselves and are also perceived by others. The researchers (Szolin et al., 2022) further found that game users may also change avatar preference based on factors of self-identification, potentially influenced by personality traits. Important psychological factors were discussed involving the difference between a person's ideal self (the self that an individual wants to be), the ought-self (the self that an individual believed they ought to be), and the actual-self (the self the individual perceives themselves to be). The literature review was conducted as a means of exploring and extending previous research with regard to avatar selection and the avatar-user relationship in relation to game disorders. Despite this, the review does highlight multiple potentially significant factors that may affect a game users' avatar selection as well as the way in which a participant may see themselves compared to their avatar. Szolin and colleagues (2022) concluded that a number of key issues influence the user-avatar dynamic. In particular, the researchers found that game users with game disorder may choose an avatar that relates to the player's version of their ideal self. As such, avatar usage patterns may incorporate elements of game world fantasy that may be considered unobtainable in the real world or physical reality.

Similarly, Banks and Bowman (2013) examine potential explanations behind player/avatar interactions. The researchers explore player-avatar attachments to better understand the interconnection between agency and intimacy. This paper endeavours to provide a holistic approach to understand avatar attachment, describing video game environments as interactive spaces that provide for a player to interact with an avatar as a virtual embodiment of one's self (Banks & Bowman, 2013). As such, Banks and Bowman (2013, p. 2) suggest that the relationship between a

player and an avatar could be looked as a “psychological merging of a players and avatars mind”. Potential factors affecting avatar attachment identified included the idea that a player has a sense of identification as one’s avatar, suspension of belief in relation to in game environments, and a player’s sense of control over in-game actions conducted through the avatar. Furthermore, avatar usage may be affected by a sense of responsibility that a player feels towards an avatar (Banks & Bowman, 2013). This may be relevant to the current study as participants may identify with the nurse avatar character and feel a sense of responsibility to find the correct medication name to not cause harm to a patient character in the Medicina videogame. This may be embodied in the feedback by one participant who stated:

The characters in the game are cleverly designed with nurses, me and patients. If I get it right, the nurse gives me encouragement, which is very important. If I get it wrong, there could be very serious consequences for the patient. (‘P4’)

Thus, the findings of the paper by Banks and Bowman (2013) suggest that avatars could be considered as a virtual embodiment of one’s self within a game, and that attachment, agency, intimacy, identification, and a sense of responsibility to the avatar may influence avatar usage patterns.

Therefore, the literature by Banks and Bowman (2013) and Szolin and colleagues (2022) attempt to explore complex characteristics and psychological factors underpinning a player’s selection and usage of avatars. This research may help to provide an understanding of the avatar patterns identified in the current research. However, an element that may be lacking within these explorations is specific quantitative data providing evidence for the extent to which a participant would actually choose an avatar, This may include avatar usage, such as avatar selection as a frequency/proportion of gameplay sessions. Thus, the current study provides valuable data regarding avatar usage patterns in a novel study with significant original contributions to knowledge. The findings also highlight the need for future research to be conducted to provide a further in-depth analysis and appreciation of participant avatar selection. In doing so, future

research may provide a deeper understanding of avatar usage patterns, the factors affecting it, and the impact of the patterns of avatar selection on participant engagement, game features (such as realism and reducing emotional stress), and outcomes in nursing education for international nursing students.

6.5.4 Difficulty Level Usage

The present study also examined patterns in usage of difficulty levels. There were three difficulty levels – easy, medium, and hard. Each difficulty level had different time limits which reduced as the difficulty level increased: easy (16 seconds), medium (12 seconds), and hard (8 seconds). The content of the game (the medication names) did not vary by difficulty level. Rather, the difference between the difficulty levels was solely the time limitation. The results of the study indicated that most participants (71%) played all three difficulties at least once. Like the findings on overall frequency of use and engagement, there was also a great deal of variability in difficulty level usage. Medium was the preferred difficulty level overall. In fact, results showed the medium difficulty level was played by the highest proportion of players, the highest proportion of sessions, highest mean number of sessions, highest mean time, and most likely to be the final difficulty level played. Easy was the least popular difficulty level, despite it being typically the first level people used. It was perhaps especially interesting to see the very high number of people who played the hard level frequently – in some cases even more than other difficulty levels. Hard was played at least once by a surprising 86% of players and was the most common difficulty level played on the final session of gameplay. The mean number of sessions played was only slightly lower for hard (mean of 5.14 sessions) than for medium level (mean of 5.71). However, both medium and hard level usage were markedly higher than the easy level (mean 3 sessions).

An interesting finding was the pattern of progression between levels identified in the gamelogs. For the first game played, the difficulty most commonly chosen was easy level (64%). In contrast, medium level was the first played level for 29% of players while hard was the first level chosen by just one player. However, the pattern was reversed for the final game played. For the

final game played, the most commonly chosen difficulty was hard level (57%). Medium level was the final played level for 43% of players. In contrast, no players chose the easy level as the final level played. Participants progressed through the difficulty levels at different session intervals. Most of the participants (79%) had a completely unique pattern of movement between first difficulty levels that was not shared by any other participant. The only shared progression pattern (three participants) involved starting at the easy difficulty level, moving straight to the second level on the second play, followed by changing to the hard difficulty on the third episode. That is, playing one session each moving from easy to medium to hard. It is interesting to note that the progression between difficulty levels occurred very rapidly, with participants trying each difficulty level in quick succession on the first play. In fact, among participants who played all three difficulty levels, the mean time between the first difficulty level and the third difficulty played was just 11 minutes. All participants played all three difficulties on the first day of playing, with a minimum of just 3 minutes between the first attempt at the variables and a maximum of 18 minutes. Thus, the pattern of movement between difficulty levels suggests that progression was not occurring as a consequence of mastering each level before gradually progressing to the subsequent level. Instead, this rapid pattern in the first session indicates that the progression occurred as a behaviour of scoping out and engaging with the game.

None of the computer-based videogames in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012) or mobile-based CALL videogames in language learning (e.g., Amer, 2014; Jere-Folotiya et al., 2014; Kohnke et al., 2021; Pham et al., 2018; Thongsri et al., 2019) identified in the research literature collected gamelogs and reported detailed information about difficulty level usage patterns. As such, comparison of the findings of the current study with existing evaluated studies is limited. A further expanded search of serious games in education also did not identify detailed evaluation of player usage of difficulty levels such as conducted in the present study for the purposes of broader comparison. Hence, this is a novel contribution of the current study.

6.5.5 Game Usage Summary

In summary, research question three asked, “How do EAL nursing students use and interact with the Medicina multiplatform videogame?”. Usage patterns were identified related to overall engagement, duration/frequency played, scoring, avatar preference, device preference, and difficulty levels. Gamelogs revealed participants played a mean of 13.47 sessions of Medicina for a mean total time of 35 minutes, with a mean of 264 medication names answered correctly. Three patterns of engagement were identified. Participants strongly preferred the WebGL platform over Android devices. Avatar preference was more balanced, with most participants playing each of the avatars at least once. Medium was the preferred difficulty level overall, played by the highest proportion of players, sessions, and durations. Easy was the least popular difficulty level. Progression between difficulty levels occurred within a mean of 11 minutes. Therefore, answering research question three, the study found international nursing students showed overall positive levels of usage of the Medicina videogame including answering a high number of medication names correctly. In addition, international nursing students interacted with the game predominately via desktop/laptop devices (WebGL), tended to use both avatars at least once, and preferred to use the medium or hard difficulty levels.

A significant original contribution of the current research came from the incorporation of gamelog technology. Understanding who is playing a game and how they are playing it is of substantial value for the design, development, and evaluation of CALL videogames as well as their implementation in nursing education practice. The more researchers can understand about players’ behaviours, interaction, and preferences surrounding gameplay, the better they can design CALL videogames that are both engaging and enjoyable as well as being effective in improving language skills and outcomes for nursing students. This is the first study of its kind. Using gamelogs, the research was able to actually quantify and discuss game player patterns in a way not achieved in previous CALL videogame studies in nursing education. Despite notable literature about the benefits of CALL in nursing education and language learning (e.g., Amer, 2014; Jere-Folotiya et al.,

2014; Kohnke et al., 2021; Müller, 2011b; Müller & Price, 2012; Thongsri et al., 2019), detailed research about the diverse nature of player behaviour and game experiences is still very much in its early stages and evolving. However, it is undoubtedly complex and multidimensional. Gamelogs have not been traditionally used in the past, even within the field of CALL. However, as outlined in the current study, gamelogs have substantial value in this field of research. Gamelogs are well-placed to provide comprehensive data which are objective, quantitative, sizeable, event and time-based, and less affected by potential biases (D’Mello, 2021; Harteveld & Drachen, 2015). The information may therefore include aspects not previously considered or foreseen which can help lead to greater ability to understand the exact data points that intrinsically exist within the context of that pedagogical tool. As a result, the study provided many novel insights and significant original contribution to knowledge regarding game usage behaviours.

6.6 Game Usability

An important aspect to consider when evaluating CALL videogames is the user experience. The current study examined the usability and user perception of the Medicina videogame using the System Usability Scale (SUS) (Brooke, 2013). The SUS was a written quantitative measure comprising 10 items which was given to participants in the posttest period. The questions were rated on a Likert Scale with five response options ranging from ‘strongly disagree’ to ‘strongly agree’. A total score was then calculated in line with standard SUS procedures (Brooke, 2013), with higher scores indicating higher levels of perceived usability.

The results of the SUS measure indicated overall positive perceptions of the usability of the Medicina videogame among participants in the current study. Descriptive statistical analyses were conducted and revealed the mean System Usability Scale (SUS) score was 76.25, with a median of 82.5, and a mode of 83. More than two thirds of respondents (70%) rated the system usability as 78 or above out of 100. The System Usability Scale is calculated and interpreted in a specialised manner (Brooke, 2013). Research indicates that the average SUS score is 68 (Bangor et al., 2008; Sauro, 2018; Sauro & Lewis, 2012). According to research by Sauro and Lewis (2012), the overall

mean SUS score is 68 based on analyses from 446 studies and more than 5,000 individual SUS responses. For web-based applications specifically the mean SUS score is also 68 (Bangor et al., 2008). Scoring above 68 is considered above average, while scoring below 68 is considered below average (Sauro, 2018). Hence in the current sample the usability of the Medicina videogame reported mean usability levels that were above average. In addition, the SUS results in this study were within the range classified as ‘acceptable’ or ‘excellent’ based on adjective-based SUS interpretation guidelines (Bangor et al., 2008; Sauro, 2018).

Evidence for the positive usability of the game is further supported by results of individual scale items. For example, most participants felt that the game was easy to use, that the elements of the game, such as controls, avatars, levels and audio, were well-designed, that they would like to play the game frequently, that most people would learn to use the game quickly, and that they felt confident using the game. In contrast, students did not feel that the game was awkward or too complex, and they did not need the support of a technical person in order to use the game. Overall, the final total score on the system usability scale was above average. Hence, the results demonstrated that the multiplatform Medicina videogame had a very high level of usability among participants.

The SUS is the most frequently used standardised questionnaire in studies evaluating the usability of serious games (Yáñez-Gómez et al., 2017), is “technology agnostic” for evaluation of systems involving multiple platforms (Bangor et al., 2008, p. 574), and is reliable in studies with small sample sizes (Sauro, 2013; Tullis & Stetson, 2004). However, while the SUS is the most widely used standardised questionnaire of its kind (Tullis & Albert, 2008), it is not possible to readily compare the findings of the current study with the literature review for CALL videogames in nursing education due to the lack of previous research on this topic. A review of the research literature indicated that none of the four computer-based games in nursing education (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012) identified as having been previously evaluated in published literature reported using the SUS scale or other similar measure for

evaluating the usability of the videogame. This makes comparison with the pre-existing relevant research difficult. However, if compared with technological systems in general, the results of the study are consistent with or superior than previous research. In particular, the findings of previous research indicate that the average score on the SUS is 68 out of 100 (or 68%) (Bangor et al., 2008; Brooke, 2013; Sauro, 2018; Sauro & Lewis, 2012). Thus, with a median score of 82.5, the usability of the Medicina videogame in the study was found to be positive and above average.

Through this result, it is possible to gain insights into the usability and effectiveness of Medicina and its potential impact on the learning experience. Firstly, it is important to note that the median SUS score of 82.5 found in the present study indicates a high level of usability and positive user perception for Medicina among international nursing students in Australia. The score provides evidence to indicate that the videogame was user-friendly, well-designed, intuitive, and allowed students to navigate through the game effectively and engage with the content. Overall, the SUS score suggests that the international nursing students in the study had a positive perception of the videogame. The positive perception may be attributed to various factors. However, the results of the individual items indicate that the videogame had clear instructions, appealing graphics, a user-friendly intuitive design, and engaging interactive gameplay. It also suggests students had low level of user frustration and difficulties when playing the game. The findings of positive player perception may provide evidence that the game was able to capture and maintain the interest and motivation of the international nursing students, which may have encouraged or assisted their active involvement in the learning process. Furthermore, the high level of usability may indicate that Medicina has the potential to positively impact the learning experience to enhance learning outcomes. Providing an engaging, interactive, and user-friendly learning environment, Medicina may help facilitate knowledge and skill acquisition. In addition, the positive usability of the game may have reduced barriers to learning or cognitive load, allowing the participants to focus on the content while fostering engagement, motivation, and active learning to ultimately achieve better learning outcomes. The high SUS score in the study has practical implications for the development

of CALL videogames and implementation of such pedagogical tools in nursing educational settings. For example, it provides initial evidence to support the CALL videogame being adopted and integrated into educational contexts.

While the SUS score achieved in this study indicates high usability and is above average in comparison with the scale and other studies, it does indicate there is some room for improvement. Developers can use the information obtained from individual items in the scale to identify areas for changes in the future to further refine the videogame and optimise the student experience. Further improvement can ensure that the videogame remains effective in meeting the evolving contexts and needs of international nursing students.

In summary, research question four stated, “What is the usability of the Medicina multiplatform videogame?”. The study found Medicina had a median usability (SUS) score of 82.5 out of 100, which is above average and ‘excellent’ on adjective-related interpretations. Participants reported that Medicina was easy to use and learn, they felt confident using the videogame, would like to use the game frequently, and thought that the elements of the videogame (such as levels, avatars, and controls) were well-designed. Thus, answering research question five, the results indicate that Medicina has a high degree of usability and a positive user experience among the sample of international nursing students. The findings support the suggestion that the Medicina multiplatform videogame is well-designed and was developed in a way that may promote usability, user experience, motivation, engagement, and active participation with the learning content. The results highlight the potential value of Medicina for implementation in nursing education practice.

6.7 Game Perceptions

In addition to gamelogs which evaluated the objective quantitative game usage of participants, the current study also contained a qualitative feedback questionnaire which examined the participant’s subjective qualitative opinions about the game and its features. Qualitative feedback questions in the posttest indicated that participants had positive perceptions of the game and its features. In particular, an important question in the qualitative feedback questionnaire related to how the game

affected students' language skills. All participants commented in the feedback questionnaire that the Medicina videogame supported their language skills. For example, participants felt the game improved listening skills and familiarity, confidence, and ability with medication names, including discerning between similar medication names and the awareness of word-parts. The results showed that participants had highly positive opinions that the game could help them to prepare for clinical placements.

There were several key patterns that emerged in the results. One of the most frequent themes was that participants felt the game increased confidence and familiarity. For example, the game can “boost confidence” (‘P5’), while “getting familiar with medication helps to gain more confident” (‘P7’, sic). Some participants also stated that the game made them “establish cautiousness” (‘P5’), more participants aware of similar drug names to help prevent them making mistakes. For example, one participant stated that “the game helps being aware of the some (sic) similar drug names and which may keep you from making mistakes in serious situations” (‘P9’), while different participant noted that “If I get it wrong, there could be very serious consequences for the patient” (‘P4’). Furthermore, participants highlighted the benefits of Medicina for language skills and outcomes in nursing education. For example, one participant stated that “through this game, I found that I became much more familiar with how to say the names of medications and much more confident, which will help me work more efficiently in my next placement” (‘P4’). Hence, these findings regarding player perceptions of the Medicina videogame and its value, are highly positive and of particular importance given their potential impact on nursing-related skills and performance during clinical placement.

In addition to benefits for language skills, participants had positive perceptions of the Medicina videogame and its features. Key positive features highlighted by participants included difficulty levels, time limitation, multisensory stimuli, immediate feedback, avatars and characters, background audio, fun and enjoyable gameplay, challenge, narrative, and realism. For example, participants liked the hospital-related background audio and felt this feature increased the challenge

associated with the game, improved attention skills and listening skills, and created a sense of realism similar to the clinical nursing environment. Avatars and the multisensory stimuli in *Medicina* were another common theme in the feedback from participants. More than two thirds (70%) of feedback questionnaire respondents had positive comments about the avatar characters and participants highlighted the benefits of the avatars, immediate multisensory feedback, motivation, narrative, and realism of *Medicina* in the nursing education context. Furthermore, participants perceived *Medicina* to be fun, interesting, enjoyable, and engaging. Overall, participants liked the challenge provided by the videogame and felt that *Medicina* motivated and engaged them while building confidence and competence in core nursing tasks and language skills. There was also a positive perception of the difficulty levels among participants and the benefits the difficulty levels may provide for player engagement and improving language skills. Moreover, another crucial common finding was the narrative and realism of the videogame for nursing education and practice, with participants commenting that *Medicina* mimics the hospital environment and nursing workplace. The findings of the feedback questionnaire also indicated that the game raised awareness about medication administration and the serious risks of medication errors for patient safety. Therefore, participants in the study had positive perceptions of the *Medicina* videogame for language skills, clinical nursing skills, clinical nursing practice, and psychological factors such as confidence, motivation, and engagement.

The results of qualitative feedback responses are similar to previous studies regarding CALL videogames in nursing education by Müller (2011b). For example, Müller and Price (2012) used a qualitative survey to evaluate perceptions of *Brevissima* in a sample of 11 international nursing students. *Brevissima* is a single-platform computer-based CALL videogame in nursing education (Müller & Price, 2012). Students perceived *Brevissima* to be useful for linguistic development such as listening skills, word form, and use of medical abbreviations, particularly in clinical contexts (Müller & Price, 2012). Participants' opinions of the gameplay were positive, with users finding the game fun and relaxing; avatars added realism and emotion to the educational process. More than

one third of participants spontaneously mentioned game scores during feedback, with scoring providing a source of motivation and self-assessment (Müller & Price, 2012). Therefore, consistent with previous studies in this field, participants had positive perceptions and opinions about the Medicina multiplatform videogame.

In summary, research question five stated, “What are EAL nursing students’ perceptions of the Medicina multiplatform videogame?”. The results showed participants enjoyed the videogame and reported improved language skills, familiarity with medication names, confidence, understanding of Australian accents and word-parts, with benefits for nursing skills and clinical placements. Key positive features highlighted by participants included difficulty levels, time limitation, multisensory stimuli, immediate feedback, avatars and characters, background audio, fun and enjoyable gameplay, challenge, narrative, and realism. Thus, answering the research question, international nursing students had positive perceptions of the Medicina videogame, its features, and its effects on improving language skills and nursing education outcomes.

6.8 The Context of COVID-19

When discussing the findings of the current study and comparing it with previous research literature, an understanding of the unique historical and societal context is needed. Data collection for the current study occurred during the COVID-19 pandemic. The COVID-19 pandemic, also known as coronavirus or COVID, is a global pandemic of the ‘Severe Acute Respiratory Syndrome Coronavirus 2’ (SARS-CoV-2) virus which began in December 2019 (Department of Health and Aged Care, 2023). As of February 2024, COVID-19 had resulted in more than seven million deaths worldwide and is one of the deadliest pandemics in history (World Health Organisation, 2024). In addition to deaths, the pandemic has caused substantial social, political, and economic disruption (Van Nguyen et al., 2022), including the “worst recession since the Great Depression” (International Monetary Fund, 2020). The crisis has also affected the community in terms of education, employment, housing, recreation, interpersonal relationships, and health (including physical and psychological well-being) (Van Nguyen et al., 2022). Measures implemented in an

effort to reduce the number of fatalities and community spread of COVID-19 included social distancing, face masks, quarantine/isolation, studying/working from home, lockdowns, and border closures (e.g., Campbell & Vines, 2021; Storen & Corrigan, 2020; Van Nguyen et al., 2022). International students in Australia faced significant difficulties and were severely negatively affected due to the pandemic (Morris et al., 2020). Consequently, this study and the results discussed were potentially impacted in a number of ways by the unique global sociohistorical context of the COVID-19 pandemic during which data collection occurred.

Firstly, the study bore witness to the devastating impact a pandemic can have on international student numbers in nursing education and other fields in a country with a large international student population such as Australia. Due to the pandemic, federal and state governments in Australia mandated strict border closures (Campbell & Vines, 2021). As a result, international student arrivals in Australia almost completely ceased, and did so in sudden, unexpected, and dramatic fashion (dropping over 99% in 2020-2021) (Australian Bureau of Statistics, 2023). Detailed discussion of international student arrival data in Australia due to COVID is presented in chapter 4 (section 4.6).

In response to the pandemic, educational institutions rapidly reduced on campus activities, changed course delivery methods (to online and offshore), introduced new regulations for research projects, and cancelled many existing support programmes for international students which had a considerable impact on higher education staff and international students (Martin, 2020; Owens et al., 2022; Wells Advisory, 2021). Furthermore, the reduced cohort of international students who were already in Australia (typically second- or third-year students) may have been adversely affected by the pandemic, under more pressures, and felt less able to be involved in research. In particular, the pandemic had significant negative effects on international students already in Australia in terms of illness, emotional stress, finances, hunger, housing, employment, and academic performance (Morris et al., 2020). The immediate and long-term impact on international student programmes in Australia is potentially profound. For example, with no ELICOS students arrived nationally during the key pandemic periods in 2020 to 2021 (Australian Bureau of Statistics,

2023) many ELICOS institutions in Australia closed and the economic loss in the ELICOS sector as a result of the pandemic was estimated to be AUD\$4.6 billion (English Australia, 2021). These programmes were previously instrumental in assisting international students by improving their language skills as well as providing a pathway to access further tertiary study, including for international nursing students.

In addition, university and department-specific programmes also experienced significant cuts and closures (Owens et al., 2022), which the researcher in the current study witnessed. For example, at Flinders University, the only specialised language support programme for international nursing students in the College of Nursing and Health Sciences was suddenly ceased at the start of the COVID-19 pandemic. This programme provided voluntary specialised professional language development programme designed to improve language skills among international nursing students at Flinders University. Previous evaluation of the professional language development programme found that the classes supported around 600 international nursing students each year, had an attendance rate of 38-50%, and received positive reviews from both international nursing students and nursing educators (Murray & Müller, 2019). In addition, the programme achieved positive outcomes in this population such as increasing nursing course attendance, reducing course fails, and improving Grade Point Averages in international nursing students who attended the programme (Murray & Müller, 2019). The programme was designed to be long-term and involved a specialised lecturer position. Despite the success of the programme (published just prior to the pandemic), the programme was suddenly cut by the university at the start of the pandemic and has not been reinstated. In addition, the closure of the programme significantly impacted staff, with the university cutting the teaching positions for the educators who previously taught this programme. Furthermore, the closure considerably negatively affected research such as the current study, because the language development programme was originally planned to be the source of participants for the study. As a result, the COVID-19 pandemic and the resulting programme closure had a direct, significant impact on the research including study design, materials,

recruitment procedures, delaying and prolonging data collection, and reducing the sample size achieved.

Furthermore, the methodological choices were constrained by time in the context of the COVID-19 pandemic. The impact of COVID on participant recruitment and the multiple methods employed to mitigate this impact were discussed in section 4.6 of chapter 4. In addition to changing participant recruitment sources due to pandemic-related programme closures, the move to online learning impacted the research in other ways. Initially, it was planned that participants would have the option to be loaned a mobile device (such as a tablet) with the game pre-loaded for use during the study. However, due to the social and educational changes that occurred during the pandemic as previously outlined (e.g., Martin, 2020; Owens et al., 2022; Wells Advisory, 2021), the recruitment methods were changed to move from in-person local recruitment where loaning of devices is possible, to instead be a nation-wide multi-site study where recruitment was conducted solely online and loaning of devices was not possible. Consequently, this change may have reduced the number of participants overall as well as the number of participants using the mobile platform version of the game. However, since the participants were required to use only their own pre-existing personal devices as a result of the change and some people may not have owned Android mobile devices, it may have in fact increased the accuracy and fidelity of the results.

It is interesting and noteworthy that the context of the COVID pandemic had a visible impact on feedback provided by students about the Medicina videogame. In particular, one participant even commented that the game and the medication name audio should include people wearing masks (“mouths are covered with masks”, ‘P1’)! This is not a comment previously reported in the published studies identified which have evaluated computer-based videogames in nursing research or mobile phone-based CALL videogames in language learning (e.g., Amer, 2014; Boyle, 2012; Foss et al., 2014; Jere-Folotiya et al., 2014; Kohnke et al., 2021; Müller, 2011b; Müller & Price, 2012; Pham et al., 2018; Thongsri et al., 2019). Thus, the results may have been affected by the unique circumstances of the pandemic. Consequently, the impact of the COVID-19 pandemic on all

aspects of our lives is anecdotally well known, but arguably not yet fully encapsulated in research. Thus, the impact of the COVID pandemic on international nursing student support programmes and related research may be considered in and of itself an original contribution to knowledge of the current research. Hence, though it was not expected, planned, or desired, the current study provides initial observations and exploratory information about the impact of the COVID-19 pandemic on international nursing student populations, support programmes, and research in Australia. Further research is needed and warranted.

6.9 Chapter 6 Conclusion

This chapter gave a detailed discussion of the study's research findings. Findings of the study provide preliminary support for the effectiveness, usage, and usability of the game. Participants reported that the Medicina videogame had a positive effect on their language skills including making medication names more familiar, improving their ability to recognise medication names, and increasing their confidence in understanding spoken medication names. Data regarding phonological awareness indicated a non-significant positive trend with word recognition test scores higher at posttest than at pretest. In addition, results showed that international nursing students had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall MSLQ score at baseline, with non-significant improvements in extrinsic motivation, task value, and overall MSLQ at posttest. Potential explanations for findings included insufficient power due to sample size (type II error) (Sullivan & Feinn, 2021), regression towards the mean (Davis, 1976), and sample population characteristics at baseline in the context of COVID.

Gamelogs revealed participants played Medicina on a mean of 13.47 sessions for a mean total time of 35 minutes. The mean total score was 65,882 which indicated a mean of 264 medication names answered correctly by participants playing the Medicina videogame. Three patterns of engagement were identified: 'no engagement' (did not play the game at all), 'lighter engagement' (played the videogame but did so for less than 15 minutes), and 'deeper engagement' (participants who played the videogame and did so for 15 minutes or more). This engagement pattern was

consistent with previous studies. There was a strong preference for the WebGL platform over Android devices, while avatar preference was more balanced. Medium was the preferred difficulty level overall, played by the highest proportion of players, the highest proportion of sessions, highest mean number of sessions, highest mean time, and most likely to be the final difficulty level played. Easy was the least popular difficulty level. Patterns of gameplay revealed participants most often started with the easy level first, before moving to medium and hard, and that the progression between difficulty levels happened on the first day within a mean of 11 minutes. Overall, the findings indicated positive levels of engagement and high levels of exposure to medication names, which is crucial to improving language skills for specialised vocabulary, developing automaticity, increasing language processing speed, and reducing cognitive load (Müller, 2011a; Schmitt, 2008; Webb, 2007). Participants rated the usability of the Medicina videogame as positive and above average, and had positive perceptions of the game, its design, and its features. Participants felt the Medicina videogame supported their language skills, improved their familiarity and confidence with medication names (as well as Australian accents and word-parts), and would be beneficial for clinical placements.

Chapter 7 chapter will provide a conclusion of the thesis, summarising the findings and reflecting on the study. The significant original contribution to knowledge will be outlined and implications for practice in nursing education will be explored. In addition, the next chapter identifies the limitations of the study and proposes suggestions for further research.

CHAPTER 7 CONCLUSION

7.1 Chapter Introduction

Chapter 6 outlined the discussion resulting from the study's research findings evaluating the multiplatform Medicina videogame in a sample of international nursing students in Australia. Findings regarding the sample and research questions related to language skills, psychological measures, game usage, usability, and participant perceptions were discussed. The significant original contribution to knowledge will now be outlined and implications for policy and practice in nursing education will be summarised. In addition, this chapter identifies limitations of the study and posits suggestions for further research.

7.2 Significant Original Contribution to Knowledge

The present study provided significant original contribution to knowledge. The novel insights and significant contributions achieved by this research encompass multiple aspects. These novel contributions can be found in the design and development of the videogame, the materials and methods of data collection employed, and the interesting and impactful findings identified.

The current study involved the design, development, and evaluation of a multiplatform CALL videogame to improve language skills in international nursing students. The multiplatform videogame entitled Medicina was built by the researcher for this study. The study redesigned and expanded an existing single-platform computer-based Medicina CALL videogame (Müller, 2011b) and used it as a basis to develop the new multiplatform CALL videogame. The development of the multiplatform Medicina videogame is outlined in detail in Chapter 3. Based on a review of games evaluated in published peer-reviewed research literature, this research was the first multiplatform version of Medicina, the first multiplatform CALL videogame for improving language skills in international nursing students, and the first multiplatform CALL videogame in nursing education more broadly.

The study combined two previous types of serious videogames as pedagogical tools (namely, computer-only CALL videogames and mobile phone-only CALL videogames) which have

historically been developed and evaluated separately. It used recent technological advancements to combine the two intervention types to create a new multiplatform videogame, making it accessible to users of any laptop, desktop, or Android mobile device. Notable changes in mobile devices (such as smartphones) include larger screens, introduction of touch screens, improved audio-visual clarity, larger memory and data storage, higher data allowances from telecommunications providers, more powerful processors, faster connectivity and network speeds, and increased availability of applications (apps) (Godwin-Jones, 2017). Furthermore, whereas CALL videogames have historically been dependent on platform-specific technologies, mobile devices increasingly have access to web-based technologies. This enables students on any device to use the same application via access to web-based CALL videogames. In particular, the cross-platform game engine Unity (Unity Technologies) launched 'Unity 5' in 2015 (Robertson, 2015). Unity 5 supported multiplatform game development across 21 platforms (including Android mobile devices) and, crucially, introduced the ability to develop WebGL videogames via Unity for the first time, allowing developers to make games which can be played using web browsers with no plug-ins required (Robertson, 2015). Consequently, advancements in game engine technologies such as Unity became available to consumers which enabled multiplatform game development including both web-based WebGL and Android mobile platforms (Robertson, 2015). Thus, technological advancements were an important step regarding the development and utilisation of multiplatform CALL videogames and the ability to develop the multiplatform Medicina CALL videogame for the current research.

From a game design document standpoint, the task was to create a new pedagogical tool as similar as possible to Müller's (2011b, 2012, 2013) Medicina game whilst developing and constructing the new multiplatform game that was novel and extensive in design. Thus, while the design was influenced by Müller's (2011b, 2012, 2013) single-platform game, the videogame used in this study was developed and constructed by the researcher for the current research. The building process involved lengthy amounts of complex coding using multiple coding languages; the

designing, rendering, and placement of multiple graphical assets, sprites, animations, and audio files; building of the game actions and interactions; attention to multiplatform-related issues such as touch screens; and the construction of the gameplay, content, and features in a novel multiplatform game. It involved a new delivery medium (two platforms via WebGL and Android), new game assets (such as avatar graphics), new gameplay features (including three difficulty levels with time limitations), and new authentication procedures. The development of the game required new technologies (such as different game engine, file formats, software, coding languages, and databases), including the creation of the unique backend system stored in an SQL database and developed by the researcher using JSON, C# and PHP scripting language for this study. From these actions, the researcher built the two new versions of the game (WebGL and Android), the comprehensive backend system, gamelogs, and research management system necessary to run the game and study. The original game developed by Müller (2011b, 2012, 2013) was of extremely high quality and was an effective pedagogical tool for improving language skills in international nursing students. However, due to the technological changes which have occurred since that game's development and the new evaluations undertaken in this study, a new game needed to be built by the researcher for this study. Indeed, the aim was to create a game that was as similar as possible to the original in terms of design appearance, gameplay, and content while being delivered in a new multiplatform method with new evaluations.

In terms of educational videogames evaluated in the research literature, *Medicina* was one of only four computer-based videogames in nursing education identified (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). It is also the first of the four videogames to develop and evaluate a multiplatform version deployable on mobile platform. In addition, while mobile phone-based videogames have previously been used in other educational fields (such as second language learning), a search of the research literature conducted as part of this study found no existing mobile phone-based videogames for international nursing students or nursing students in general. Hence, the research expanded an existing pedagogical tool (mobile phone-based CALL

videogames), applying it to a new field (nursing education), as well applying it to a new, sizeable, and growing demographic (international nursing students). In addition, the study used the pedagogical tool for an issue not targeted previously via the technology (phonological awareness and specialised medical vocabulary, especially medication names).

The project also involved the design and development of a 'Research Management System', built by the researcher for this study. The Research Management System provided one central easily accessible electronic location for participants for all aspects of the study. This study contained multiple materials to be accessed at different points over three phases (pretest, intervention period, and posttest). Using the website, the pretest survey, WebGL game play, Android game download, and posttest survey were all accessed and completed in one place. This simplified and centralised the process for both the participants and researchers. It also provided a platform that was safe, secure, and easy for participants to use. In addition, the website helped the researcher to control the sequence of events in the study. Importantly, the Research Management System's back-end system also enabled the development, collection, and storage of the comprehensive gamelogs for the researcher – a crucial part of the study. Furthermore, the study was a multicentre trial involving participants from 12 external universities across Australia. Consequently, the system provided a location that could be accessed by participants from any learning institution at any time and from anywhere, enabling data collection to be conducted remotely online. This was especially vital given the context of the COVID-19 pandemic.

Another aspect of the original contribution to knowledge of this study is its design as a multicentre research trial. The benefit of multicentre trials includes a more diverse or heterogeneous sample population which increases the external validity (generalisability) of the results. In total 48 external tertiary institutions in Australia were contacted for involvement in the study (see Table A1 in Appendix A). The final number of Australian universities agreeing to be involved in the multicentre trial was 12 universities with a Bachelor of Nursing programme (Appendix A). The multicentre sites spanned the country, representing one Australian territory and six out of six states

in Australia (Table A1). This study is the first multicentre evaluation of *Medicina*, a CALL videogame for international nursing students, or a computer-based videogame in nursing education using an Australian sample. It is also one of the few published multicentre evaluation studies of computer-based videogames in the field of nursing education worldwide (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). Similarly, the study is one of the very limited number of multicentre studies of serious games in health education published in the research literature more broadly (Gorbanev et al., 2018).

In addition, this is the first study to explore the impact of the *Medicina* multiplatform videogame on language skills among international nursing students. Furthermore, compared with the published evaluation studies identified in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018), this study is only the second investigation of a CALL videogame in nursing education (Müller, 2011b) which includes quantitative evaluation of the videogame's effect on language skills in this population or context. Research question one stated, "Does the use of the *Medicina* multiplatform videogame improve language skills in EAL nursing students?". Results showed *Medicina* had a positive effect on language skills including increasing familiarity with medication names, improving the ease of recognising medication names, increasing confidence in understanding spoken medication names, and a non-significant increase in phonological awareness. Thus, answering research question one, the study's findings indicated that the *Medicina* multiplatform videogame does improve language skills among international nursing students. Furthermore, given the higher than typical level of language proficiency prior to entering the study, the results showing that playing *Medicina* improved what was already advanced language skills are perhaps more surprising and promising. It might be assumed that improvement in language skills would not occur in advanced learners, such as in the current sample. Despite this, the participants in this study showed improved language skills in the posttest after playing *Medicina*. This finding highlights the need for and value of support

programmes targeting language skills among international nursing students from all skill levels and backgrounds, including among more advanced learners.

Furthermore, one of the significant original contributions to knowledge of this study is the use of comprehensive gamelogs to identify player usage patterns. Extensive and detailed gamelogs were built by the researcher to investigate the way players use and interact with the videogame in multiple vital areas such as engagement levels, frequency of gameplay, duration of gameplay, scoring (including number of medication names answered correctly), avatar choice, platform choice, difficulty levels (both usage and progression), and different event patterns (such as first play, highest play, and final play). Compared with the published evaluation studies identified in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018), this research is the first evaluation of a CALL videogame in nursing education to use comprehensive gamelogs to identify in-depth player usage patterns. This method enabled the collection of a large number of quantitative, objective, direct, and real-time measurements of participant behaviour. Compared with traditional questionnaire methods (which may involve brief, delayed, subjective, self-reports), gamelog data may not only provide more substantial information about player behaviours, but may also increase the validity of the results by reducing or avoiding the impact of recall bias, social desirability bias, testing effects, and participant fatigue. Using this novel data collection method, multiple new insights and knowledge was identified in the current study. Research question three asked, “How do EAL nursing students use and interact with the Medicina multiplatform videogame?”. Multiple novel findings were identified regarding player usage patterns including overall engagement, duration/frequency played, scoring, avatar preference, device preference, and difficulty levels. For example, gamelogs revealed participants played Medicina on a mean of 13.47 sessions for a mean total time of 35 minutes. The mean total score was 65,882 which indicated a mean of 264 medication names answered correctly by participants playing the Medicina videogame. Three patterns of engagement were identified (no engagement, lighter engagement, and deeper engagement). Therefore, answering research question three, the

study showed positive levels of game usage and engagement including high levels of exposure to medication names among international nursing students playing *Medicina*. This is crucial to improving language skills for specialised vocabulary, developing automaticity, increasing language processing speed, and reducing cognitive load (Müller, 2011a; Schmitt, 2008; Webb, 2007).

The present research is also important for being the first of its kind to identify patterns of platform usage preferences. Compared with the past evaluation studies identified in the literature review (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012), this is the first evaluation of CALL videogames in this field or population to evaluate player usage patterns regarding platform selection. The results of the study identified new knowledge regarding platform use. Previous research has emphasised the advantages of mobile-based CALL videogames (e.g., Chinnery, 2006; Miangah & Nezarat, 2012; Ogata & Yano, 2004). However, the findings of the current study indicated that participants were significantly more likely to play the game using the web-based platform (using desktop or laptop devices) rather than the mobile platform version (using Android mobile devices). Potential rationale for this preference were discussed in section 6.5.2 in Chapter 6. This represents a significant original contribution to knowledge and highlights the value of developing multiplatform versions of CALL videogames in nursing education. The findings also support the value of studying a videogame available on multiple platforms in a single study.

The study is also novel for being the first to investigate difficulty levels in this field and population (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). This investigation included examination of students' pattern of usage of difficulty levels and progression between levels and led to many new insights. For example, Medium was the preferred difficulty level overall, played by the highest proportion of players, the highest proportion of sessions, highest mean number of sessions, highest mean time, and most likely to be the final difficulty level played. Easy was the least popular difficulty level. Patterns of gameplay revealed participants most often started with the easy level first, before moving to medium and hard.

Notably, the study identified an immediate rapid progression between difficulty levels within a mean of 11 minutes of using the videogame for the first time.

In addition, this is the first evaluation to include an investigation of avatar selection patterns in such videogames among international nursing students. The findings of gamelogs indicate that both avatars were used. There was a fairly even split between the two avatars, with results showing that most participants (59%) tried both avatars at least once. In addition to the quantitative data, feedback from participants in the posttest questionnaire provided further novel knowledge regarding avatar usage in the videogame. Medicina's avatars and the multisensory stimuli featuring the avatars were a common theme in the feedback from participants. More than two thirds (70%) of feedback questionnaire respondents had positive comments about the avatar characters and liked their inclusion in the game. Participants reported that they "like the characters" ('P6') and felt the avatar character "makes [the game] more interesting" ('P7') and "gives some attractions for players" ('P2'). While describing their positive opinion of the avatars in the game, one participant emphasised the benefit the avatars added for realism, saying the avatars provided "good visual distraction. In clinical environment, especially the Paediatric Department, there will be a lot of distractions. Clean background would make the game too easy compared to reality" ('P5'). Another participant highlighted the interaction of the avatars, immediate multisensory feedback, motivation, narrative, and realism of Medicina in the nursing education context:

The characters in the game are cleverly designed with nurses, me and patients. If I get it right, the nurse gives me encouragement, which is very important. If I get it wrong, there could be very serious consequences for the patient. ('P4')

Therefore, findings indicated that avatars were positively perceived by participants, and that avatars potentially had an effect on interactivity, motivation, enjoyment, and engagement. Furthermore, comments from participants indicated that avatars may add a sense of realism and identification with the characters and narrative of the videogame in the nursing education context. Therefore, despite being a seemingly non-essential element of learning and the videogame overall, the findings

of the study suggest that international nursing students viewed avatars as helpful in some way to their learning.

The study is also novel for its investigation of psychological factors in this population and topic. The Motivated Strategies for Learning Questionnaire (MSLQ) was developed by Pintrich and colleagues (1991). The MSLQ is one of the most widely used questionnaires designed to measure academic motivation and learning strategies in university students (Wang et al., 2023). The MSLQ is a validated scale which has been tested across a wide variety of content/university topics (such as medical students, chemistry, statistics education) as well as diverse populations and cultures (Duncan & McKeachie, 2005). This study used a short-form MSLQ to measure intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall total MSLQ score. Psychological states were measured both at baseline (pretest) and again after using the videogame (posttest). This is the first study to examine baseline state-based psychological factors in this population, pedagogical tool, and/or target skill, using multi-item psychological pretest-posttest measure (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). Similarly, this is the first evaluation to investigate the effect of the CALL videogame on psychological factors using the MSLQ (or any other standardised scale) in a pretest-posttest design. Results showed that participants had positive levels of intrinsic motivation, extrinsic motivation, self-efficacy, task value, test anxiety, and overall MSLQ score at baseline and at posttest. Non-significant improvements in extrinsic motivation, task value, and overall MSLQ were also found at posttest. Thus, answering research question two, international nursing students had positive psychological feelings regarding learning medication names via the videogame both before and after playing *Medicina*. International nursing students strongly believed that medication names were valuable and important to learn, and felt motivated and confident to do so using *Medicina*. This represents a significant and novel insight regarding CALL videogames, international nursing students, and nursing education.

Another contribution to knowledge of this study is the use of the System Usability Scale (SUS) to measure the usability of the videogame (Brooke, 2013). The SUS is a validated scale, is the most frequently used standardised questionnaire in studies evaluating the usability of serious games, and is reliable in studies with small sample sizes (Brooke, 2013; Sauro, 2013; Tullis & Albert, 2008; Tullis & Stetson, 2004; Yáñez-Gómez et al., 2017). This is the first evaluation of a videogame in nursing education to investigate the videogame's usability via the System Usability Scale (or other standardised usability scale) (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012). This study found the Medicina multiplatform videogame had a median usability (SUS) score of 82.5 of out 100, which is positive, above average, and 'excellent' on adjective-related interpretations. Participants reported that Medicina was easy to use and learn, they felt confident using the videogame, would like to use the game frequently, and thought that the elements of the videogame (such as levels, avatars, and controls) were well-designed. Thus, as the first evaluation of the usability of this pedagogical tool, the results indicated that Medicina has a high degree of usability and a positive user experience among the sample of international nursing students. The findings support the suggestion that the Medicina multiplatform videogame is well-designed and was developed in a way that may promote usability, user experience, motivation, engagement, and active participation with the learning content. The results highlight the potential usability of Medicina for implementation in nursing education practice.

In addition, this was the first study to explore international nursing students' perceptions of the Medicina multiplatform videogame. The results showed participants enjoyed the videogame and reported improved language skills, familiarity with medication names, confidence, understanding of Australian accents and word-parts, with benefits for nursing skills and clinical placements. Key positive features highlighted by participants included difficulty levels, time limitation, multisensory stimuli, immediate feedback, avatars and characters, background audio, fun and enjoyable gameplay, challenge, narrative, and realism. Thus, answering research question five, international nursing students had positive perceptions of the Medicina videogame, its features, and its effects on

improving language skills and outcomes in nursing education. As part of the exploration, a particularly interesting finding was that participants had strongly positive reactions to the avatars, difficulty levels, multisensory immediate feedback, and background audio. Comments indicated that these features were especially positively perceived by international nursing students, and potentially had an effect on interactivity, motivation, enjoyment, and engagement. The feedback also indicated these features may add a sense of realism and identification with the characters and narrative of the videogame in the nursing education context. Therefore, despite being seemingly non-essential elements of learning and the videogame overall, the findings of the study suggest that international nursing students viewed these features as helpful to their learning.

Although not intended or anticipated, the current study also highlighted the impact of a devastating, prolonged global pandemic such as COVID-19 on academic support programmes and postgraduate student research, especially concerning marginalised and vulnerable groups such as international nursing students. The impact of the COVID-19 pandemic on all aspects of our lives is anecdotally well known, but arguably not yet fully encapsulated in research. Thus, documentation and discussion of the impact of the COVID pandemic on support programmes and research involving international nursing students in Australia may be considered in and of itself a significant original contribution to knowledge of the current research.

7.3 Implications for Policy and Practice

The current study has provided valuable insights into the use of a multiplatform CALL videogame for improving language skills in international students in nursing education contexts. This is a relatively new, emerging, and evolving field of research. Hence, the current study adds further information and knowledge providing support for this tool as an effective learning method in nursing education. While further research is needed, the present study has important implications for policy and practice in nursing education.

CALL videogames are not only simulations. They can be custom-designed to address a challenging target skill among a demographic in a way that enables repeated exposure in private. In

this case, the skill relates to the ability to hear different pronunciations more clearly and with less effort. In doing so, this frees up space for attention to be paid to nursing and other tasks. The current research provides initial support for the suggestion that evidence-based programmes involving multiplatform CALL videogames (such as the one used in the present study) should be developed and implemented in nursing education programmes. This includes putting *Medicina* or other future CALL videogames into practice with international nursing students. Real-world practice should incorporate policies which include the implementation of a supportive framework specific to international nursing student communities which will directly inform successful delivery of evidence-based CALL videogames such as *Medicina*. The findings of the current research provide initial support for the suggestion that nursing education practice may benefit from the inclusion of multiplatform CALL videogames such as *Medicina*. CALL videogames could be included in the nursing education curriculum and more readily available to international nursing students across levels, courses, and institutions. As part of this inclusion, there arguably needs to be a cultural shift and awareness that views CALL videogames such as *Medicina* as an effective educational tool worthy of implementation. These changes to culture and practice would be most beneficial if they occur at all levels within the nursing school (teaching, clinical practice, research, and administrative teams).

The development of pedagogical tool focussing on medication names in this study is also significant for nursing education. Medication use is the most common type of intervention in healthcare (Lim et al., 2022). Medication administration and patient safety are fundamental concerns of nursing education and nursing care. Nurses spend considerable time dealing with medications, and medication errors, including those related to medication names, are common in hospitals (Keers et al., 2013). In fact, medication errors occur in up to 18% of in-hospital medication administration episodes in Australia (Roughhead et al., 2013). Two leading causes of medication errors committed by nursing students were communication problems and verbal medication orders (causing 55% of errors), and one of the leading types of medication errors

involved participants being given the incorrect medication (Gunes et al., 2020). The World Health Organisation (2017, p. 5), reports that “medication errors are a leading cause of avoidable harm in health care systems across the world”. Furthermore, these medication errors can have serious consequences for patient safety, cause “severe harm, disability, and even death” (WHO, 2017, p. 5), and cost USD\$42 billion each year (WHO, 2017). As a result, the reduction of medication errors is a healthcare priority nationally within Australia (Australian Commission on Safety and Quality in Health Care, 2017) and globally (WHO, 2017). The WHO (2017, p. 12) has urged educational and research institutions to become “catalysts for change” to reduce medication errors. Given the prevalence, significance, and nature of medication errors, new pedagogical tools in nursing education that provide international nursing students with safe opportunities to practice medication names, improve language skills (including listening skills and phonological awareness), and promote competence in this area of nursing education are strongly needed. As a result, the development of customised learning tool such as Medicina multiplatform videogame targeting medication names in international nursing students may have a positive impact on the safety of patients as well as nursing students, nursing educators, hospitals, and the broader community and economy.

In addition, Australia has a very multicultural population which needs and benefits from a multicultural healthcare workforce as a result (Australian College of Nursing, 2023). Australia also receives sizeable financial benefits from international students in tertiary education (Austrade, 2019; Department of Education and Training, 2019a, 2019b, 2019c). If Australia is going to attract international nursing students in the future and diversify its nursing workforce, changes should incorporate a comprehensive, strengths-based, culturally responsive approach which enables flexible delivery and tailored educational materials to support learning. However, in addition to their strengths and resources, international students may face important challenges in their education. Research into the needs of EAL nursing students have identified significant linguistic challenges (e.g., Amaro et al., 2006; Crawford & Candlin, 2013; Donnelly et al., 2009; Leki, 2003;

Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Sanner & Wilson, 2008; Sanner et al., 2002; Starr, 2009). In fact, language difficulties were noted to be “the single most significant obstacle facing the ESL nursing student” (Olson, 2012, p. 26). These language concerns include poor listening and reading skills, problems understanding lecture content, difficulties communicating in clinical settings and, in particular, problems with low-frequency academic and technical vocabulary such as medical terminology (Crawford & Candlin, 2013; Malu & Figlear, 1998; Müller, 2011a; Olson, 2012; San Miguel et al., 2006; Starr, 2009). Consequences of poor linguistic skills in EAL nursing students can be significant and include academic failure and removal from clinical placements, which may also have implications for patient safety (Jalili-Grenier & Chase, 1997; Müller, 2011a; San Miguel et al., 2006). As such, the unique needs of EAL nursing students, as well as the importance of developing culturally sensitive programmes of support, have become growing areas of research in recent years. Despite the prevalence and significance of this issue, many tertiary nursing education departments do not provide consistent (or sometimes any) support for the academic language development of international nursing students (Murray & Müller, 2019).

Hence, understanding the prevalence, scope, and significance of this population and issue, there is a need and obligation to include consideration of international nursing student perspectives including the linguistic difficulties of nursing students in the academic curriculum to support positive academic outcomes and prepare international nursing students for their future clinical roles. This can be accomplished in a few ways – one of which is through multiplatform CALL videogames such as *Medicina* as investigated in the current research. Teaching of language skills that focus on phonological awareness, and low frequency academic language such as medication names, especially when spoken in the local accent (in this case Australian) is essential when adapting and developing existing language skills to reach appropriate levels of proficiency for clinical practice in real-world situations. Furthermore, implementation of CALL allows students to be autonomous, empowered to take control of their education, and to learn at a level and pace that is

individualised to their unique needs and resources to become skilled, motivated, and resilient nurses. These skills and qualities need to be fostered in international nursing students during their nursing education.

In particular, there is a significant, urgent need for purpose-designed programmes which provide culturally sensitive, strengths-based support for international nursing students. This includes the multiplatform *Medicina CALL* videogame of the current study, with its focus on improving specialised academic language skills in international nursing students. International nursing students have many strengths as well as potential challenges, placing them at greater risk of academic or clinical placement failure and has implications for patient safety (Jalili-Grenier & Chase, 1997; Müller, 2011a; San Miguel et al., 2006). Prevention of these outcomes begins with the attitude that experienced nursing educators and academic faculties have towards international nursing students. International students should be supported as individuals with valuable strengths and resources and respected as important members of the health care team. This promotes understanding and acceptance by nurse educators and increases their preparedness to help international nursing students succeed. Ideally, targeted CALL videogames such as *Medicina* should be available to international nursing students early in the nursing course, prior to students developing challenges or failing classes/placement. Moreover, such changes to policy and procedure should focus on emphasising the strengths of international nursing students, have positive expectations of their abilities and success, and seek to empower students to have a leading role in their own education. Academic institutions and nursing educators need to be cognisant of the needs and strengths of international nursing students and the impact of these on academic and clinical student outcomes. Similarly, there needs to be an awareness that language skills are unique and individualised. Educational policies and tools should reflect this need. It is important that flexibility, autonomy, and learner-controlled learning be incorporated into nursing educational procedures. True cultural change is necessary at every level of the nursing school – including top-level administrators, teachers, and support staff. If a nursing education institution is to actively recruit,

retain, and graduate successful international nursing students, the institution needs to be committed to creating a positive environment conducive to student learning and success which supports and values international nursing students.

Furthermore, Australian universities often have an international student services department encompassing all students across all degrees (Müller et al., 2015; Murray & Müller, 2019). However, these services are typically geared towards general academic skills (such as essay writing) and counselling, not nursing-specific skills (Müller et al., 2015). It was evident while conducting this research that Australian nursing education facilities often do not have separate school-based services unique and geared toward international nursing students, which is supported by previous research (Müller et al., 2015; Murray & Müller, 2019). Previous research has found decentralised, population- and nursing-specific academic language development programmes in Australia to be positively perceived and effective in improving outcomes for international nursing students (Murray & Müller, 2019). In some cases, the services did exist previously but were ceased by tertiary institutions during the pandemic especially (and not reinstated since). This was witnessed when conducting the present research with regards to the specialised professional language development programme for international nursing students at Flinders University (Murray & Müller, 2019). The negative impact of the programme's sudden closure due to the pandemic was noted on the recruitment, sample, and methodology of the current study.

However, nursing education is different to many other higher education degrees and professional qualifications. To register as a nurse in Australia, students complete a three year Bachelor degree (including the completion of clinical placements), meet minimum English language requirements, and apply for registration through the Nursing and Midwifery Board of Australia in partnership with the Australian Health Practitioner Regulation Agency (AHPRA, 2018). Due to the nature of nursing education, international nursing students have unique and diverse needs compared with international students in other degrees, especially for the clinical skills/knowledge and specialised medical terminology needed in nursing education which the

general university-wide support services do not and cannot adequately address (Müller et al., 2015; Murray & Müller, 2019). Therefore, the current study highlights the need and value of a dedicated programme and trained teacher within the school of nursing whose role is to assist international nursing students (Müller et al., 2015; Murray & Müller, 2019).

In addition, the present research has important implications for supporting nursing educators regarding the development, evaluation, and implementation of multiplatform CALL videogames in nursing education. The current project provides further insight that, on a practical level, development and testing of CALL videogames can require considerable time, effort, money, and technical skills. As well as cultural changes, academic institutions need to better support the development and implementation of CALL videogames for international nursing students at a practical, logistical, and financial level. For example, support may include access to funding for the time and effort required while developing the game, access to training especially regarding development of skills and knowledge, and access to game development software (including funding for license fees). Academic institutions should also consider providing financial assistance and practical aid and awareness to allow cooperation between computing departments/faculties, or access to external professional game-development services, to assist academic staff to develop games.

More support should also be given to nursing educators and research students when evaluating and testing support programmes for international students. A significant issue encountered in this study was the difficulties recruiting research participants both internally and externally and conducting data collection activities. Additional support for researchers and research students when evaluating new pedagogical tools - especially for recruiting participants - would be very beneficial for nursing educators and researchers. This may also include the fostering of an academic culture that supports and values nursing educators and research students and provide more practical assistance to increase participation in research projects. With regards to research and CALL videogames into the curriculum, it would also be important to communicate their existence

and value to students, to make students aware they exist and worthy of their participation. This is especially relevant given the limited time and energy available to nursing students and the conflicting pressures and responsibilities faced. Changes to policy and procedure around nursing education research is particularly relevant given the need for further research in this field.

A culture and practice which is open to researchers from external institutions to better allow cross-functional recruitment is vital. Multicentre research is a potential solution which may assist to improve response rates in research (and the subsequent benefits this entails). However, at present, multicentre research in Australia is extremely onerous and time consuming, with poor outcomes. Australian universities are arguably too insular, being hesitant to engage in external research. This is understandable in many ways, for example, given the additional workload and seeking to limit potential survey fatigue among students. However, it is arguably potentially detrimental overall to nursing research and nursing education in the long-term. Australia has a much smaller population than many other countries, and the institutions and research participants are spread over much greater physical distances. For research involving minority or niche populations in particular (such as international nursing students), multicentre research studies could be a good avenue to help address poor recruitment and response rates. However, multicentre research is challenging in multiple ways. Currently, researchers must obtain ethical approval at own their faculty and own human research ethics department, then also get organisational approval from every other institution individually. Each institution has their own procedures, with individual lengthy forms to complete. There is no overlap. The current practice makes the process lengthy, complicated, and laborious. Given the potential benefits of multicentre research (such as increased external validity), steps could to be taken by tertiary nursing education faculties and institutions in Australia regarding practice to improve access to external research. This may include simplifying and streamlining application procedures, providing contact lists, promoting its benefits, and increasing access/approval to external institutions for nursing education researchers. National education bodies could undertake further work to agree on a common approach for cross-institutional research in Australia. This

would both reduce confusion in practice for educators/researchers conducting cross-institutional research and make it easier to provide learning opportunities for students available via external research across jurisdictions. This change to practice could improve outcomes for nursing educators, researchers, students, and academic institutions alike.

Furthermore, nursing education faculties could explore ways to emphasise and encourage student participation in research. Suggestions include from the outset and regularly having face to face discussions with students about the importance and value of participating in nursing education research. Some institutions may consider introducing schemes like extra credit for participation, or compulsory participation over the course of their degree. Many courses do this – including other departments at the same university (such as Flinders University’s psychology department). It is important to note that students would not be required to participate in every study and would have voluntary consent. However, participation in a very small number of studies over the course of their degree would be helpful. This may be especially valuable in an educational system that has recently become increasingly research based – requiring staff to achieve strenuous research outputs and targets while departments are being heavily cut and restructured. However, while compulsory research participation may work in some departments (such as psychology), given the focus of nursing education and health, such a programme may not be either ethical or logistically feasible in nursing education. It may also raise concerns over the ethics of compulsory participation in healthcare research. In lieu of this, nursing education departments should consider improved communication with nursing students about the potential benefits of participating in research, increased communication of current research seeking volunteers, encouraging participation, and fostering a culture that values nursing education research. However, while raising these issues, it is important to acknowledge that recruitment of study participants and getting students to engage in research is a notoriously difficult and complex long-term problem which is not easily solved.

In addition, the results of the study have significant implications for the use of CALL in nursing education and serious games more broadly. The findings demonstrate the need to include

web-based platforms that can be accessed via desktop and laptop computers when developing and implementing CALL-based videogames. Despite the general popularity and ubiquity of mobile devices, researchers and educators should not automatically assume that mobile platforms are the only or preferred options for their pedagogical tool. Rather, both platforms should be available so the student can use the platform they prefer. Furthermore, the findings show that nursing researchers and nursing educators should not assume that patterns of platform preferences in entertainment-focussed games also applies to serious educational games, especially those for language learning with dominant audio focus. At a student-level, the study shows that multiplatform CALL videogames in nursing should be accessible and available on multiple platforms, using devices and technology that are already available to the students. Thus, there is a need to have a comprehensive CALL model for international nursing students. Autonomous study using CALL, where embraced, is likely more cost-effective and easier to implement, while being available at the students' own pace and skills level. Building on students' strengths and resources, CALL empowers international students with timely, vital nursing skills that will aid them in their nursing career.

Overall, broadly available strengths-based support programmes for international nursing students which develop skills vital to clinical nursing practice (including language skills and specialised medical vocabulary) are needed. However, it has arguably not been given as much priority in nursing education practice and research. The current research provides initial support for the effectiveness, use, usability, and positive perception of CALL videogames (such as *Medicina*) in nursing education. However, there is a need for increasing attention to the development and implementation of official organisational practices regarding support programmes for international nursing students. Such changes are needed in all levels including academic, research, and clinical nursing education.

7.4 Limitations

The current research effectively addressed its key aims and provided significant original contribution to knowledge. Despite this, some limitations of the research were identified. In

particular, a noted limitation of this study is the small sample size. A small sample size can occur for many reasons. It can have a significant impact on the results through increasing the chances of type I or type II statistical errors (Sullivan & Feinn, 2021). A type I error is the mistaken rejection of a true null hypothesis (a ‘false positive’ finding), while a type II error is the mistaken acceptance of a false null hypothesis (a ‘false negative’ conclusion) (Sullivan & Feinn, 2021). A small sample size can also reduce the external validity of the findings, thus reducing the generalisability of the conclusions to larger populations (Sullivan & Feinn, 2021). The recruitment process, completion (attrition), and sample size of the study were significantly negatively affected by the COVID-19 pandemic. The COVID-19 outbreak began at the same time recruitment for the current study started. In response to the pandemic, the federal and state governments in Australia enacted strict border enforcement and closures. These caused a sudden, unexpected, near total cessation of international student arrivals in Australia and South Australia (Australian Bureau of Statistics, 2023). Consequently, the programme which was the planned primary source of participants was cancelled suddenly without warning. As a result, the impact of COVID on recruitment was significant and severe.

Multiple changes were investigated and implemented in order to mitigate the effect of COVID and maximise recruitment as much as possible. These efforts spanned all facets of the research including changes to questionnaires and recruitment materials, study design, sample characteristics, recruitment sources, and administrative aspects. The sample population was broadened in over six separate modifications which saw the recruitment efforts expand nation-wide across all tertiary educational nursing programmes in Australia. In total 48 external institutions were contacted (see Appendix A). Detailed information regarding the impact of the COVID pandemic on the study and the substantial efforts implemented to mitigate its effects are discussed in section 4.6 of chapter 4 and section 6.8 of chapter 6. However, despite the considerable effort made to improve participant numbers, the final sample size was smaller than desired. The pandemic was prolonged and at the time of writing this dissertation was continuing. Thus, due to time constraints of candidature,

further extension of the data collection period to continue seeking additional participants was not possible and unlikely to result in a substantially increased sample size.

Therefore, COVID had a direct impact on sample size in the current study due to massively reduced number of international nursing students available and closure of sources optimal for recruitment. However, the pandemic may have also further affected sample size via COVID-related survey fatigue. The phenomenon of survey fatigue occurs when participants become bored, tired, or uninterested in participating (often due to receiving requests from multiple different surveys or longitudinal research designs), leading to negative outcomes (De Koning et al., 2021). Survey fatigue can occur before and/or during participation. For example, it may reduce the number of people joining the study or lead participants to drop out before completion. Potential factors contributing to COVID-related survey fatigue could include increased volume of survey requests (De Koning et al., 2021).

Although in its early stages, research indicates that COVID-19 led to abnormally high levels of fatigue and low response rates. The number of new participants enrolling in clinical trials globally fell by 79% in 2020 compared to 2019 (Sathian et al., 2020). In some countries the reduction in participant numbers was as high as 97% (Sathian et al., 2020). Similarly, De Koning and colleagues (2021) analysed the impact of COVID on surveys distributed to neurosurgeons, trainees, and medical students compared with pre-pandemic. The authors found a significantly reduced response rate during the pandemic and concluded that the “COVID-19 pandemic has led to survey fatigue characterized by non-response” (De Koning et al., 2021). Surveys recruiting via email were especially negatively affected by COVID survey fatigue (De Koning et al., 2021; Moraes et al., 2021). One study found a response rate of 2% for email-based recruitment during COVID, which was significantly lower than for other methods such as social media (Moraes et al., 2021).

Furthermore, research suggests that the impact of COVID on response rates was especially marked in Australia, where the current study was conducted. In fact, studies indicate the response

rate in Australia was reportedly around one-sixth of the rate of other countries during the pandemic in the same studies (Chen et al., 2022; Holton et al., 2022). For example, a cross-cultural study involving nurses and midwives in Australia and Denmark during COVID-19 found that the response rate was substantially lower among Australian nurses and midwives at around 7%, compared with 37% in the Danish cohort (Holton et al., 2022). Even official government surveys in Australia with traditionally high response rates experienced significantly lower participation during COVID-19 and abnormally high rates of non-response. For example, the 'General Social Survey' conducted by the Australian Bureau of Statistics reported a non-response rate of 38% in 2020, compared with 14% in 2019 (Australian Bureau of Statistics, 2019, 2020). This finding represents a 171% increase in participation non-response rates in just one year due to COVID.

There is also evidence to suggest that COVID-related survey fatigue may have disproportionately affected people from CALD backgrounds. In the 2020 US Census, response rates overall were 20 percentage points lower than normal and response rates were notably lower than normal among noncitizens and certain races such as Hispanic populations (Rothbaum & Hokayem, 2021). The finding is relevant as the population in the current study was international students, which relates to noncitizens from diverse racial backgrounds. In addition, the pandemic had significant negative effects on international students in Australia in terms of illness, emotional stress, finances, hunger, housing, employment, and academic performance (Morris et al., 2020). Given the effect of the pandemic on survival needs (such as food and housing) and academic performance (Morris et al., 2020), it is plausible the pandemic may have also affected participation in surveys among international nursing students. In summary, the sample size was likely substantially affected by COVID-related survey fatigue, exacerbated by the research location (Australia), population of interest (CALD), and the contact method (email, due to face to face being unfeasible due to COVID-19).

However, despite the small number of participants, it should be noted that the overall sample size is relatively consistent with those of many other studies of computer-based CALL videogames

in nursing education, especially among those conducted in Australia. A literature review found that half of the computer-based videogames in nursing education previously evaluated involved a sample size of 25 or fewer participants (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). For example, the original *Medicina* research involved a quantitative analysis in a sample of 25 international nursing students based in Australia (Müller, 2013). A qualitative study on the *Brevissima* computer-based CALL game was conducted with a sample of 11 international nursing students in Australia (Müller & Price, 2012). However, it must be clarified that the *Brevissima* evaluation involved qualitative data only and as such is not directly comparable (Müller & Price, 2012). Furthermore, a systematic review of studies evaluating serious game usability found that the overwhelming majority of serious games were evaluated in studies involving less than 20 participants, with the most common number of participants being 10 users (Yáñez-Gómez et al., 2017). Similarly, a review of serious games focusing on medication use (evaluated in patients rather than nurses) found that 92% (11 out of 12 games) used “very small sample sizes” to evaluate the serious games, including more than half of reported samples having 20 participants or less (Abraham et al., 2020, p. 6). In addition, a meta-analysis of CALL using mobile devices found that of 291 implementation studies identified, (Burston, 2015), the majority involved no more than 25 participants, with more than a third of studies having under 10 participants. However, it should be noted that these three reviews (Abraham et al., 2020; Burston, 2015; Yáñez-Gómez et al., 2017) included both quantitative and qualitative studies, and a detailed analysis of sample size by study design was not available. In summary, the sample size in the current study is arguably relatively consistent with the sample size used in serious game research more broadly, as well as in nursing education specifically.

Furthermore, despite the limitation discussed, one of the strengths and original contributions to knowledge of this study is the evaluation using multiple institutions. In total 48 external tertiary institutions in Australia were contacted for involvement in the study (see Table A1 in Appendix A). The final number of Australian universities agreeing to be involved in the multicentre trial was 12

universities (Appendix A). The multicentre sites spanned the country, representing one Australian territory and six out of six states in Australia (Table A1). Multicentre studies are generally considered more methodologically rigorous and robust than studies conducted in a single centre (such as one university) (Bellomo et al., 2009). The advantages of multicentre studies include a more diverse or heterogeneous sample population which increases the external validity (generalisability) of the results (Bellomo et al., 2009; Chung et al., 2010). The disadvantage of multicentre studies is that they can be significantly more complex, difficult, and time consuming to run. For example, it involves needing to get approval from many different authority/governing sources (Sandy et al., 2011). This was a disadvantage which the current study also encountered.

In addition, despite the benefits a multicentre study presents, it may lead to potential differences with the sample compared to single-centre trials due to reduced homogeneity. For example, in the current study participants were sourced from multiple different institutions, Australian states, and nursing degree year levels (e.g., first, second, and third years). Consequently, participants would likely have entered the study with differences in course curricula, levels of experience, and previous education in nursing skills and medical terminology (including medication names) and participation in other programmes of support. Similarly, students began the study with different backgrounds including diverse durations of time living in Australia and different levels of English language skills and phonological awareness. These differences may have affected willingness to participate or level of engagement with the videogame. However, this was unavoidable given the variances in education between institutions and diversity in student backgrounds and experience. Furthermore, given the findings involved examination of change over time (before and after using *Medicina*), it is unlikely to have had a substantial effect on results. Moreover, this variation is reflective of the diversity that would be seen if the CALL videogame was implemented in nursing education practice. Thus, this heterogeneity increases the generalisability and external validity of the findings.

Previous evaluations of similar educational videogames have most commonly involved just one institution. For example, a review of serious games in medical education found that over 90% of studies involved just one institution (Gorbanev et al., 2018). Furthermore, the review found that just one single study investigating serious games in medical education involved more than two institutions (Gorbanev et al., 2018). Similarly, in a review of serious games use in patients focussing on medication use, 92% of studies (all but one study) were conducted in a single site or state (Abraham et al., 2020). In a review of computer-based videogames in nursing education specifically, of the four games identified, two (50%) were single institution studies, one involved two institutions and one involved participants from five institutions (e.g., Boyle, 2012; Foss et al., 2014; Müller, 2011b; Müller & Price, 2012; Pront et al., 2018). Moreover, the previous evaluations of the single-platform Medicina videogame involved students from one single institution (Flinders University) (Müller, 2013). In contrast, in the current study, participants were sought from multiple institutions including every tertiary nursing programme nation-wide. Therefore, given the benefits conferred by multicentre research, it is arguable that the limitations of the current study due to small sample size may be offset (or at least partially offset) by the advantages to external validity due to being conducted with participants from multiple institutions. This is especially significant as it is the first multicentre evaluation of Medicina to date as well as the study involving the largest number of institutions to date for computer-based videogames in nursing more broadly. Thus, the multicentre sample represents a significant original contribution to knowledge of the current study.

Similarly, participants completed the questionnaires and used the videogame remotely and independently, without supervision from the researcher. It is likely this involved a diverse range of locations (including university, home, and public settings) with different levels of noise, interruptions, and distractions. Furthermore, given the informal unsupervised environment, students may have accessed other reference materials to complete answer questions in the game. Participants were asked about the use of supplementary materials in the posttest questionnaire to attempt to examine this issue. Most stated they did not use other learning materials. However, the researcher

had no indication that this might have occurred outside of these instances. This may have affected completion rates and performance. However, this flexibility, portability, remote independent study and user-controlled participation is actually a positive of the research and reflective of the environment that would be present in implementation of the game.

In terms of study design, another potential limitation of the study was the lack of a control group. To evaluate the effectiveness of the multiplatform Medicina videogame, the current study used a one-group pretest-posttest design. A randomised controlled trial is widely considered the most methodologically rigorous tool to examine cause-effect relationships between an intervention and outcome (Hariton & Locascio, 2018). Advantages of randomised controlled trials include reduction of bias and ability to control for threats to internal validity (such as history, testing effects, and maturation). As a result, a randomised controlled trial was initially considered for this study. However, it was determined to be not feasible in the present study on expert advice from the supervisory team due to significant practical constraints, including difficulty recruiting sufficient participants and ethical approval issues for the study. Based on these factors, the research aims, the target population, and the educational context, it was determined that a single group pretest-posttest design would be the most appropriate method for this study to examine the research questions. Due to the study design, the information produced from this research is descriptive, exploratory, and correlational. Causation cannot be inferred. The study design used in the current research is consistent with the design of other computer-based and mobile-based CALL videogames. For example, a literature review conducted as part of the current research found that of five mobile-based CALL videogames identified only one game was evaluated in a randomised controlled trial. Furthermore, the reality of researching support programmes with small, niche, or disadvantaged communities (such as international nursing students) is that rigorous, randomised, placebo-controlled trials will not always be appropriate or feasible. In such contexts, a small sample size is very common and performing particular data analysis methods is not always possible as a result.

During the planning phase of the study, challenges were encountered with the selection of measures with regard to psychological impacts of the game. A search of the research literature did not find a validated questionnaire appropriate for the current context in its existing form. The questionnaire found to be most appropriate for the current study was the Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich and colleagues (1991). The MSLQ is one of the most widely used questionnaires designed to measure academic motivation and learning strategies in university students (Wang et al., 2023). The MSLQ is a validated scale which has been tested across a wide variety of content/university topics (such as medical students, chemistry, statistics education) as well as diverse populations and cultures (Duncan & McKeachie, 2005). It is also a measure that explicitly permits changes to wording and choice of specific subscales to adapt it to the unique needs of individual studies (Pintrich et al., 1991).

However, the MSLQ is a very long questionnaire. The full instrument contains 81 items, with the motivation section having 31 items. As a result, modifications are common among previous research using the MSLQ and multiple short-form versions have been developed and evaluated (e.g., Curione et al., 2022; Loose et al., 2023; Soemantri et al., 2018; Wang et al., 2023) including in a study of medical education students in Australia (Soemantri et al., 2018). Analysis of short-form versions of the MSLQ in previous research have demonstrated positive reliability and validity (Loose et al., 2023; Soemantri et al., 2018; Wang et al., 2023). For example, Loose and colleagues (2023, p. 14440) found that “in comparison to longer versions, the 6-item version came at little-to-no cost in terms of psychometric properties”. In the current study, the psychological measures section was just one part of a larger study. Multiple other measures would be used in addition to the MSLQ. Moreover, the study had a pretest and posttest design, meaning students would need to answer the questions twice. Therefore, there were concerns that the MSLQ was too long for the present study and may lead to participant fatigue and recruitment difficulties. As a result, after lengthy consultation with the supervisory panel, the decision was made to use a modified, shortened version of the MSLQ scale for the current study. Although the original MSLQ is a validated

measure, the short-form 10-item MSLQ developed for use in the current research has not yet been validated. However, this decision was necessary taking into consideration the aims of the study, the methodology (pretest/posttest design, questionnaire), the sample population, the impact on participants (time, cognitive load, fatigue), and the practical challenges experienced with recruitment (especially in the context of COVID).

In summary, although the findings of the study were potentially affected by the limitations discussed (such as smaller sample size), substantive efforts were taken wherever possible to mitigate these limitations and their potential effect on the findings. These obstacles were often unanticipated and outside the researchers control due to issues such as the global COVID pandemic. Furthermore, despite these limitations, the results of the study remain valuable and valid, and support the conclusions of the specific research questions.

7.5 Future Directions

While the current study has significant original contributions to knowledge and valuable implications for nursing education practice, this field is still in its initial stages and further research is needed. Knowledge gained from the design and development phase of the videogame, findings from the data analysis and discussion, as well as feedback received from participants and nursing educators during the recruitment and data collection, revealed some areas for future research.

Firstly, as previously explored, the present study was limited by sample size and lack of randomised controlled trial design due it not being feasible in the current context. This was consistent with research in the field examined in the literature review. However, future research could aim to replicate the results in a larger randomised controlled trial.

Secondly, the current study had new findings with regards to gamelogs. As discussed earlier, the findings regarding game and platform use observed in the current study were novel, significant, and unexpected. For example, the results of the study provided evidence to suggest that participants played the multiplatform CALL videogame far more frequently using WebGL platform (deployable on desktop/laptop devices) than the mobile platform using Android devices. These results were

based on objective, quantitative measures from gamelogs. The findings obtained from the gamelogs were vital for investigating how and when people played using what platform, leading to new discoveries, and greater detail than identified in previous research. However, the study did not incorporate questions to investigate the motivations or reasons why participants chose to play the videogame the way they did. Although initially considered for inclusion in the posttest feedback questionnaire, questions focussing on reasons for platform choice and game play patterns were not included due primarily to concerns regarding participant fatigue as well as the unexpected nature of the finding. Further research is needed to investigate when and why students choose to use a platform, or why they may prefer one platform rather than another.

Similarly, future investigation regarding engagement patterns and difficulty level patterns could also be conducted. Given the emerging and novel nature of this finding, it may be valuable and worthwhile for a future exploratory study to be conducted, perhaps using an in-depth qualitative design to investigate what factors or reasons affect international nursing students' pattern of game and platform usage. For example, as a first stage, qualitative interviews could be conducted with a small number of nursing students to provide more detailed questioning and understanding of the issues. These findings could then be used as a basis to design questions for a second stage study with a quantitative questionnaire or mixed methods design of a larger sample of students. The types of questions could focus on issues such as the technical, practical, logistical, educational, or psychological reasons of platform and gameplay patterns and preferences. For example, participants could be asked questions about what motivated them to choose to play one platform over another, when they play (day, time of day), pattern of game play (frequency, duration of playing), and how they view playing (as part of education or entertainment). Students could also be asked how their gameplay and choice of platform fits with their other educational behaviours (playing as part of their course-related studying or separately), or location of gameplay (such as at home, outside of home, on public transport). Technical motivations for platform choice (such as screen size and access to devices) and the impact of particular features of the game (such as focus on listening skills

and audio) could also be explored. Such information regarding the practical and personal motivation and reasons for game usage, combined with the findings from the current study, could then be used to improve the design, development, evaluation, and implementation of educational CALL videogames such as *Medicina* in the future.

Thirdly, the population of interest in the current study was international nursing students. However, international students are not the only students in nursing education who may benefit from assistance and support with phonological awareness and medical terminology such as medication names. Domestic nursing students may also struggle with these skills. In fact, during the data collection phase, multiple external nursing educators spontaneously commented that domestic students often struggle with the target skills and would benefit from using *Medicina*. In addition, during participant recruitment, multiple domestic nursing students who were born in Australia enquired about taking part and showed great interest in the research. Therefore, although the focus of this current research was international nursing students, future research and clinical implementation could consider expanding into the domestic nursing student population too as an emerging area of interest.

Similarly, while the current focus was on nursing students, *Medicina*'s topical focus of medication names mean it could be expanded to include other medical and health professionals whose role includes medication management. For example, types of roles who may potentially benefit include disability and aged carers, health sciences, dental, pharmacy, and medical students. In particular, an emerging field of potential expansion is international students in the disability and aged care sector. Data from the 2016 Australian census shows that 50.2% of personal care attendants and 37% of disability and aged care workers were born overseas (Eastman et al., 2018). This is significantly higher than average, compared with 30% of the total Australian workforce who were born overseas. Among personal care attendants, 42% were born in 'non-main English-speaking countries', which is more than double the rate for the overall Australian workforce (20%) (Eastman et al., 2018). The most common region of birth for overseas-born care workers are

Southern Asia (such as India, and Nepal) and South-East Asia (such as the Philippines), totalling 52% (Eastman et al., 2018). Between 2012 and 2016, the vast majority (76.3%) arrived on temporary visas, including the temporary student visa (Eastman et al., 2018). Similarly, information from the Australian Government's '2020 Aged Care Workforce Census' found that 35 percent of direct care workers in aged care identify as being from a CALD background (representing nearly 50,000 workers) and that this figure is rapidly increasing - up from 26 per cent in 2016 (Department of Health and Aged Care, 2021a).

Furthermore, Australian Government data shows that among the Australian health workforce in 2019, 45% of pharmacists working in Australia were born overseas, 60% of dentists were born overseas, and 40% of registered nurses were born overseas (Department of Health and Aged Care, 2021b). Again, this is significantly higher than the average of 30% across the Australian workforce. Like nursing, allied health roles such as aged/disability care, pharmacy, and dental practice also involve clinical skills and (to varying degrees) handling or administration of medication, where medication errors occur and have the potential for serious consequences. Therefore, future research and eventual clinical implementation could include expansion into other health-related education fields where international students may benefit from a strengths-based programme of support designed to improve language skills and phonological awareness. Hence, the use of a multiplatform CALL videogame focussed on a vital topic such as medication names such as *Medicina* may be particularly valuable in these fields of health education in the future.

As data collection was conducted during the COVID-19 pandemic, there were significant historical/societal changes occurring which may have potentially affected the population and results. Therefore, it may be worthwhile and potentially interesting to conduct further research later when the global pandemic has ceased. For example, studies could be conducted to aim to replicate the findings and investigate if the presence/absence of the COVID pandemic is associated with changes in the findings (such as patterns of game usage and platform usage). This would also be

useful to further investigate potential explanations for the novel findings identified in the current study.

Future research may also extend the issues examined in this current study. For example, the current study explored phonological awareness related to a game teaching medication names and evaluating its effects over a brief intervention period. Future research could seek to investigate the degree of transferability of language skills for phonological awareness and medication name knowledge in nursing education curriculum, clinical placements, and workplace, such as other medical terminology. Longitudinal research could also be conducted to explore the longer-term impact on phonological awareness skills to see if the improvements are maintained over time. Furthermore, longitudinal research could be considered to explore the transferability of skills learnt in the game on student outcomes and performance in the academic curriculum, clinical placements, and in the nursing workforce, as well as the impact on error rates in medication administration. Learning and performance outcomes among international nursing students who have used the multiplatform CALL videogame versus those using only traditional learning methods could be compared. Thus, a crucial area of further investigation is the translation of learning to practice for international nursing students after learning listening skills and phonological awareness skills using a multiplatform CALL videogame that teaches medication names.

While conducting the literature review it became evident that there is a diverse range of terms used to describe videogames such as the one used in the current study. For example, terms include videogame, computer game, digital game, electronic game, application, educational game, game-based learning, or serious game. Language and the choice of terminology has the potential to influence our perceptions and actions. However, the perception of the terms and the impact of the videogame's description on participation, engagement, and learning outcomes does not appear to have been investigated previously in this field. Future studies could investigate the association between the choice of terminology (e.g., description of the game as a videogame, serious game, digital game, application, or other terms) and potential effects on perception of the research/tool,

willingness to participate, usage of the game (such as choice of platform), and subsequent learning outcome. For example, regarding platform choice, if described as a computer game versus an application, are participants more likely to play using a computer versus a smartphone respectively? Given the diversity of terms available and the challenges recruiting participants, such research could yield novel findings which would help improve future research and implementation of CALL videogames.

Furthermore, although the original MSLQ is a validated measure, the shortened MSLQ developed for use in the current research has not yet been validated. Future studies could be devoted to the validation of the data collection measures used in the research, particularly the short-form MSLQ. In addition, given the paucity of measures available and the increasing research in this field, future studies could develop and validate a brief questionnaire designed to measure task-specific psychological impacts (such as motivation, confidence, and test anxiety) for CALL videogames in educational contexts.

The study was affected by a small sample size and low response rates despite the extensive multicentre recruitment efforts which included contacting every higher education institution with a tertiary nursing course in Australia. The issue of poor response rate is not unique to the current study. Although research on the topic is limited, previous research has indicated that response rates in Australia are very low overall and are lower compared to other countries (e.g., Chen et al., 2022; Daikeler et al., 2022; De Koning et al., 2021; Holton et al., 2022; Moraes et al., 2021). However, literature examining the issue in the Australian context is strongly lacking at present. More research is needed to investigate what is happening, as well as why it is happening and how to improve it. Firstly, to understand the scope of the problem, future research should conduct a literature review or meta-analysis to examine the response rate of existing studies in Australia. As part of the review, response rates could be examined for different contact methods (e.g., email versus phone), compared with other countries (is it lower in Australia or similar to other cultures?), different study designs (such as longitudinal or once-off), and comparison by sample population (e.g., university

students, health professionals, patients, or children). Analyses could also include research conducted before and during COVID (to investigate the impact of the pandemic on response rates in Australia). Although it was a global outbreak, the infection rates, the impacts, and responses (including at government, social, and academia) were vastly different between countries and cultures. It is therefore reasonable to suggest that the impact on survey fatigue and response rates would be different in different countries as a result. Thus, the analyses could consider country or region level comparisons as an important direction for future research. Secondly, once the scope of the issue is better understood, research should be conducted to understand why the response rate is so low in Australia. Studies on response rates internationally often emphasise reasons like access to technology/internet. However, that is unlikely to be the primary reason in Australia, especially when our response rates appear to be lower than other developed countries (e.g., Daikeler et al., 2022; Holton et al., 2022; Moraes et al., 2021). Therefore, studies could investigate cultural, psychological, social, or economic factors why Australians participate in so few surveys. Thirdly, the research should evaluate methods to improve response rates for the Australian culture to improve recruitment for future studies. For example, impact of incentives, method of recruitment/contact, wording, and optimal survey design (e.g., question style, length). Recruitment and data collection involve significant time, effort, and cost. Thus, it is vital to better understand response rate determinants and develop clear strategies in nursing education departments to address declining research participation. Nursing education research is vital for economic reasons, institutional good standing and reputation, as well of course the contribution to knowledge and improving lives. There needs to be changes to procedures which acknowledge the difficulty in data collection for Australian samples and address this issue for future research and future students. Furthermore, to tackle the challenges of research in Australia and increase participation, researchers, academic staff, and academic institutions need to acknowledge the difficulties and impact on (extended) timeframes, plan for higher resources, encourage increased student

involvement, and encourage community and academic partnerships to increase sample sizes (including multicentre research such as used in the current study).

7.6 Chapter 7 Conclusion

Chapter 7 provided final reflection on the current research including its significant original contribution to knowledge, implications for policy and practice, limitations of the study, and recommendations for future research.

In the Australian healthcare system, international nursing students represent a sizeable, positive, and vital part of the development of a diverse nursing workforce and culturally competent care for a culturally and linguistically diverse patient population. In addition to the opportunities and benefits these students offer, international students may face important challenges in their education. In particular, international nursing students often struggle with language acquisition especially related to specialised academic language such as medication names. Recently there has been increased awareness of the need to develop culturally responsive teaching tools in nursing education for this population. One potential tool is CALL videogames. CALL offers support through the use of specifically designed interventions in order to aid the linguistic development and academic language acquisition and phonological awareness for international nursing students. Despite the potential benefits of CALL videogames for nursing students, nursing educators have been slow to implement this technology and there has been a paucity of games developed and evaluated, as well as a lack of research conducted into this field.

The current study investigated a multiplatform CALL videogame to improve language skills in international nursing students using a videogame that teaches medication names. Firstly, the research aimed to develop the *Medicina* videogame, a multiplatform CALL videogame available across multiple devices, to improve the ability of international nursing students to correctly identify spoken medication names and link it to their written form. Secondly, the research questions aimed to evaluate the effectiveness, usage, usability, and perceptions of the multiplatform CALL videogame in a trial involving international nursing students. The aims of the research were met.

The application was developed and built by the researcher as part of this study and subsequently evaluated in a multicentre, single-group pretest-posttest design involving international nursing students from tertiary nursing education courses from around Australia. The findings of this research are consistent with the theoretical frameworks underpinning this research, namely the Cummins (1979, 1981, 1999, 2000, 2003, 2013) model of academic language proficiency, which was also underpinned by the strengths-based approaches (Hammond & Zimmerman, 2012). The findings of the study have important implications for the potential implementation of CALL videogames and for practice in nursing education. Overall, the study provided support for the potential effectiveness, usage, and usability of a multiplatform CALL videogame focused on medication names to improve language skills in international nursing research. Despite the promising and novel findings and contribution to knowledge, some limitations were identified. Reflecting upon the findings, implications and limitations, potential avenues for future research were suggested.

At present, there is an increasing multicultural nursing workforce. There is also a demand for more international nursing graduates, which means a need for improved medical terminology skills and avoidance of medication-related errors. In addition, nursing education staff and faculties are under increasing pressure, with limited nursing educator time, budgets, resources, and availability of clinical placements in Australia. Furthermore, international nursing students are in need of culturally relevant strengths-based programmes of support to build their existing resources and ensure successful academic and clinical outcomes. The opportunity for international nursing students to access an engaging, learner-controlled evidence-based educational tool which targets specialised language skills for academic and clinical nursing practice is vital. In this complex context, multiplatform CALL videogames such as *Medicina* can be employed as an effective pedagogical tool in nursing education to improve outcomes for international nursing students.

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APPENDICES

Appendix A: Multicentre Site Recruitment

Table A1

Summary of Multicentre Site Recruitment

Australian State	Institution Type	Contacted	Agreed to be Involved
South Australia			
Flinders University	University	Yes	Yes
The University of Adelaide	University	Yes	Yes
University of South Australia	University	Yes	Yes
TAFE SA	TAFE	Yes	Yes
Intensive English Language Institute	ELICOS	Yes	Yes
New South Wales			
Avondale University	University	Yes	No
Charles Sturt University	University	Yes	No
Southern Cross University	University	Yes	Yes
The University of Newcastle	University	Yes	No
The University of Sydney	University	Yes	No
University of New England	University	Yes	No
University of Technology Sydney	University	Yes	No
University of Wollongong	University	Yes	Yes
Western Sydney University	University	Yes	Yes
TAFE NSW	TAFE	Yes	No
Victoria			
Deakin University	University	Yes	No
Federation University Australia	University	Yes	Yes
La Trobe University	University	Yes	No
Monash University	University	Yes	No
RMIT University	University	Yes	No
Swinburne University of Technology	University	Yes	No
The University of Melbourne	University	Yes	No
Victoria University	University	Yes	No
Box Hill Institute	TAFE	Yes	No
Chisholm Institute	TAFE	Yes	No
Gordon Institute of TAFE	TAFE	Yes	Yes
Holmesglen Institute	TAFE	Yes	No
Acknowledge Education	TAFE/Mixed	Yes	No
Queensland			
Central Queensland University	University	Yes	No
Griffith University	University	Yes	Yes
James Cook University	University	Yes	No
Queensland University of Technology	University	Yes	No
The University of Queensland	University	Yes	No
University of Southern Queensland	University	Yes	Yes

University of the Sunshine Coast	University	Yes	No
TAFE Queensland	TAFE	Yes	No
Western Australia			
Curtin University of Technology	University	Yes	No
Edith Cowan University	University	Yes	Yes
Murdoch University	University	Yes	No
University of Notre Dame	University	Yes	No
TAFE WA	TAFE	Yes	No
Tasmania			
University of Tasmania	University	Yes	Yes
TasTAFE	TAFE	Yes	No
Northern Territory			
Charles Darwin University	University	Yes	Yes
Australian Capital Territory			
University of Canberra	University	Yes	No
Canberra Institute of Technology	TAFE	Yes	No
Multi-State			
Australian Catholic University	University	Yes	No
Torrens University Australia	University	Yes	No

Summary

- Total number of Australian higher education institutions contacted by the researcher for involvement in the study: 48.
- Total number of higher education institutions which agreed to be involved in the study by sending recruitment information to international nursing students: 15.
- Proportion of higher education institutions contacted who agreed to be involved: 31%.
- Total number of universities agreeing to be involved in the multicentre trial: 12
- Number of Australian states represented: 6 out of 6.
- Australian territories represented: 1

Note: The course types offered by the three TAFE/ELICOS institutions differed from the universities involved (e.g., Diploma rather than Bachelor of Nursing), and no participants were ultimately recruited from these centres. Therefore, the three TAFE/ELICOS sites were not included in data analyses and were excluded from the total number of multicentre trial sites involved.

Appendix B: Publication Authorship Approvals



Office of Graduate Research
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Bedford Park, SA 5042
GPO Box 2100, Adelaide 5001 Australia
Email: hdrexams@flinders.edu.au
Phone: (08) 8201 5961
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 [Authorship of Research Output Procedures](#), and
 - IV. each of the other authors provides permission for use of their work to be included in the thesis on the [Submission of Thesis 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	Adam Fletcher Koschade
Student ID	2056732
College	College of Nursing and Health Sciences
Degree	Doctor of Philosophy (PhD)
Title of Thesis	Medicina: A Multiplatform Videogame to Improve Language Skills in International Nursing Students

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

Pront, L., Müller, A., Koschade, A., & Hutton, A. (2018). Gaming in nursing education: A literature review. *Nursing Education Perspectives*, 39(1), 23-28. <https://doi.org/10.1097/01.NEP.0000000000000251>

Section of thesis where publication is referred to

Literature Review (Chapter 2)

Student's contribution to the publication

15	%	Research design
100	%	Data collection and analysis
90	%	Writing and editing


Outline your (the student's) contribution to the publication:

I conducted the systematic literature review by performing a comprehensive search of 18 electronic databases. My search identified 1,280 records. After removing 94 duplicates, I reviewed the titles and abstracts of the remaining 1,186 titles. Based on the inclusion and exclusion criteria, I excluded 878 papers in the title/abstract review. Next I performed a detailed review of the full text of 308 remaining papers, which resulted in 294 identified as not meeting the criteria. Overall, 14 articles pertaining to four games met the inclusion criteria and were included in the review. Subsequently, I conducted a detailed analysis of the 4 games (14 papers). Based on this data collection and analysis, I wrote the literature review paper totalling 4700 words, including preparing the table and figures. After review and editing of the paper by all authors, I formatted the paper ready for journal submission.

Although I am not first author, I had a significant contribution to the paper. Furthermore, the paper relates to a core theme of my research and is of vital relevance and importance in my literature review chapter. Hence, there is clear reason to include this paper in my dissertation.

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 Mrs Leeanne Pront Signed  Date 27/9/2023
 Associate Professor
 Name of Co-Author 2 Amanda Müller Signed _____ Date _____
 Name of Co-Author 3 Professor Alison Hutton Signed _____ Date _____

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.

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Section of thesis where publication is referred to Literature Review (Chapter 2)

Student's contribution to the publication	<u>15</u>	%	Research design
	<u>100</u>	%	Data collection and analysis
	<u>90</u>	%	Writing and editing

Outline your (the student's) contribution to the publication:

I conducted the systematic literature review by performing a comprehensive search of 18 electronic databases. My search identified 1,280 records. After removing 94 duplicates, I reviewed the titles and abstracts of the remaining 1,186 titles. Based on the inclusion and exclusion criteria, I excluded 878 papers in the title/abstract review. Next I performed a detailed review of the full text of 308 remaining papers, which resulted in 294 identified as not meeting the criteria. Overall, 14 articles pertaining to four games met the inclusion criteria and were included in the review. Subsequently, I conducted a detailed analysis of the 4 games (14 papers). Based on this data collection and analysis, I wrote the literature review paper totalling 4700 words, including preparing the table and figures. After review and editing of the paper by all authors, I formatted the paper ready for journal submission.

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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 Mrs Leeanne Pront Signed _____ Date _____

Associate Professor
Name of Co-Author 2 Amanda Müller Signed *Amanda Müller* Date 28/9/23

Name of Co-Author
3 Professor Alison Hutton Signed _____ Date _____

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.

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Student's contribution to the publication

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100	%	Data collection and analysis
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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	Mrs Leeanne Pront	Signed	_____	Date	_____
	Associate Professor				
Name of Co-Author 2	Amanda Müller	Signed	_____	Date	_____
Name of Co-Author 3	Professor Alison Hutton	Signed		Date	26/09/2023

Appendix C: Literature Review Tables

Table C1

Summary of Studies of Videogame-Based Learning in Nursing Education

Game	Reference	Game stage	Important advantages and game features discussed
Brevissima	Müller & Price (2012)	Development, evaluation	Motivation; fun; engagement; problem-solving; response time and accuracy; repeated exposure; time limits; scoring; multisensory stimuli; immediate feedback; avatars; working memory; automated processing; logistical benefits.
CHERMUG	Boyle (2012)	Development	Motivation; fun; engagement; user-centred learning; feedback; repeated practice; rewards; competition; game levels; monitor student progress; logistical benefits.
CHERMUG	Boyle et al. (2012)	Development, evaluation ^a	Decisions; visualisation; challenging; repetition; experience; motivation; engagement; interactivity; authenticity; game usability and usefulness.
CHERMUG	Boyle, Van Rosmalen, & Manea (2012)	Development	Improving skills and knowledge; content to support learning; decision-making; active learning; motivation; engagement; interactivity; confidence; challenging; repeated practice; mini-games; visualisation; safe environment.
CHERMUG	Boyle & MacArthur (2013)	Development	Motivation; engagement; repeated practice; game progression; navigation; competition; scoring; ease of access; anonymity; authenticity; interactivity; student support.
CHERMUG	Johnston et al. (2013)	Development	Problem-solving; interactivity; motivation; engagement; safe environment; real-life problems; immediate feedback; active learning; competition; progression through levels; navigation tools; visualisation; repeated experience.
CHERMUG	Boyle et al. (2014)	Development, evaluation ^a	Improving knowledge/skills; decisions; problem-solving; repetition; autonomy; learning from mistakes; motivation; engagement; interest; enjoyment; competence; self-efficacy; feedback; scoring; rewards; game usability and usefulness; interactivity; challenging.
Medication Game	Mordt et al. (2011)	Development	Intuitive decisions; motivation, fun and engagement; repeated exposure; time limitation; challenges; rewards; sound; handling stress; feedback; competition.
Medication Game	Foss et al. (2013)	Development	Intuitive decisions; motivation; repeated exposure; anxiety; self-efficacy; confidence; scoring; active learning; practice in controlled environments; immediate feedback; rewards; challenging; time limitation.
Medication Game	Foss et al. (2014)	Development, evaluation	Repeated practice; repeated gameplay; self-efficacy; stress; engagement; enjoyment; user-centred learning; learning styles; feedback; scoring.
Medicina	Müller (2011b)	Development, evaluation ^b	Improving skills; repeated exposure; familiarity; active listening; reaction and processing time.

Medicina	Müller (2012)	Development, evaluation ^b	Processing speed; attention; motivation; engagement; multimodality; repeated exposure; automaticity; interactivity; time limitation; distraction; cognitive load; feedback; reward; scoring; avatar.
Medicina	Müller (2013)	Development, evaluation ^b	Processing speed; attention; motivation; fun; simulate real-life task; repeated exposure; automaticity; feedback; time limitation.
Medicina	Müller & Mathews (2013)	Development, evaluation ^b	Response time; motivation; engagement; simulate real-life task in safe environment; repeated exposure; automaticity; interactivity; multimodality; immediate feedback; avatar; time limitation; flexibility; portability; accessibility; logistical/financial issues.

^aSame evaluation is reported. ^bSame evaluation is reported.

Table C2*Summary of Studies: Mobile-Based Videogames in Language Learning*

Author (date)	Game	Platforms	Country	Target L2	Language skill	Task type	Participants	Study duration	Study design	Evaluation focus
Amer (2014)	Idiomobile	Apple, Android, BlackBerry	USA, Middle East	English	Idiomatic expressions, collocations	Narrative scenario game, quizzes, flashcards	64 students (45 completed), in university or English language courses.	1 week	Uncontrolled, pretest/posttest, 4 groups	Usage, usability
Jere-Folotiya et al. (2014)	GraphoGame	Nokia	Zambia	ciNyanja	Phonics, spelling, literacy	Quizzes	573 first grade students (aged 5-9 years) & 68 teachers from 42 government schools	2 weeks	RCT, 6 groups	Effect on language learning
Kohnke, Zou & Zhang (2021)	Brains@PolyU	Not specified	Hong Kong	English	Discipline-specific vocabulary	Quizzes	159 tertiary students from 4 disciplines.	1 month	Uncontrolled, pretest/posttest, 4 groups	Effect on language learning
Pham, Nguyen & Chen (2018)	English Practice	Android	World-wide	English	Grammar, vocabulary	Quizzes, flashcards, matching games, grammar lessons, chat room	53,825 active game users, ages 18+	3 months	Uncontrolled, exploratory	Usage, engagement
Thongsri, Shen & Yukun (2019)	BW Vocabulary	Apple, Android	China	English	Vocabulary	Quizzes, flashcards, vocabulary list, tests.	200 tertiary students (100 STEM, 100 non-STEM)	3 weeks	Uncontrolled, pretest/posttest, 2 groups	Effect on language learning

Appendix D: Pretest Questionnaire

Q1

Welcome to the 'Scope and Speed of Language Learning Using Computer Games'
Pre-Test Survey!

Thank you for agreeing to take part in this research!

Please click the 'Next' button to login and begin the survey.

End of Block: Intro

Start of Block: Informed Consent

Q2 Consent for Participation in Research

Thank you for your interest in this research! Please read the consent form before deciding whether to proceed with this survey.

[Consent form](#)

Do you consent to participate in this research?

- Yes, I agree to participate in this study (1)
- No, I do not agree to participate in this study (2)

End of Block: Informed Consent

Start of Block: About You

Q3

About You

Gender

- Male (1)
- Female (2)
- X (3) _____
- Prefer not to say (4)

Q4 Age

Q5

Are you an international student?

- Yes (5)
 - No (6)
-

Q6 How much time have you spent in Australia?

Q7 What country do you come from?

Q8 Do you speak English as a second or foreign language?

- Yes (21)
 - No (22)
-

Q9 What is your first language?

Q10 What type of nursing course are you studying?

- Bachelors (1)
 - Honours (2)
 - Certificate/Diploma (3)
 - Postgraduate (e.g., Masters) (4)
 - Other: (5) _____
-

Q11 What year of your course are you currently studying?

- First year (1)
 - Second year (2)
 - Third year (3)
 - Fourth year or higher (4)
-

Q12 On average, how many hours per week do you spend playing videogames on any device (such as smartphone, tablet, computer/laptop, console or handheld device)?

- Less than 1 hour (1)
 - 1 to 4 hours (2)
 - 5 to 9 hours (3)
 - 10 to 19 hours (4)
 - More than 20 hours (5)
-

Q13 Which of the following devices do you FREQUENTLY use to play videogames? (Select all that apply)

- A computer device (e.g., desktop, laptop) (1)
 - A mobile device (e.g., smartphone, tablet) (2)
 - A console device (e.g., PlayStation, Xbox) (3)
 - A handheld device (e.g., Gameboy, Nintendo DS) (4)
 - None of the above (5)
-

Q14 What type of videogame player do you consider yourself?

- Newbie/novice (1)
- Casual (2)
- Core/intermediate (3)
- Hardcore/expert (4)

End of Block: About You

Start of Block: WRT intro

Q15

Audio Section

For the next section, please listen to the audio and click the medication name that you can hear for each question.

Please ensure your speakers/headphones are turned on and at a comfortable listening volume.

Please note the audio will play automatically and will only be played once.

Audio Check

Before you begin, the next page contains a question to check that your audio is working properly.

Please listen to the audio, then select the word that you can hear.

Please note the audio will play automatically.

Please click the 'Next' button to proceed.

Q16

Audio Check

Please select the word that you can hear.

- Alcohol wipe (1)
 - Bedpan (2)
 - Dressing trolley (3)
 - Surgical mask (4)
 - None - I cannot hear any sounds (5)
-

Q17

If you are having problems hearing the audio, please try again using headphones and/or a different device (such as desktop computer).

Once you have done so, please answer the audio check question again below.

If you are still unable to hear the audio, please contact the researchers before proceeding.

Audio Check

Please select the word that you can hear.

- Alcohol wipe (1)
 - Bedpan (2)
 - Dressing trolley (3)
 - Surgical mask (4)
 - None - I cannot hear any sounds (5)
-

Q18 If you are still having problems hearing the audio, please contact the researchers before proceeding.

Q19 Now, please click the 'Next' button to proceed to the main audio questions.

Questions will be shown one at a time. There are 30 questions in this section in total.

Remember, the audio will play automatically and will only be played ONCE for each question.

End of Block: WRT intro

Start of Block: WRT NEW P2

Q20

For the following section, please listen to the audio and click the medication name that you can hear for each question. Please note, it can only be played once.

Question 1:

- cardibital (1)
 - cardibetal (2)
 - cardabital (3)
 - cardabetal (4)
-

Q21 Question 2:

- cephazolin (1)
 - ceflazoline (2)
 - cephazoline (3)
 - ceflazolin (4)
-

Q22 Question 3:

- zypresatin (1)
 - zyprexetine (2)
 - zyrexetine (3)
 - zyresatin (4)
-

Q23 Question 4:

- humazosine (1)
 - humazosin (2)
 - humozosine (3)
 - humozosin (4)
-

Q24 Question 5:

- lamefenac (1)
 - lamefanac (2)
 - lamifanac (3)
 - lamifenac (4)
-

Q25 Question 6:

- trimidronate (1)
 - trimidronet (2)
 - imidronate (3)
 - imidronet (4)
-

Q26 Question 7:

- novarone (1)
 - nopharone (2)
 - novasone (3)
 - nophasone (4)
-

Q27 Question 8:

- cilofferim (1)
 - sarofferim (2)
 - cilofflam (3)
 - sarofflam (4)
-

Q28 Question 9:

- paroxebam (1)
 - paroxepam (2)
 - paraxebam (3)
 - paraxepam (4)
-

Q29 Question 10:

- refamide (1)
 - rifamide (2)
 - rifanide (3)
 - refanide (4)
-

Q30 Question 11:

- seplodipine (1)
 - cyprodibine (2)
 - cyprodipine (3)
 - seplodibine (4)
-

Q31 Question 12:

- dilamythin (1)
 - dinamythine (2)
 - dilamycin (3)
 - dinamycin (4)
-

Q32 Question 13:

- cefaden (1)
 - gefaden (2)
 - cefadine (3)
 - gefadine (4)
-

Q33 Question 14:

- lamistine (1)
 - lanastine (2)
 - lamisten (3)
 - lanasten (4)
-

Q34 Question 15:

- celemite (1)
 - celemide (2)
 - ceremite (3)
 - ceremide (4)
-

Q35 Question 16:

- asterol (1)
 - isterol (2)
 - astelol (3)
 - istelol (4)
-

Q36 Question 17:

- parinriptan (1)
 - parinriptane (2)
 - sparinriptan (3)
 - sparinriptane (4)
-

Q37 Question 18:

- defenstatin (1)
 - diphenstatin (2)
 - diphenstatine (3)
 - defenstatine (4)
-

Q38 Question 19:

- lanithiazide (1)
 - lanitiazide (2)
 - lamitiazide (3)
 - lamithiazide (4)
-

Q39 Question 20:

- cardachetin (1)
 - cardatretin (2)
 - carditretin (3)
 - cardichetin (4)
-

Q40 Question 21:

- humabicyl (1)
 - humabicyl (2)
 - humobicyl (3)
 - humobicyl (4)
-

Q41 Question 22:

- cilopam (1)
 - saropam (2)
 - cilobam (3)
 - sarobam (4)
-

Q42 Question 23:

- argotonide (1)
 - ergotonise (2)
 - ergotonide (3)
 - argotonise (4)
-

Q43 Question 24:

- sulfachiptan (1)
 - surfatriptan (2)
 - sulfatriptan (3)
 - surfachiptan (4)
-

Q44 Question 25:

- dialamide (1)
 - dilalamide (2)
 - dialanide (3)
 - dilalanide (4)
-

Q45 Question 26:

- flutacot (1)
 - flutacort (2)
 - flytacort (3)
 - flytacot (4)
-

Q46 Question 27:

- clotidine (1)
 - cilothidine (2)
 - cilotidine (3)
 - clothidine (4)
-

Q47 Question 28:

- pirinosetrol (1)
 - pirinosetron (2)
 - parinosetron (3)
 - parinosetrol (4)
-

Q48 Question 29:

- cephabicin (1)
 - cephapicin (2)
 - ceflabycin (3)
 - ceflapicin (4)
-

Q49 Question 30:

- lovaprazole (1)
- loveprazole (2)
- novaprazole (3)
- noveprazole (4)

End of Block: WRT NEW P2

Start of Block: MSLQ-R

Q50 Questionnaire The following questions ask about your motivation for and attitudes about the topic of this research. Remember there are no right or wrong answers, just answer as accurately as possible.

Use the scale below to answer the questions. If you think the statement is very true of you, select 7; if a statement is not at all true of you, select 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

	1 Not at all true of me (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 Very true of me (7)
1. When learning a topic like medical terms, I prefer games that really challenge me so I can learn new things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. The most important thing for me right now in this game is getting a good score	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I'm confident I can understand the basic concepts related to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

medical terms

4. When I take tests I think of the consequences of failing

5. I am very interested in medical terms

6. I have an uneasy, upset feeling when I take an exam

7. I expect to do well in tasks related to medical terms

8. The most satisfying thing for me in this game is trying to understand the content as thoroughly as possible

9. I think medical terms are useful for me to learn

10. I want to do well in this game because it is important to show my ability to my family, friends, employer, or others

Appendix E: Posttest Questionnaire

Q1

Welcome to the 'Scope and Speed of Language Learning Using Computer Games'
Post-Test Survey!

Thank you for agreeing to take part in this research!

To login and begin the survey, please click 'next'.

End of Block: Intro

Start of Block: Pretest Wrt intro

Q1

Audio Section

For the next section, please listen to the audio and click the medication name that you can hear for each question.

Please ensure your speakers/headphones are turned on and at a comfortable listening volume.

Please note the audio will play automatically and will only be played once.

Audio Check

Before you begin, the next page contains a question to check that your audio is working properly.

Please listen to the audio, then select the word that you can hear.

Please note the audio will play automatically.

Please click the 'Next' button to proceed.

Q2 Audio Check

Please select the word that you can hear.

- Alcohol wipe (1)
 - Bedpan (2)
 - Dressing trolley (3)
 - Surgical mask (4)
 - None - I cannot hear any sounds (5)
-

Q3

If you are having problems hearing the audio, please try again using headphones and/or a different device (such as desktop computer).

Once you have done so, please answer the audio check question again below.

If you are still unable to hear the audio, please contact the researchers before proceeding.

Audio Check

Please select the word that you can hear.

- Alcohol wipe (1)
 - Bedpan (2)
 - Dressing trolley (3)
 - Surgical mask (4)
 - None - I cannot hear any sounds (5)
-

Q4 If you are still having problems hearing the audio, please contact the researchers before proceeding.

Q5 Now, please click the 'Next' button to proceed to the main audio questions.

Questions will be shown one at a time. There are 30 questions in this section in total.

Remember, the audio will play automatically and will only be played ONCE for each question.

End of Block: Pretest Wrt intro

Start of Block: Pretest WRT NEW P2

Q1

For the following section, please listen to the audio and click the medication name that you can hear for each question. Please note, it can only be played once.

Question 1:

- cardibital (1)
 - cardibetal (2)
 - cardabital (3)
 - cardabetal (4)
-

Q2 Question 2:

- cephazolin (1)
 - ceflazoline (2)
 - cephazoline (3)
 - ceflazolin (4)
-

Q3 Question 3:

- zypresatin (1)
 - zyprexetine (2)
 - zyrexetine (3)
 - zyresatin (4)
-

Q4 Question 4:

- humazosine (1)
 - humazosin (2)
 - humozosine (3)
 - humozosin (4)
-

Q5 Question 5:

- lamefenac (1)
 - lamefanac (2)
 - lamifanac (3)
 - lamifenac (4)
-

Q6 Question 6:

- trimidronate (1)
 - trimidronet (2)
 - imidronate (3)
 - imidronet (4)
-

Q7 Question 7:

- novarone (1)
 - nopharone (2)
 - novasone (3)
 - nophasone (4)
-

Q8 Question 8:

- cilofferim (1)
 - sarofferim (2)
 - cilofflam (3)
 - sarofflam (4)
-

Q9 Question 9:

- paroxebam (1)
 - paroxepam (2)
 - paraxebam (3)
 - paraxepam (4)
-

Q10 Question 10:

- refamide (1)
 - rifamide (2)
 - rifanide (3)
 - refanide (4)
-

Q11 Question 11:

- seplodipine (1)
 - cyprodibine (2)
 - cyprodipine (3)
 - seplodibine (4)
-

Q12 Question 12:

- dilamythin (1)
 - dinamythin (2)
 - dilamycin (3)
 - dinamycin (4)
-

Q13 Question 13:

- cefaden (1)
 - gefaden (2)
 - cefadine (3)
 - gefadine (4)
-

Q14 Question 14:

- lamistine (1)
 - lanastine (2)
 - lamisten (3)
 - lanasten (4)
-

Q15 Question 15:

- celemite (1)
 - celemide (2)
 - ceremite (3)
 - ceremide (4)
-

Q16 Question 16:

- asterol (1)
 - isterol (2)
 - astelol (3)
 - istelol (4)
-

Q17 Question 17:

- parinriptan (1)
 - parinriptane (2)
 - sparinriptan (3)
 - sparinriptane (4)
-

Q18 Question 18:

- defenstatin (1)
 - diphenstatin (2)
 - diphenstatine (3)
 - defenstatine (4)
-

Q19 Question 19:

- lanithiazide (1)
 - lanitiazide (2)
 - lamitiazide (3)
 - lamithiazide (4)
-

Q20 Question 20:

- cardachetin (1)
 - cardatretin (2)
 - carditretin (3)
 - cardichetin (4)
-

Q21 Question 21:

- humabicil (1)
 - humabycin (2)
 - humobycin (3)
 - humobicil (4)
-

Q22 Question 22:

- cilopam (1)
 - saropam (2)
 - cilobam (3)
 - sarobam (4)
-

Q23 Question 23:

- argotonide (1)
 - ergotonise (2)
 - ergotonide (3)
 - argotonise (4)
-

Q24 Question 24:

- sulfachiptan (1)
 - surfatriptan (2)
 - sulfatriptan (3)
 - surfachiptan (4)
-

Q25 Question 25:

- dialamide (1)
 - dilalamide (2)
 - dialanide (3)
 - dilalanide (4)
-

Q26 Question 26:

- flutacot (1)
 - flutacort (2)
 - flytacort (3)
 - flytacot (4)
-

Q27 Question 27:

- clotidine (1)
 - cilothidine (2)
 - cilotidine (3)
 - clothidine (4)
-

Q28 Question 28:

- pirinosetrol (1)
 - pirinosetron (2)
 - parinosetron (3)
 - parinosetrol (4)
-

Q29 Question 29:

- cephabicin (1)
 - cephapicin (2)
 - ceflabycin (3)
 - ceflapicin (4)
-

Q30 Question 30:

- lovaprazole (1)
- loveprazole (2)
- novaprazole (3)
- noveprazole (4)

End of Block: Pretest WRT NEW P2

Start of Block: MSLQ-R

Q78 Questionnaire The following questions ask about your motivation for and attitudes about the topic of this research. Remember there are no right or wrong answers, just answer as accurately as possible.

Use the scale below to answer the questions. If you think the statement is very true of you, select 7;

if a statement is not at all true of you, select 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

	1 Not at all true of me (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 Very true of me (7)
1. When learning a topic like medical terms, I prefer games that really challenge me so I can learn new things (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. The most important thing for me right now in this game is getting a good score (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I'm confident I can understand the basic concepts related to medical terms (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. When I take tests I think of the consequences of failing (14)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I am very interested in medical terms (17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I have an uneasy, upset feeling when	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I take an exam (19)							
7. I expect to do well in tasks related to medical terms (21)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. The most satisfying thing for me in this game is trying to understand the content as thoroughly as possible (22)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I think medical terms are useful for me to learn (23)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I want to do well in this game because it is important to show my ability to my family, friends, employer, or others (30)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: MSLQ-R

Start of Block: FBQ

Q34 EFFECTS ON YOU

Familiarity – Do you think the game was effective in making medication names more familiar?

	1	2	3	4	5	6	7	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	
Not at All	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	More familiar

Q35 Listening – Do you feel more confident that you will understand spoken medication names?

	1	2	3	4	5	6	7	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	
Not at All	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	More confident

Q36 Effort – Do you think you can recognise medication names more easily?

	1	2	3	4	5	6	7	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	
Not at All	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	More easily recognised

Q37 Extra help – Did you use any other language resources to help you learn the same things in the game? (choose one or more)

- Internet (1)
- Textbook (2)
- Friends/tutor (3)
- None (4)
- Other (5) _____

Q38 YOUR IDEAS & OPINIONS

What needs to be improved in the game?

Q39 What did you think was good about the game?

Q40 How can the game help you prepare for clinical placement?

Q41 What advice would you give others about playing the game, such as how to best use it?

Q42 Should the characters be removed from the game? Why or why not?

Q43 We welcome any other ideas, opinions, or comments

End of Block: FBQ

Start of Block: GQQ-R

Q44
Survey

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
I think that I would like to use this game frequently (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found the game unnecessarily complex (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I thought the game was easy to use (14)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think that I would need the support of a technical person to be able to use this game (15)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I found the various elements of this game well designed (e.g. controls, avatar, levels, audio) (16)

I thought there was too much inconsistency in this game (17)

I would imagine that most people would learn how to use this game very quickly (18)

I found the game very awkward to use (19)

I felt very confident using the game (20)

I needed to learn a lot of things before I could get going with this game (21)

End of Block: GQQ-R



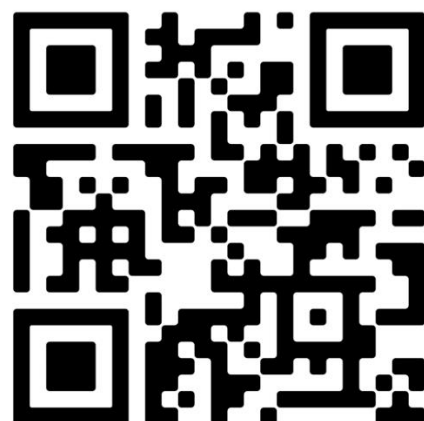
VOLUNTEERS NEEDED

International nursing students
needed to test a videogame which
teaches medication names and
improves language skills

Benefits:

- Learn real confusable medication names
- Improve listening and reading skills
- Practice skills for classes and clinical placements
- Hear Australian accents
- Play videogame on smartphone, tablet, or computer
- 100% online - join now from anywhere

For more information, scan QR code or email adam.koschade@flinders.edu.au



Appendix G: Letter of Introduction



College of Nursing and Health Sciences
GPO Box 2100
Adelaide SA 5001
Tel: 08 8201 3378
amanda.muller@flinders.edu.au
<http://flinders.edu.au/nursing>
CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Student

I hold the position of Senior Lecturer in the College of Nursing Health Sciences at Flinders University, and I work with the research student Adam Koschade. We are undertaking research leading to publications on the subject of the scope and speed of language learning using computer games.

I would be most grateful if you would volunteer to assist in this project by playing computer games, doing two short tests, and completing a questionnaire for the game. No more than 3 hours over two weeks would be required.

Participation in the study will offer students important benefits essential to their classwork and clinical skills.

Students participating in the study will play a multiplatform computer game (playable on laptop/desktop computers and android mobile devices) which teaches real confusable medication names.

The game hones listening skills and teaches valuable medical terminology which nursing students often find difficult. It supports both classroom learning and clinical placement. In particular, this game allows students to familiarise themselves with the sorts of things they will hear and use in patient handovers, while taking patient histories and while reading patient records. Made in Australia, it will also allow students to practice hearing and getting used to Australian accents.

The study and resources are all online. They can be accessed anytime, from anywhere. This would be especially valuable for students who, because of the pandemic, will be beginning their semester offshore and/or studying online by distance. Thus, students can not only participate in the study, but also start to practice and improve their English language skills – even from offshore or before commencing their degree.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Any enquiries you may have concerning this project should be directed to adam.koschade@flinders.edu.au .

Thank you for your attention and assistance.

Yours sincerely

Dr Amanda Muller

Lecturer (English for Specific Purposes)

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (project number 6275). For more information regarding ethical approval of the project the Secretary of the Committee can be contacted by telephone on 8201 5962, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Appendix H: Participant Information Sheet



Dr Amanda Muller
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Sturt Campus
Flinders Drive, Bedford Park SA 5042
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 8201 3378
amanda.muller@flinders.edu.au
<http://flinders.edu.au/nursing/>
CRICOS Provider No. 00114A

INFORMATION SHEET

Title: 'The scope and speed of language learning using computer games'

Primary Investigator:

Dr Amanda Muller
College of Nursing and Health Sciences
Flinders University
Ph: 8201 3378

Co-investigator:

Research student: Adam Koschade adam.koschade@flinders.edu.au.

Description of the study:

This study is part of the project entitled '*The scope and speed of language learning using computer games*'. This project will investigate how well students can learn important medical and colloquial language for health-related work.

Purpose of the study:

This project aims to find out if computer games which have been created to teach language actually improve student performance.

What will I be asked to do?

There are three stages of the study: an online pre-test of your skills before the game, the playing of the game online, and an online post-test of your skills after the game (this includes giving your opinion about the game). In summary, the schedule looks like this:

1. 15 minute online pre-test of your ability before playing the game, plus a questionnaire
2. Play the game online for at least 10 minutes a day for 7 days, over a 14 day period
3. 15 minute online post-test of your ability after playing the game, plus a questionnaire

What benefit will I gain from being involved in this study?

The sharing of your experiences will improve the planning and delivery of future programs. We are very keen to deliver a service and resources which are as useful as possible to people.

Participation in the study will offer students important benefits essential to their classwork and clinical skills.

Students participating in the study will play a multiplatform computer game (playable on laptop/desktop computers and android mobile devices) which teaches real confusable medication names.

The game hones listening skills and teaches valuable medical terminology which nursing students often find difficult. It supports both classroom learning and clinical placement. In particular, this resource allows students to familiarise themselves with the sorts of things they will hear and use in patient handovers, while taking patient histories, and while reading patient records.

Made in Australia, this game will also allow students to practice hearing and getting used to Australian accents. This is particularly helpful at a time when students may be undertaking their degree off-campus.

The study and resources are all online. They can be accessed anytime, from anywhere. This would be especially valuable for students who, because of the pandemic, will be beginning their semester offshore and/or studying online by distance.

First years who have not mastered English as much as later year students may find it particularly helpful. However, students from all year levels would benefit and are welcome to participate in this study.

Thus, students can not only participate in the study, but also start to practice and improve their English language skills – even from offshore or before commencing their degree.

Will I be identifiable by being involved in this study?

We do not need your name and you will be anonymous. Any identifying information will be removed and the typed-up file stored on a password protected computer that only the researchers will have access to. Your comments will not be linked directly to you.

Are there any risks or discomforts if I am involved?

It is an anonymous study, so the investigator anticipates little risk from your involvement. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

How do I agree to participate?

Participation is voluntary. You may answer 'no comment' or refuse to answer any questions and you are free to withdraw from the study at any time without effect or consequences. A consent form accompanies this information sheet. If you agree to participate please email adam.koschade@flinders.edu.au.

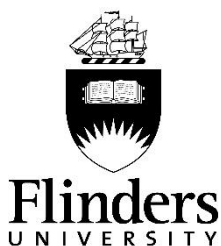
How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (6275). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Appendix I: Consent Form



CONSENT FORM FOR PARTICIPATION IN RESEARCH

(by experiment...)

The scope and speed of language learning using computer games

I

being over the age of 18 years hereby consent to participate as requested in the letter of introduction for the research project on the scope and speed of language learning using computer games.

I have read the information provided.

1. Details of procedures and any risks have been explained to my satisfaction.
2. I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.
3. I understand that:
 - I may not directly benefit from taking part in this research.
 - I am free to withdraw from the project at any time and am free to decline to answer particular questions.
 - While the information gained in this study will be published as explained, I will not be identified, and individual information will remain confidential.
 - Whether I participate or not, or withdraw after participating, will have no effect on any treatment or service that is being provided to me.
 - Whether I participate or not, or withdraw after participating, will have no effect on my progress in my course of study, or results gained.
7. I have had the opportunity to discuss taking part in this research with a family member or friend.

Participant's signature.....Date.....

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name.....

Researcher's signature.....**Date**.....

NB: Two signed copies should be obtained. The copy retained by the researcher

Appendix J: Ethics Approval

SBREC6275 Original Application

Flinders University
SOCIAL AND BEHAVIOURAL RESEARCH ETHICS COMMITTEE

Office Use Only

Project No.

APPLICATION FOR ETHICAL APPROVAL OF SOCIAL OR BEHAVIOURAL RESEARCH INVOLVING HUMAN SUBJECTS

IMPORTANT – refer to the ‘Application Submission Process’ and ‘Application Submission Guidelines’ documents available from SBREC [Guidelines, Application Form and Templates](#) web page before completion of the form.
Submit completed form and all relevant attachments in PDF format to human.researchethics@flinders.edu.au

New Ethics Application	<input checked="" type="checkbox"/>		
Response to Deferral Notice	<input type="checkbox"/>	Project Number	<input type="text"/>

Research Involving Children or Vulnerable Adults

If you are intending to conduct research involving children or vulnerable adults you are required to have undergone a Criminal History Check. A set of procedures has been agreed between the University and the Department for Communities and Social Inclusion (DCSI) Screening and Licensing Branch. For specific information about these procedures please refer to the [Research Involving Children or Vulnerable Adults](#) webpage and the [Criminal History Check Procedures](#) webpage.

Accordingly, Section H (Certification and Signatures) asks whether the research will involve children and vulnerable adults and if yes, asks for confirmation that a current Criminal History Check is in place.

A. PROJECT TITLE and TIMEFRAME

A1. Project Title

The scope and speed of language learning using computer games

A2. Plain language, or lay, title

Do computer games help language learning?

A3. Period for which approval is sought

Projects may not commence until formal written notification of final ethics approval has been provided.

Date data collection is <u>planned</u> to commence:	02/02/2014	
<u>Important Note</u> – data collection cannot commence until final ethics approval has been granted by the SBREC.	Q following approval:	
Date data collection is expected to be completed:	1/12/2016	
Date project is expected to be completed:	1/12/2017	

B. RESEARCHER / SUPERVISOR INFORMATION

Correspondence regarding ethics approval will be emailed to the Principal Researcher with copies to all other researchers listed on the application unless otherwise indicated. Please note that is a requirement that *all supervisors* receive a copy of all correspondence relating to the

project. *Principal Researcher* (student or staff member)

Title: Dr	First Name: Amanda	Family Name: Muller
Status:	Staff: <input checked="" type="checkbox"/>	Flinders Uni Student: <input type="checkbox"/> Associate: <input type="checkbox"/>
Flinders Uni Student No. (Principal researcher only)		Degree enrolled in: (please do not use acronyms)
Supervisor(s) (also list as researcher below)		
Flinders Uni School/Department or Organisation:	School of Nursing & Midwifery	
Postal Address: (students only)	GPO Box 2100 ADELAIDE SA 5001	
Phone:	08 8201 3378	Principal Researcher Email: amanda.muller@flinders.edu.au

ALL QUESTIONS SHOULD BE ANSWERED IN THE SPACES PROVIDED.

C. PROJECT DETAILS

C1. Brief outline of:

A the project:

This study tests a suite of newly created educational computer games in the School of Nursing & Midwifery, which is designed to teach the different types of language: medication names, medical abbreviations, medical terminology, phrasal verbs, idioms, and slang terms used in medical settings. The study asks how well this game improves international student's processing of language, both when heard and read, and any improvements in recall.

B significance:

Language difficulties impact upon international students' learning and clinical performance. Thus, they need to be familiarised with the kinds of language they will encounter at university and in the health sector. It is typical for students to not have enough experience interacting with medical terminology and colloquial words before they are required to use it. This suite of games is designed as a step to remedying this situation, and this project is an attempt to ascertain the efficacy of these games.

C research objective(s):

No.	Research objective
1.	Ascertain the efficacy of the suite of language learning computer games.
2.	
3.	

C2. Medical or Health Research involving the *Privacy Act 1988*

Is the research related to medical or health matters?

Yes	<input type="checkbox"/>	Place letter 'X' in the relevant box
No	<input checked="" type="checkbox"/>	

A Will personal information be sought from the records of a [Commonwealth Agency](#)?

If YES, to question (A) below; if NO, go to item C4.

Yes	<input type="checkbox"/>
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No	X
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If YES, complete Part A of the Appendix 'Privacy Legislation Matters' that relates to compliance with the Guidelines under Section 95 of the Privacy Act 1988.

B Will health information be sought from a **Private Sector Organisation** or a **health service provider funded by the [State Department of Health](#)**?

If NO, go to question (b) below.

Yes	
No	X

If YES, complete Part B of the Appendix 'Privacy Legislation Matters' that relates to compliance with the Guidelines under Section 95 of the Privacy Act 1988.

If you answered 'NO' to both (a) and (b) above go to item C4.

C3. Health Research Involving or Impacting Aboriginal or Torres Strait Islander Peoples

Does your project comprise of health research involving Aboriginal or Torres Strait Islander peoples?

Yes	
No	x

IMPORTANT

Proposals to conduct health-related research involving Aboriginal or Torres Strait Islander peoples or communities in South Australia must also be submitted to the [Aboriginal Health Council of South Australia \(AHCSA\)](#).

C4. Project Information and Data Type

Publication Y or N

Publication	Intend to publish results? (e.g., article, book, thesis)	y
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Data Type

Is DATA to be obtained primarily	Quantitative	Y	Qualitative	Y	If OTHER, please state:
Is information to be sought by	Questionnaire	Y	Interview		
	Experiment		Computer/Online	Y	
	Focus Group		Secondary analysis of data		
			Other		

Recording / Observation

If YES, outline what will be recorded or observed below

Will participants be video, audio recorded, photographed or observed? If YES, please place a letter 'X' in the relevant response box or boxes and outline what will be recorded or observed.	Video	N	
	Audio	N	
	Photographed	N	
	Observed	N	

C5. Research Method

Outline of the research method, including what participants will be asked to do

WHO will be recruited? (e.g., students, staff, CEOs, children, members of public)

Students

SOURCE of participants (e.g., organisation, members of public, University, school)

University

RESEARCH METHOD – participants will be asked to:

There are three stages of the study: a pre-test of skills, playing the language learning games, and a post-test of skills (and at this stage the student gives their opinion about the games). This study uses both a quantitative and qualitative design:

1. Multiple regression for pre- and post-test results
2. The General Linear Model (GLM) Repeated Measures test for correct/incorrect game play selections, and login information
3. A thematic analysis of answers gathered in the questionnaire.

Students will be required to complete a pre-test of their ability to process language tasks. At this time, basic demographic information will be recorded and they will be asked to choose an anonymous game-playing 'name'. Students will then be asked to play a computer game for a minimum of 15 minutes per day for 7 days. To allow for students' time demands, this 7-day target can be completed within a 14-day time period. Each student's correct and incorrect selections will be recorded during gameplay, as will the number of logins and game restarts. Students will later attend a post-test on similar language tasks they completed in the pre-test. They will also be given a questionnaire asking about what they think of the game and its usefulness

RECORDING - Audio/video recording/ photographs None

WHERE will each component of the research be conducted? (e.g., University, organisation, private office, public) Online

C6. Research Objectives

Briefly describe how the information which will be requested from participants addresses the research objectives identified in C1(a)

The information gained from the project will tell us if the game is an effective means of familiarising international students with both heard and read forms of language found in medical settings. The study will tell us how quickly and well a student can learn language by playing the game, and it will gather qualitative feedback about the use of gaming in education.

D. PARTICIPANT INFORMATION

D1. Brief outline of:

A Identity and Basis for Recruitment

Who will the participants be? What is the basis for their recruitment to the study? What

The participants will be university students from the School of Midwifery because they are the target end- users and the most likely to express difficulty with language tasks in health fields.

Participant Type	Basis for Recruitment	Component of Research Involved In (e.g, survey, interview, focus group, observations)
University students	The games are designed to meet their linguistic needs.	questionnaire

B Participant Numbers Approached and Population Pool

Please specify the number of people that will be approached (or an approximation if the exact number is

I will approach an anticipated 542 international students.

Participant Type / Group	Population Pool	Numbers to be approached	Expected / Required No.
B.Nurs (prereg)	320	320	25
B.Nurs (grad entry)	118	118	15
B.Nurs (postreg)	104	104	10

C Source of Participants

From what source will participants be recruited (e.g. public department, organisation)?

The students will be recruited from the School of Nursing & Midwifery.

Participant Type	Source of Participants

D Conflict of Interest

Please specify whether any of the researchers involved in the project have any role, or relation to, the source from which participants will be recruited (e.g., organisation). Please indicate whether a possible conflict of interest may exist (financial or other interest or affiliation. For example; doctor/patient; employer/employee; lecturer/student; collegial relationship; recruitment of friends and/or family; other).

	Researcher(s) Name (ALL Researchers)	Possible conflict of interest? Please provide a considered response of whether there is <u>or isn't</u> a possible conflict of interest. If YES, please consider and explain how this will be managed.
1.	Dr Amanda Muller	I am a Lecturer in the School of Nursing and Midwifery, and I develop the English for Specific Purposes programme, which is an auxiliary programme that students voluntarily attend. I don't grade students. I don't have any effect on students' marks in their Nursing or Midwifery course. There are no graded or personal consequences for any student whether they do or do not volunteer for the study

E Participant Age

Will any participants be less than 18 years of age? IF YES, please indicate the age range or potential participants and confirm whether information has been presented in a manner and format appropriate

Yes	
No	x

Please note: that 17 year old Flinders University students may participate in research without parental consent. Participants recruited outside of the University under the age of 18-years will require parental consent unless a compelling argument can be made to the

Committee.

Age range of each participant type / group	Information presented in a manner / format appropriate to age group and participants? Yes/No

F Informed Consent

Do participants have the ability to give informed consent? If YES, please explain how participants will indicate willingness to be involved (e.g., completion of questionnaire, return of consent form etc). If NOT, please explain why not. If participants will be aged under 18 indicate whether they will be given the opportunity to assent to research participation (e.g., sign parental consent form).

Yes. All participants need to give informed consent. They will need to ask to join the study, then sign a consent form, and also complete a questionnaire.

D2. Cultural and/or Religious Background

Indicate whether the participant group will be comprised of people from a specific cultural or religious background (for example, Indigenous and/or Torres Strait Islander peoples, Greek people etc) OR if any such

There are no specific cultural or religious backgrounds. I expect the participants to be culturally/religiously diverse.

D3. Language

Will there be any issues with language? If YES, please explain what the issues are and whether information will need to be presented in a language other than English.

Yes	<input type="checkbox"/>
No	<input checked="" type="checkbox"/>

If YES, (a) explain what the issues are and (b) whether information will need to be presented in a language other than English

WHO will translate information and how will anonymity and confidentiality matters be managed if translation will be conducted by someone other than a researcher?

D4. Participant Contact and Recruitment

A Contact and Recruitment

Please provide a detailed explanation of how potential participants will be contacted and recruited. For example, if making direct contact (e.g., face-to-face, in class, telephone) HOW will contact details be obtained and how will participants indicate their willingness to be involved in the project?

Students will be approached as a group through school-wide email and they will indicate if they want to be involved by replying in an email to the researcher.

C Email Text

If potential participants will be approached via email, provide the text that will be emailed.
 If participants will be contacted via email please provide the text that will be used in the email sent to potential participants to ensure that informed consent can be given.

Important – email text for student projects should be written by the supervisor to act as a Letter of Introduction for the student.

as

Verbal Script to recruit /contact Not applicable

Email Text to recruit / contact -

Dear Student,

Would you like to join a project testing how well language learning computer games can improve your skills? We need volunteers who can:

- do a pre-test of particular language skills before you start
- play games each day for 15 minutes
- do a post-test of the same language skills as the pre-test, plus give your opinions

We want to know how quickly students can learn using these games and how it affects students' performance in real-life.

If you are interested, more detailed information can be found in the letter of introduction and participant information sheet attached.

Please feel free to email amanda.muller@flinders.edu.au if you have any questions. Thanks, Amanda Muller

D5. Information given to participants

What information will be given to participants? For example, the letter of introduction, information sheet,

will be provided to potential participants.

Please note that letters of introduction, information sheets and consent forms must be provided before a decision is made on whether or not to participate.

What information will be given to participants and/or recruiting organisations?	When will information be given?
Letter of introduction, information sheet, consent form	when participants are approached
Questionnaire	when participants complete the post-test
Feedback	shortly after participants complete their involvement in the study

D6. Direct Recruitment Approaches

Does recruitment involve a direct personal approach to potential participants (e.g., face-to-face, classroom, telephone) by the researchers or by other parties/organisations to be involved in contact and recruitment?

Yes	<input type="checkbox"/>
No	<input checked="" type="checkbox"/>

If YES, please (1) justify why a direct recruitment approach is required and (2) explain how the researchers will address any real, or perceived, coercion felt by potential participants?

I don't approach students directly – rather through a general school-wide email sent by the school itself. Also, I do not expect that the students will feel coerced by this approach. I develop the English for Specific Purposes programme, which is a voluntary auxiliary programme for students. I don't grade any students in any courses. I don't have any effect on students' marks in their Nursing degree. Thus, there are no graded or personal consequences for any student whether they do or do not volunteer for the study.

D7. Confidentiality and Anonymity

Indicate any confidentiality and anonymity assurances to be given to potential participants and explain the procedures for obtaining free and informed consent of participants.

Please answer the following questions:	Y or N
Will participation be anonymous?	Y
Will participation be confidential?	Y
IF a lecturer /topic coordinator be involved in participant recruitment will they know who has participated?	N

Important

If answered 'Yes' or 'No' to any questions, please ensure that potential participants are advised accordingly in the Information Sheet to ensure informed consent can be obtained.

The study is completed online and participation is anonymously automated online. The user chooses a pseudonym and their real name remains known only to themselves. The only indication I have of who participates in the study is in the consent forms, but individual people are not identified within the study itself.

D8. Permissions

Indicate any permissions that may need to be sought to conduct the research, recruit specific people, access existing data sets or post advertising material and attach correspondence requesting permission AND granting permission. If this correspondence is not yet available please respond that a

copy will be submitted to SBREC on receipt. For example, permission may need to be sought from

recruit employees, Head of a University department or school, data custodians, community organisations etc).

Please note that permissions should be sought, in the first instance, from the Chief Officer or Head of the peak organisation or governing body unless adequate justification can be provided that contextual circumstances require a different approach.

Please note for class projects where permission letters are required to conduct the research, permission letters will need to be provided for every student.

	Permission will be sought from:	Permission <u>request</u> attached?	Correspondence <u>granting</u> permission attached?
1.	Head of School of Nursing & Midwifery	no	no

D9. Incidental People

Indicate whether anyone may be incidentally involved in the research (e.g., members of the public, colleagues, family members, children etc). In certain professional studies consideration may need to be given how such people will be informed about the research and how consent may be obtained for their incidental involvement. An oral statement given to a person / group incidentally involved prior to the commencement of the research

There is no incidental involvement. It is an online study.

D10. Time Commitment

Indicate the expected time commitment(s) by participants AND the proposed location(s) for every component of the research (e.g., survey, interview, focus group, observation). This information should be clearly conveyed

	Component of Research (e.g., questionnaire, interview)	Expected Time Commitment	Proposed Location
1.	pre-test	10 minutes	online
2.	game play	105 minutes	online
3.	post-test	20 minutes	online

E. RESEARCH CONDUCTED OVERSEAS

E1. Recruitment of Overseas Participants

Will any participants be recruited from overseas or will the research be conducted outside of Australia? Please note that regardless of the physical location of the researcher, if participants recruited will be located overseas the NHMRC considers it to be 'overseas' research.

Yes	<input type="checkbox"/>
No	<input checked="" type="checkbox"/>

If YES, please ensure you are familiar with the University's Policy on Travel, Accommodation and Subsistence available from

<http://www.flinders.edu.au/ppmanual/policySecretariat/travel.html> which states that all travel is prohibited to Level 5 regions (see section 7). Please be reminded that all travel to level 4 areas requires approval from the person responsible for authorising travel in your area and the Cost Centre Head.

If 'YES', go to item E2. If 'NO' go to section F.

E2. Identity of Overseas Country

If research participants will be recruited from overseas indicate from which country or countries they will be

E3. Overseas Ethics Approval Processes

Indicate whether there any ethics approval processes, relevant to the research, in the country (or

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

If '**NO**', indicate how this is known to the applicant and provide either (a) written correspondence confirming that no ethics approval is required or (b) in the case of student projects, written confirmation from the students supervisor that this is the case.

If '**YES**', indicate whether the ethics approval processes are **mandatory**.

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

Give a brief explanation of how the **ethics approval process functions** and the values and principles on which they rely.

E4. Student Supervision

If the researcher is a student, explain how their academic supervision will be maintained while they are in the

E5. Overseas Co-researchers

Will co-researchers be recruited in the country or countries in which the research will be conducted?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

If 'YES' continue with item E5. If 'NO' go to section F.

If YES, how will their **expertise** and capacity to conduct the component of the research they will be involved in be determined?

	Co-researcher full name and title	Role in research
1.		

F. SPECIFIC ETHICAL MATTERS

F1. Project Value and Benefits

Outline the value and benefits of the project to the participants, the discipline, the community etc.

This research is important because it empirically tests the effectiveness and value of an educational resource aimed at a specific discipline area and its specialised vocabulary. The School of Nursing & Midwifery will be able to best help international students by ascertaining the degree to which the game suite is effective in raising communicative competence (and by extension, their academic pursuits and future careers). Thus, information will be gained about whether educational language games are interesting to students, efficient at teaching, and a good way to learn special vocabulary that usually requires time-consuming rote learning methods. The study will provide concrete evidence that the game might benefit students from nursing to medicine and even paramedic studies.

If the programme is effective in improving communicative competence, the results will be published in an English as a Second Language and/or Nursing journal to explain the innovative approach and its exact benefits for the students. Thus, should other schools adopt the computer game suite, international nursing students outside of Flinders may ultimately benefit as a result of this research, as might other health fields.

F2. Burdens and/or Risks

Notwithstanding the value and benefits of the project (listed above), outline any possible burdens and/or risks of the project for research participants, researchers and incidental people (e.g. possible identification, disclosure of illegal activity, transport of participants, conducting research in participants homes, participant distress etc).

If **illegal activities** may be disclosed by participants during the course of the research please explain how this will be managed and clarify whether the researcher is a mandated reporter. Please note that even if a researcher is not a mandated reporter that researchers could be held criminally liable if they fail to disclose information to authorities relating to serious indictable offences (e.g., murder, rape child abuse) under S241 of the Criminal Law Consolidation Act of South Australia.

There are no burdens other than the time needed to participate in the study, but the participants are aware of this when volunteering to participate.

F3. Management of Burdens and/or Risks

IF any issues were raised in item F2 (above), explain **how the researcher will respond** to each identified burden and/or risk.

IMPORTANT

☐ If there is any possibility that research participation may cause some participants to experience emotional discomfort (e.g., anxiety, distress, embarrassment) the Committee recommends that contact details of free support services (e.g., counselling, Life Line) are included in the Information Sheet to be provided to respondents prior to a decision being made about whether or not to participate.

☐ If the researcher(s) are mandated reporters or it is possible that illegal activities could be uncovered or disclosed, participants should be advised in the Information Sheet that although information will be treated with the strictest confidence **by the researcher, that disclosure of information either must be reported to relevant authorities or cannot be safe from legal search**

The participants can discontinue with the study at any time.

F4. Concealment

Will the true purpose of the research be concealed from participants?

Yes	
No	x

F5. Feedback and/or Debriefing

Describe any feedback or debriefing to be provided to participants that may be relevant to the research, including how participants will be informed of any deliberate deception or concealment. Please provide copies

A debriefing email will compiled after the participant’s involvement in the study has concluded. No individuals will be identified.

F6. Questionnaires

If participants will be required to complete a questionnaire indicate what the arrangements will be for the secure and confidential return of questionnaires to the researcher (e.g., sealable self-addressed envelope, collection by researcher or someone other than researcher, secure collection box etc)

Please also indicate how participants will be informed of the arrangement (e.g., verbal instruction,

WHO will distribute the questionnaire/survey to participants? It will be completed online, no distribution required.

HOW will participants return completed questionnaires/surveys? It will be completed online, so no return system required.

WHO will collect completed questionnaires/surveys? It will be completed online, so no collection required.

HOW will participants be informed of the arrangements?
The participants will be informed in the information sheet and introduction letter.

F7. Participant Reimbursement

Is it the intention of the researcher to reimburse participants? Refer to the Application Submission Guidelines available from the SBREC [Guidelines, Application Form and Templates](#) web page for guidelines on participant

Yes	
No	x

If **YES**, how much or what will participants be given as a reimbursement? Please also provide a justification for the amount or item provided as reimbursement.

F8. Data Transcription

Indicate whether data may need to be **transcribed**. If **YES**, please indicate **who** will transcribe the data (e.g, researcher(s), secretarial assistance, professional transcription company). If anyone other than the researcher(s) will transcribe data, confirm whether they will be asked to sign a **confidentiality agreement**, a template for which is available from the SBREC [Guidelines, Application Form and](#)

No transcription required because the data is entered by the participants online.

F9. Participant Control of Data

Indicate whether participants will have any control in the immediate reporting and future use of data collected for the purposes of the research. Will participants have the ability to review and edit individual interview transcripts (if relevant) and/or the final report prior to publication?

No. The participants control the data they enter into the online questionnaire.

F10. DATA STORAGE AND RETENTION

Note that the data should be retained in accordance with the [Australian Code for the Responsible Conduct of Research](#) and [Flinders University policy](#).

F10(a) Data Transmission Protocols

During the research project:

What protocols will be used for the secure transmission of data (if required) to e.g., transcribers, interpreters or other members of research team?	n/a
If transcription or interpreter services will be used will the data received be deleted by transcribers / interpreters on completion of services?	n/a

F10(b) Data Type

On completion of the project, data will be stored:

In writing	<input type="checkbox"/>	On Flinders University computer server	<input checked="" type="checkbox"/>
On audio tape/CD	<input type="checkbox"/>	On video tape/DVD	<input type="checkbox"/>
Other (please indicate):			

The Committee advises that, unless written transcriptions have been reviewed and agreed to by participants, audio tapes should be retained as they may be required for the verification of results and/or secondary data analysis.

F10(c) Data De-identification

Will data be stored in a de-identified form?

Yes	<input checked="" type="checkbox"/>
No	<input type="checkbox"/>

If YES, please confirm whether this means:		'X'
1.	that the data <u>cannot</u> in any way be linked to an individual or organisation (non-identifiable data); OR	<input checked="" type="checkbox"/>
2.	that the data has had all identifying information removed but the means still exists to <u>re-identify</u> an individual and/or organisation (re-identifiable data).	<input type="checkbox"/>

If **NO**, explain how any relevant anonymity and confidentiality standards will be met for data storage.

F10(d) Data Storage Location

Clarify where the data will be stored securely. Wherever possible, research data should be held in the researcher’s department or other appropriate institutional repository, however

researchers are permitted to hold copies of research data for their own use, and for copies of the data to be stored in locations other than Flinders University. If data will not be stored at Flinders University, explain why and indicate where and how long it will be stored for in accordance with the retention periods listed below (see [Australian Code for Responsible Conduct of Research](#), paragraph 2.1, 2.2.2 and 2.2.3).

On the Flinders University server.

F10(e) Data Retention Period

Data will be stored securely at location listed above for:

	At least <u>12-months</u> after the completion of the project if the research project is for assessment purposes only, such as class research projects completed by <u>all</u> students. <u>Note:</u> Applies to research projects which include a whole topic list of students on one application, not for projects that include one or a few student researchers.
X	At least <u>five years</u> from the date of publication
	At least <u>seven years</u> if the research involves a South Australian Government Department (e.g., DECD) from the date of publication
	<u>Permanently</u> if data relates to work that has a community or heritage value, preferably within a national collection

G. OTHER MATTERS

G1. Other Ethics Committees

Indicate any other centres involved in this research AND/OR any other Ethics Committee(s) being approached for approval of this project including the approval status of each. If copies of approvals cannot be provided at the time of application submission please confirm that copies of all approvals will be submitted to the Committee on receipt. **IMPORTANT** Please note that Flinders University and the Southern Adelaide Local Health Network (SALHN) have agreed that ethics approvals for social and behavioural research granted by an SA Health Human Research Ethics Committee will be accepted by Flinders University without further scrutiny. If this applies to your project please refer to the [SBREC multi-site research](#) web page for further information.

Please note that if other Ethics Committees request amendments to your project once SBREC has also approved your project, you will need to submit a request to modify your project using the Modification Request Form available for download from the SBREC [Modifications and Extensions](#) web page.

G2. Funding

Has funding been received / applied for? If **YES** answer all questions below.

Yes	
No	x

If funding has been applied for (or received), please declare any affiliation or financial interest that any researchers listed in the application may have.

G3. Attachment Checklist

Copies of the following supporting materials applicable to this research project must be attached to this application. See the SBREC [Guidelines, Application Form and Templates](#) web page for template participant

Attached

Not applicable

Letter of Introduction (from the principal researcher or, in the case of student projects, the supervisor, on University letterhead)		<input checked="" type="checkbox"/>	
Information Sheets for participants		<input checked="" type="checkbox"/>	
Consent Form(s) for Participation in Research (standard) by:	- Interview		<input checked="" type="checkbox"/>
	- Focus Group		<input checked="" type="checkbox"/>
	- Experiment		<input checked="" type="checkbox"/>
	- Other (please specify).....		<input checked="" type="checkbox"/>
Consent Form (parent / guardian)			<input checked="" type="checkbox"/>
Consent Form (observation of professional activity)		<input checked="" type="checkbox"/>	
Questionnaire or survey instruments			<input checked="" type="checkbox"/>
Interview questions, or list of topics to be discussed, as appropriate			<input checked="" type="checkbox"/>
Focus group questions, or list of topics to be discussed, as appropriate			<input checked="" type="checkbox"/>
Advertisement for recruitment of participants			<input checked="" type="checkbox"/>
Feedback and/or debriefing material			<input checked="" type="checkbox"/>
Appendix: Privacy Legislation Matters			<input checked="" type="checkbox"/>
Video/DVD to be viewed by participants			<input checked="" type="checkbox"/>
Translated copies of all participant documentation (if relevant)			<input checked="" type="checkbox"/>

G4. Research Involving or Impacting on Indigenous Australians

Has a copy of this ethics application been forwarded to the Executive Officer, of [Yunggorendi First](#)

Yes	<input type="checkbox"/>
No	<input checked="" type="checkbox"/>

If yes, please note that comments from Yunggorendi will be incorporated into the response emailed to the researcher from the SBREC.

H. CERTIFICATION and SIGNATURES

The Researcher and/or Supervisor whose signature appears below certifies that they have read the Ethical Guidelines for Social and Behavioural Research available from the [SBREC website](#), and the guidelines of any other relevant authority referred to therein, and accept responsibility for the conduct of this research in respect of those guidelines and any other conditions specified by the Social and Behavioural Research Ethics Committee.

By submitting this application the applicant(s) agree to comply with the National Statement on Ethical Conduct in Human Research (March 2007) and the Australian Code for the Responsible Conduct of Research (2007) and are expected to be familiar with their responsibilities under each document.

Research Involving Children or Vulnerable Adults

Please note that if your research involved children and/or vulnerable adults, and you do not have a current Criminal History Check in place, that your application will be returned to you unassessed and without ethics approval.

Does your proposed research involve you, or any member of your research team, in undertaking any activities involving children or vulnerable adults?

	Yes
<input checked="" type="checkbox"/>	No
	n/a

If yes, have you, and/or any member(s) of the research team who will be conducting these activities, applied for and been notified that you and/or they have cleared a criminal history check, and that this clearance is current for the life of the proposed study?

	Yes
	No
x	n/a

I/we, whose signature(s) appear(s) below, understand that if my research involves children or vulnerable adults that I/we cannot submit this ethics application unless the researchers listed on the project have a current criminal history check for the life of the proposed study. By signing this ethics application I/we certify that the researchers listed on the project have a current criminal history check as required.

Translations

Does your proposed research require documentation to be translated into another language?

	Yes
x	No
	n/a


If YES, I/we, whose signature(s) appear(s) below, certify that copies of all participant documents provided represent an accurate translation of the English versions provided to the Committee.

Conditions Subsequent to Approval

As a condition of subsequent approval of this protocol, I/we, whose signature(s) appear(s) below, undertake to:

- (i) inform the Social and Behavioural Research Ethics Committee, giving reasons, if the research project is discontinued before the expected date of completion.
- (ii) report anything which might warrant review of ethical approval of the protocol including:
 - serious or unexpected adverse effects on participants;
 - proposed changes in the protocol (method, changes in recruitment processes etc);
 - any changes in the research team; and
 - unforeseen events that might affect continued ethical acceptability of the project.
- (iii) provide progress reports annually, and/or a final report on completion of the study, outlining:
 - progress to date, or outcome in the case of completed research;
 - maintenance and security of data;
 - compliance with the approved protocol;
 - compliance with any conditions of approval; and
 - will request an extension of time if required prior to the ethics approval expiry date.

A pro forma is available from the [Reports](#) section of the [SBREC website](#)

Principal Researcher's Signature: 	Date: 12/9/2013
Supervisor's Signature: (for <u>a</u> ll student projects)	Date:

PLEASE NOTE: notification of the Committee decision cannot be emailed to applicants until a signed electronic copy of the ethics application has been submitted to the SBREC.

SUBMISSION Instructions

Please email one signed PDF electronic copy of your ethics application (including all relevant attachments) to the Executive Officer at human.researchethics@flinders.edu.au. PLEASE NOTE that applications received after the closing dates listed in the Meeting Schedule on the [SBREC website](#) will be held over to the following meeting.

SBREC6275 Original ApplicationResponse
CONDITIONAL APPROVAL RESPONSE

Submission Instructions	IMPORTANT
<p>a) <u>Submit</u> a single PDF version of your conditional approval response (including all attachments) to the SBREC Executive Officer at human.researchethics@flinders.edu.au.</p> <p>b) You <u>do not</u> need to:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> to sign your conditional approval response; <input checked="" type="checkbox"/> submit an amended version of your application; or <p><input type="checkbox"/> submit a hard-copy. Submit PDF version only.</p>	<p><u>Response time</u> Committee response will be emailed to you in 1-2 weeks.</p> <p><u>Modifications</u> If you need to make some modifications to your project, please also submit a modification request at the same time as your conditional approval response.</p>

1. Project Information

Project No.

6275

Project Title

The scope and speed of language learning using computer games

Principal Researcher

Dr Amanda Muller

Email address:

amanda.muller@flinders.edu.au

- | | |
|----|---|
| 1. | Clarification of the size of the population pool from which international students will be drawn, or an approximation if the exact number is unknown as this information was not provided. The Committee advises that possible risks to participant anonymity and confidentiality (item D7) cannot be assessed without this information (item D1b). |
|----|---|

Researcher's response Item D1 (b) I will approach an anticipated 542 international students.

Participant Type / Group	Population Pool	Numbers to be approached	Expected / Required No.
B.Nurs (prereg)	320	320	25
B.Nurs (grad entry)	118	118	15
B.Nurs (postreg)	104	104	10

Item D7

The study is completed online and participation is anonymously automated online. The user chooses a pseudonym and their real name remains known only to themselves. The only indication I have of who participates in the study is in the consent forms, but individual people are not identified within the study itself.

- | | |
|----|---|
| 2. | Clarification of <i>who</i> will send out the recruitment email to students. If Dr Muller will send out the recruitment email the Sub-Committee advises that this would be considered a direct approach and that a written response to item D6 will be required. If a direct approach will be used please

(1) justify why a direct recruitment approach is required and (2) explain how the researchers will |
|----|---|

Researcher's response

Item D4 (a)

Students will be approached as a group through school-wide email and they will indicate if they want to be involved by replying in an email to the researcher.

Item D6

I don't approach students directly—rather through a general school-wide email sent by the school itself. Also, I do not expect that the students will feel coerced by this approach. I develop the English for Specific Purposes programme, which is a voluntary auxiliary programme for students. I don't grade any students in any courses. I don't have any effect on students' marks in their Nursing degree. Thus, there are no graded or personal consequences for any student whether they do or do not volunteer for the study.

3.	Provision of copies of correspondence granting permission to conduct the research from the Head of the School of Nursing and Midwifery. Please ensure that all correspondence clearly outlines the specifics of what permission is being granted. If the documentation cannot be provided at the time of response to conditional approval please confirm that it will be provided to the Committee on receipt. <u>Please note</u> that data collection cannot commence until all relevant permissions have been granted (item D8).
----	--

Researcher's response

Please see attached permission.

4.	Provision of a Consent Form in order for participants to give informed consent (see section 2.2.6 under General Requirements for Consent in the <i>National Statement on Ethical Conduct in Human Research</i>). The Consent Form pro forma is available from available from the
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Researcher's response

Please see attached consent form



CONSENT FORM FOR PARTICIPATION IN RESEARCH
(by experiment...)

The scope and speed of language learning using computer games

I
being over the age of 18 years hereby consent to participate as requested in the letter of introduction for the research project on the scope and speed of language learning using computer games.

I have read the information provided.

1. Details of procedures and any risks have been explained to my satisfaction.
2. I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.
3. I understand that:
 - I may not directly benefit from taking part in this research.
 - I am free to withdraw from the project at any time and am free to decline to answer particular questions.
 - While the information gained in this study will be published as explained, I will not be identified, and individual information will remain confidential.
 - Whether I participate or not, or withdraw after participating, will have no effect on any treatment or service that is being provided to me.
 - Whether I participate or not, or withdraw after participating, will have no effect on my progress in my course of study, or results gained.
7. I have had the opportunity to discuss taking part in this research with a family member or friend.

Participant's signature.....Date.....

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name.....

Researcher's signature.....Date.....

NB: Two signed copies should be obtained. The copy retained by the researcher.

SBREC6275 Modification Request1
MODIFICATION REQUEST

A Modification Request should be submitted for all items listed below:	IMPORTANT
<ol style="list-style-type: none"> 1. proposed changes to the research protocol; 2. proposed changes to participant recruitment methods; 3. amendments to participant documentation and/or research tools' 4. change of project title; 5. extension of the ethics approval expiry date / extension of time; and 6. personnel changes (e.g., additions, removals, supervisor changes) <p>Submit modification requests to uman.researchethics@flinders.edu.au Typically, the Committee's response will be emailed to you in 1-2 weeks.</p>	<ol style="list-style-type: none"> a) <u>Proposed modifications</u> should <i>not</i> proceed until formal notification of modification approval has been received. b) <u>Annual reports</u> - annual progress reports should be up to date <i>before</i> a modification request is submitted. c) Indigenous peoples – modifications that involve or impact on Indigenous peoples in Australia will also be reviewed by the Flinders University <u>Office of Indigenous Strategy and Engagement (OISE)</u>, which will impact Committee response time. d) <u>Contact Details</u> – email SBREC if details change as Ethics <i>is not</i> linked to Student Two or Human Resources.

1. Project Information

Project No. Ethics Approval Expiry Date

Project Title

Principal Researcher Email address:

Annual Reports up to date? Next annual report due?

2. Extension of time

2A Extension of Time Requested (if applicable)

Current Ethics Approval Expiry Date New Expiry Date requested

2B Justification

I have been taking a long time transferring the games into mobile app format and can only start testing again after that is finished.

3. Change of Project Title

3A Change of Project Title (if applicable)

Old project title:

New project title:

3B Participant Document Revisions

Please note: if the project title is changed, copies of all documents to be distributed to potential participants will need to be revised to include the new title (e.g., email text, Letter of introduction, Information Sheet, Consent Form). Please submit copies of the revised documents for review.

Revised Participant Documents Attached?

4. Change of Personnel

4A Change of Personnel Summary (if applicable)

Add/ remov e	Full name & title	Postal address	Email address

4B Conflicts of Interest

No conflict of interest. Independent researcher.

4C Participant Document Revisions

Please note that if personnel are added and/or removed from a project that documents to be distributed to potential participants will need to be revised to ensure that a current list of researchers is included (e.g., email text, Letter of Introduction, Information Sheet, ConsentForm).

Revised Participant Documents Attached?

5. Modified Research Protocol

5A Revision of Research Protocol Table

Please indicate in table below what type of changes are proposed.

Select Options that Apply	
Research Objectives Revision, or addition to, research objectives (item D1c)	
Research Method <input type="checkbox"/> <u>Revision</u> of approved research method <input type="checkbox"/> <u>Addition</u> to approved research method	
Research Participants <input type="checkbox"/> <u>Addition</u> of new participant group <input type="checkbox"/> <u>Exclusion</u> of participant group already approved by Committee	
Consent <input type="checkbox"/> <u>Revised</u> method for seeking informed consent from participants <input type="checkbox"/> <u>New</u> method for seeking consent	
Recruitment Process Change to approved process for participant recruitment	
Research Tools For example, survey, interview questions, focus group discussion topics. <input type="checkbox"/> <u>Revision</u> of approved research tools <input type="checkbox"/> <u>New</u> research tools	
Documents / Information For example, verbal script, email text, Letter of Introduction, Information Sheet, Consent Form <input type="checkbox"/> <u>Revision</u> of existing documents / information <input type="checkbox"/> <u>New</u> documents / information	
Other (if yes, please specify)	

5B Outline of Research Protocol Changes Provide a clear outline of changes and/or additions to the research protocol are being requested and explain why it is necessary to address the research objectives (e.g. change to research objectives; changes to recruitment process; change to research tools; addition of research tools etc).

5C Participant Document Revisions To ensure that informed consent can be obtained changes to the research protocol may need to be reflected in the documents to be distributed to potential participants.(e.g., email text, Letter of Introduction, Information Sheet, Consent Form). Revised documents and/or new participant documents may need to be provided for review.

Revised Participant Documents Attached?

6. Permissions / Other Ethics Committee Approvals

Please indicate whether any other ethics committee approvals and/or permissions need to be sought that are related to the requested modification. If yes, please either (a) provide a copy of approvals and/or permissions OR (b) confirm that copies will be submitted to the committee on receipt.

7. Aboriginal and/or Torres Strait Islander peoples

7A Impact and/or involvement of Indigenous peoples

Please indicate whether the *proposed modification* will involve or impact on Australian Indigenous peoples.

Y
N

no

7B Explanation

IF the proposed modification involves or impacts on Australian Indigenous peoples, please explain how.

8. Burdens and/or Risks

Could there be any potential inconveniences or risks to participants as a consequence of the modifications requested? If YES, outline what they are and specify whether there will be any changes to anonymity and confidentiality assurances given to participants, time commitments and research location. Please explain how you will reduce inconveniences and/or risks to participants.

9. Document amendments and/or additions

New or amended ?	Document	Brief outline of changes made	Attached yes/no

Note: All new and modified participant documents must be submitted for review and approval

SBREC6275 Modification Request2
MODIFICATION REQUEST

A Modification Request should be submitted for all items listed below:	IMPORTANT
<ol style="list-style-type: none"> 1. proposed changes to the research protocol; 2. proposed changes to participant recruitment methods; 3. amendments to participant documentation and/or research tools' 4. change of project title; 5. extension of the ethics approval expiry date / extension of time; and 6. personnel changes (e.g., additions, removals, supervisor changes) <p>Submit modification requests to human.researchethics@flinders.edu.au Typically, the Committee's response will be emailed to you in 1-2 weeks.</p>	<ol style="list-style-type: none"> a) Proposed modifications should <i>not</i> proceed until formal notification of modification approval has been received. b) Annual reports - annual progress reports should be up to date <i>before</i> a modification request is submitted. c) Indigenous peoples – modifications that involve or impact on Indigenous peoples in Australia will also be reviewed by the Flinders University Office of Indigenous Strategy and Engagement (OISE), which will impact Committee response time. d) Contact Details – email SBREC if details change as Ethics <i>is not</i> linked to Student Two or Human Resources.

1. Project Information

Project No.	Ethics Approval Expiry	Date	
	6275	15/12/2020	
Project Title	Date		
	The scope and speed of language learning using computer games		
Principal Researcher	Dr Amanda Muller	Email address:	amanda.muller@flinders.edu.au
Annual Reports up to date?	yes	Next annual report due?	17/7/2020

2. Extension of time

2A Extension of Time Requested (if applicable)

Current Ethics Approval Expiry Date	15/12/2020	New Expiry Date requested	15/12/2021
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2B Justification

3. Change of Project Title

3A Change of Project Title (if applicable)

Old project title:	
New project title:	

3B Participant Document Revisions

Please note: if the project title is changed, copies of all documents to be distributed to potential participants will need to be revised to include the new title (e.g., email text, Letter of introduction, Information Sheet, Consent Form). Please submit copies of the revised documents for review.

Revised Participant Documents Attached?

4. Change of Personnel

4A Change of Personnel Summary (if applicable)

Add/ remove	Full name & title	Postal address	Email address
Add	Adam Koschade	c/- CHNS RHD	adam.koschade@flinders.edu.au
Add	Mohanned Fahad N Bin Jamaan	c/- CSE	binj0004@flinders.edu.au

4B Conflicts of Interest

Comment on whether a conflict of interest may exist for any new personnel (e.g., role / relation to participant source). If yes, explain how this will be managed.

None. The additional people are research students who do not work with the participant population, nor teach them or grade them.

4C Participant Document Revisions

Please note that if personnel are added and/or removed from a project that documents to be distributed to potential participants will need to be revised to ensure that a current list of researchers is included (e.g., email text, Letter of Introduction, Information Sheet, Consent Form).

Revised Participant Documents Attached?

5. Modified Research Protocol

5A Revision of Research Protocol Table

Please indicate in table below what type of changes are proposed.

Select Options that Apply	
Research Objectives Revision, or addition to, research objectives (item D1c)	
Research Method – <u>Revision</u> of approved research method – <u>Addition</u> to approved research method	
Research Participants – <u>Addition</u> of new participant group – <u>Exclusion</u> of participant group already approved by Committee	Important Note If you would like to recruit any participants from any organisation that falls under the banner of the Southern Adelaide Local Health Network (SALHN); such as Flinders Medical Centre or Noarlunga Hospital; the committee advises that ethics approval will need to be sought from the Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC) <u>instead</u> of this committee.
Consent – <u>Revised</u> method for seeking informed consent from participants – <u>New</u> method for seeking consent	
Recruitment Process Change to approved process for participant recruitment	
Research Tools For example, survey, interview questions, focus group discussion topics. – <u>Revision</u> of approved research tools – <u>New</u> research tools	

Documents / Information For example, verbal script, email text, Letter of Introduction, Information Sheet, Consent Form	<input type="checkbox"/>
<ul style="list-style-type: none"> - <u>Revision</u> of existing documents / information - <u>New</u> documents / information 	
Other (if yes, please specify)	

Updated information sheet and letter of introduction to include the two new

research students' names, updating of the researcher's position and division name, consistent grammatical pluralisation of the word games, and corrected timeframe needed to complete the games.

Revised questionnaire text to include validated questions about game usage, in addition to the removal of questions about English test scores from the questionnaire.

5B Outline of Research Protocol Changes

Provide a clear outline of changes and/or additions to the research protocol are being requested and explain why it is necessary to address the research objectives (e.g, change to research objectives; changes to recruitment process; change to research tools; addition of research tools etc).

The same protocol of online pre-test, gameplay, and post-test + questionnaire is followed. The documentation remains the same with minor adjustments.

5C Participant Document Revisions

To ensure that informed consent can be obtained changes to the research protocol may need to be reflected in the documents to be distributed to potential participants.(e.g., email text, Letter of Introduction, Information Sheet, Consent Form). Revised documents and/or new participant documents may need to be provided for review.

Revised Participant Documents Attached?

6. Permissions / Other Ethics Committee Approvals

Please indicate whether any other ethics committee approvals and/or permissions need to be sought that are related to the requested modification. If yes, please either (a) provide a copy of approvals and/or permissions OR (b) confirm that copies will be submitted to the committee on receipt.

None

7. Aboriginal and/or Torres Strait Islander peoples

7A Impact and/or involvement of Indigenous peoples

Please indicate whether the *proposed modification* will involve or impact on Australian Indigenous peoples.

Y
N

<input type="checkbox"/>
<input checked="" type="checkbox"/>

7B Explanation

IF the proposed modification involves or impacts on Australian Indigenous peoples, please explain how.

8. Burdens and/or Risks

Could there be any potential inconveniences or risks to participants as a consequence of the modifications requested? If YES, outline what they are and specify whether there will be any changes to

anonymity and confidentiality assurances given to participants, time commitments and research location. Please explain how you will reduce inconveniences and/or risks to participants.

No.

9. Document amendments and/or additions

New or amended ?	Document	Brief outline of changes made	Attached yes/no
Amended	information sheet	Include the two new research students' names, updating of the researcher's position and division name, consistent grammatical pluralisation of the word games, and corrected timeframe needed to complete the games.	
Amended	letter of introduction	Include the two new research students' names, updating of the researcher's position and division name, consistent grammatical pluralisation of the word games, and corrected timeframe needed to complete the games.	
Amended	questionnaire	Revised questionnaire text to include validated questions about game usage, in addition to the removal of questions about English test scores from the questionnaire	

Note: All new and modified participant documents must be submitted for review and approval



Dr Amanda Muller
College of Nursing and Health
Sciences
GPO Box 2100
Adelaide SA 5001
Tel: 08 8201 3378
amanda.muller@flinders.edu.au
<http://flinders.edu.au/nursing>

CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Student

I hold the position of Senior Lecturer in the College of Nursing Health Sciences at Flinders University, along with research students Adam Koschade and Mohanned Bin Jamaan. I am undertaking research leading to publications on the subject of the scope and speed of language learning using computer games.

I would be most grateful if you would volunteer to assist in this project by playing computer games, doing two short tests, and completing a questionnaire for each game. No more than 3 hours over two weeks would be required.

There are two educational games available to you. The first teaches real confusable medication names and hones your listening skills for class. The second game teaches medical abbreviations. In the past, students have reported benefits from these games. This is designed to support your performance on clinical placement. You can choose one, or complete both studies.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Any enquiries you may have concerning this project should be directed to me at the address given above by e-mail amanda.muller@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely
Dr Amanda
Muller
Senior Lecturer (English for Specific Purposes)

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (project number 6275). For more information regarding ethical approval of the project the Secretary of the Committee can be contacted by telephone on 8201 5962, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

INFORMATION SHEET

Title: 'The scope and speed of language learning using computer games'

Primary Investigator:

Dr Amanda Muller

College of Nursing and Health Sciences Flinders University

Ph: 8201 3378

Co-investigators:

Research students: Adam Koschade and Mohammed Bin Jamaan

Description of the study:

This study is part of the project entitled '*The scope and speed of language learning using computer games*'. This project will investigate how well students can learn important medical and colloquial language for health-related work.

Purpose of the study:

This project aims to find out if computer games which have been created to teach language actually improve student performance.

What will I be asked to do?

There are three stages of the study: an online pre-test of your skills before the games, the playing of the games online, and an online post-test of your skills after the games (this includes giving your opinion about the games). In summary, the schedule looks like this:

1. 10 minute online pre-test of your ability before playing the games
2. Play each game online for at least 10 minutes a day for 7 days, over a 14 day period
3. 10 minute online post-test of your ability after playing the games
4. online short survey asking your opinions about the games

What benefit will I gain from being involved in this study?

The sharing of your experiences will improve the planning and delivery of future programs. We are very keen to deliver a service and resources which are as useful as possible to people.

Will I be identifiable by being involved in this study?

We do not need your name and you will be anonymous. Any identifying information will be removed and the typed-up file stored on a password protected computer that only the researchers will have access to. Your comments will not be linked directly to you.

Are there any risks or discomforts if I am involved?

It is an anonymous study, so the investigator anticipates little risk from your involvement. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

How do I agree to participate?

Participation is voluntary. You may answer 'no comment' or refuse to answer any questions and you are free to withdraw from the study at any time without effect or consequences. A consent form accompanies this information sheet. If you agree to participate please read and sign the form online at this address for the abbreviation game

<[address](#)> and the medication game <[address](#)>.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (6275). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human_researchethics@flinders.edu.au

Questionnaire

Note: This will be answered in an online format, using this text. People can choose to skip questions by not answering.

Gender (M/F/X/Prefer not to say)
 Age
 How much time have you spent in Australia?
 What country do you come from?
 What is your first language?

EFFECTS ON YOU

Familiarity – Do you think Medicina was effective in making medication names more familiar?
 Not at all 1 2 3 4 5 6 7 Familiar

Listening – Do you feel more confident that you will understand spoken medication names?
 Not at all 1 2 3 4 5 6 7 Confident

Effort – Do you think you can hear the sounds of medication names more easily?
 Not at all 1 2 3 4 5 6 7 Very easily

Familiarity – Do you think Brevissima was effective in making abbreviations more familiar?
 Not at all 1 2 3 4 5 6 7 Familiar

Listening – Do you feel more confident that you will understand spoken abbreviations?
 Not at all 1 2 3 4 5 6 7 Confident

Effort – Do you think you can recognise written abbreviations more easily?
 Not at all 1 2 3 4 5 6 7 More easily recognised

YOUR IDEAS & OPINIONS

Have you used computer games or mobile games for learning English? Yes No If yes, please
 rate your previous experience with English learning games.
 Very unsatisfactory 1 2 3 4 5 Very satisfactory

What needs to be improved in the game?

What did you think was good about the game?

How can the game help you prepare for clinical placement?

What advice would you give others about playing the game, such as how to best use it?

Should the characters be removed from the game? Why or why not?

Please rate the following

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy using online educational games					
I am willing to learn more about English					
I believe that I work hard to improve my English					
I think that my English can be improved by using online educational games in English.					
I found this game enjoyable and engaging to play					
I found the game interface and control engaging					
I think navigating inside the game is complex					

I like being able to customize the character					
I think the graphics need to be improved					
The game help information is easy to access when needed					
I don't think the game reflects the real environment					
I felt as though the character could exist in a real environment					
I don't understand the story behind the game					
I was able to understand the game goal					
I think the audio effects and sounds suit the game					
I think that I would like to use this game frequently					
I found the game unnecessarily complex					
I thought the game was easy to use					
I think that I would need the support of a technical person to be able to use this game					
I found the various element of this game well designed (e.g. controls, avatar, levels, audio)					
I thought there was too much inconsistency with this game					
I would imagine that most people would learn how to use this game very quickly					
I found the game very awkward to use					
I felt very confident using the game					
I needed to learn a lot of things before I could get going with this game					

We welcome any other ideas, opinions, or comments

6275 ETHICS modification No.2 approval notice (5 August 2019)
Human Research Ethics <human.researchethics@flinders.edu.au>
Mon 5/08/2019 8:26 AM
To: AmandaMuller<amanda.muller@flinders.edu.au>; AdamKoschade<adam.koschade@flinders.edu.au>;
Mohannad Fahad N Bin Jamaan<binj0004@flinders.edu.au>

6275 modification request No.2;

Dear Amanda,

The interim Chairperson of the [Social and Behavioural Research Ethics Committee \(SBREC\)](#) at Flinders University has reviewed and approved the modification request that was submitted for project 6275. A modification ethics approval notice can be found below.

MODIFICATION (No. 2) APPROVAL NOTICE

Project No:

6275

Project Title:

The scope and speed of language learning using computer games

Principal Researcher:

Dr Amanda Muller

Email:

amanda.muller@flinders.edu.au

Ethical Approval Expiry Date: 15 December 2021

I am pleased to inform you that the modification request submitted for project 6275 on the 18 July 2019 has been reviewed and approved by the interim Chairperson of the Committee. A summary of the approved modifications are listed below. Any additional information that may be required from you will be listed in the second table shown below called 'Additional Information Required'.

Approved Modifications	
Extension of ethics approval expiry date	x
Project title change	
Personnel change	x

Approved Modifications
Research objectives change
Research method change
Participants – addition +/- change
Consent process change
Recruitment process change 1.
Research tools change
Document / Information Changes X
Other (if yes, please specify) .

RESPONSIBILITIES OF RESEARCHERS AND SUPERVISORS

Participant Documentation

Please note that it is the responsibility of researchers and supervisors, in the case of student projects, to ensure that:

all participant documents are checked for spelling, grammatical, numbering and formatting errors. The Committee does not accept any responsibility for the above mentioned errors.

the Flinders University logo is included on all participant documentation (e.g., letters

Additional Information Required

Please ensure that the Information Sheet is revised to at least list the email addresses of the two new researchers that have been added on to this project before the document is distributed to potential participants.

of Introduction, information Sheets, consent forms, debriefing information and questionnaires – with the exception of purchased research tools) and the current Flinders University letterhead is included in the header of all letters of introduction. The Flinders University international logo/letterhead should be used and documentation should contain international dialling codes for all telephone and fax numbers listed for all research to be conducted overseas.

The SBREC contact details, listed below, are included in the footer of all letters of introduction and information sheets.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number 'INSERT PROJECT No. here following approval'). For more information regarding ethics approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au.

2. Annual Progress / Final Reports

In order to comply with the monitoring requirements of the *National Statement on Ethical Conduct in Human Research 2007 (updated 2018)*; please be reminded that; an annual progress report must be submitted each year on the 18 December (approval anniversary date) for the duration of the ethics approval using the report template available from the [Managing Your Ethics Approval](#) web page.

Please note that no data collection can be undertaken after the ethics approval expiry date listed at the top of this notice. If data is collected after expiry, it will not be covered in terms of ethics. It is the responsibility of the researcher to ensure that annual progress reports are submitted on time; and that no data is collected after ethics has expired.

If the project is completed *before* ethics approval has expired please ensure a final report is submitted immediately. If ethics approval for your project expires please either submit (1) a final report; or (2) an extension of time request (using the modification request form).

Next report due date: 18 December 2019. Final Report Due Date 15 December 2021

Student Projects

For student projects, the SBREC recommends that current ethics approval is maintained until a student's thesis has been submitted, assessed and finalised. This is to protect the student in the event that reviewers recommend that additional data be collected from

3. Modifications to Project

Modifications to the project must not proceed until approval has been obtained from the Ethics Committee.

Such proposed changes / modifications include:

- change of project title;
- change to research team (e.g., additions, removals, researchers and supervisors)
- changes to research objectives;
- changes to research protocol;
- changes to participant recruitment methods;
- changes / additions to source(s) of participants;
- changes of procedures used to seek informed consent;
- changes to reimbursements provided to participants;
- changes to information / documents to be given to potential participants;
- changes to research tools (e.g., survey, interview questions, focus group questions etc);
- extensions of time (i.e. to extend the period of ethics approval past current expiry date).

To notify the Committee of any proposed modifications to the project please complete and submit the *Modification Request Form* which is available from the [Managing Your Ethics Approval SBREC web page](#). Download the form from the website every time a new modification request is submitted to ensure that the most recent form is used. Please note that extension of

Change of Contact Details

If the contact details of researchers, listed in the approved application, change please notify the Committee so that the details can be updated in our system. A modification request is not required to change your contact details; but would be if a new researcher needs to be added on to the research / supervisory team.

4. Adverse Events and/or Complaints

Researchers should advise the Executive Officer immediately on 08 8201-3116 or human.researchethics@flinders.edu.au if:

- any complaints regarding the research are received;
- a serious or unexpected adverse event occurs that effects participants;
- an unforeseen event occurs that may affect the ethical acceptability of the project.

Andrea Mather and Rae Tyler
Executive Officers, Social and Behavioural
Research Ethics Committee Research
Development and Support
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http://www.flinders.edu.au/research/researcher-support/ebi/human-ethics/human-ethics_home.cfm

CRICOS No: 00114A This email and any attachments may be confidential. If you are not the intended recipient, please inform the sender by reply email and delete all copies of this message.

SBREC6275: Modification Request 3
MODIFICATION REQUEST

A Modification Request should be submitted for all items listed below:	IMPORTANT
<ol style="list-style-type: none"> 1. proposed changes to the research protocol; 2. proposed changes to participant recruitment methods; 3. amendments to participant documentation and/or research tools' 4. change of project title; 5. extension of the ethics approval expiry date / extension of time; and 6. personnel changes (e.g., additions, removals, supervisor changes) <p>Submit modification requests to human.researchethics@flinders.edu.au Typically, the Committee's response will be emailed to you in 1-2 weeks.</p>	<ol style="list-style-type: none"> a) <u>Proposed modifications</u> should <i>not</i> proceed until formal notification of modification approval has been received. b) <u>Annual reports</u> - annual progress reports should be up to date <i>before</i> a modification request is submitted. c) Indigenous peoples – modifications that involve or impact on Indigenous peoples in Australia will also be reviewed by the Flinders University <u>Office of Indigenous Strategy and Engagement (OISE)</u>, which will impact Committee response time. d) <u>Contact Details</u> – email SBREC if details change as Ethics <i>is not</i> linked to Student Two or Human Resources.

1. Project Information

Project Number: Ethics Approval Expiry Date:

Project Title:

Principal Researcher: Email address:

Annual Reports up to date? Next annual report due?

2. Extension of time

2A Extension of Time Requested (if applicable)
Current Ethical Approval Expiry Date:
New Expiry Date Requested:

2B Justification

3. Change of Project Title

3A Change of Project Title (if applicable)

Old project title:

New project title:

3B Participant Document Revisions

Please note: if the project title is changed, copies of all documents to be distributed to potential participants will need to be revised to include the new title (e.g., email text, Letter of introduction, Information Sheet, Consent Form). Please submit copies of the revised documents for review.

4. Change of Personnel

4A Change of Personnel Summary (if applicable)

Add/ remov e	Full name & title	Postal address	Email address

4B Conflicts of Interest

Comment on whether a conflict of interest may exist for any new personnel (e.g., role / relation to participant source). If yes, explain how this will be managed.

None. The additional people are research students who do not work with the participant population, nor teach them or grade them.

4C Participant Document Revisions

Please note that if personnel are added and/or removed from a project that documents to be distributed to potential participants will need to be revised to ensure that a current list of researchers is included (e.g., email text, Letter of Introduction, Information Sheet, Consent Form).

5. Modified Research Protocol

5A Revision of Research Protocol Table

Please indicate in table below what type of changes are proposed.

Select Options that Apply	
Research Objectives Revision, or addition to, research objectives (item D1c)	
Research Method <u>Revision</u> of approved research method <u>Addition</u> to approved research method	
Research Participants <u>Addition</u> of new participant group <u>Exclusion</u> of participant group already approved by Committee	Important Note If you would like to recruit any participants from any organisation that falls under the banner of the Southern Adelaide Local Health Network (SALHN); such as Flinders Medical Centre or Noarlunga Hospital; the committee advises that ethics approval will need to be sought from the Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC) instead of this committee.
Consent <u>Revised</u> method for seeking informed consent from participants <u>New</u> method for seeking consent	
Recruitment Process Change to approved process for participant recruitment	
Research Tools For example, survey, interview questions, focus group discussion topics. <u>Revision</u> of approved research tools <u>New</u> research tools	
Documents / Information For example, verbal script, email text, Letter of Introduction, Information Sheet, Consent Form	<input type="checkbox"/>
– <u>Revision</u> of existing documents / information <u>New</u> documents / information	

5B Outline of Research Protocol Changes

Provide a clear outline of changes and/or additions to the research protocol are being requested and explain why it is necessary to address the research objectives (e.g, change to research objectives; changes to recruitment process; change to research tools; addition of research tools etc).

Essentially, an extra questionnaire is added, plus four questions to the existing demographic questions. The protocol involves an online pre-test, gameplay, and post-test. This survey will be given with the pre-test and post-test. The four demographic questions will be added to the existing demographic questions.

5C Participant Document Revisions

To ensure that informed consent can be obtained changes to the research protocol may need to be reflected in the documents to be distributed to potential participants.(e.g., email text, Letter of Introduction, Information Sheet, Consent Form). Revised documents and/or new participant documents may need to be provided for review.

Revised Participant Documents attached?

6. Permissions / Other Ethics Committee Approvals

Please indicate whether any other ethics committee approvals and/or permissions need to be sought that are related to the requested modification. If yes, please either (a) provide a copy of approvals and/or permissions OR (b) confirm that copies will be submitted to the committee on receipt.
None

7. Aboriginal and/or Torres Strait Islander peoples

7A Impact and/or involvement of Indigenous peoples

Please indicate whether the *proposed modification* will involve or impact on Australian Indigenous peoples.
NO

8. Burdens and/or Risks

Could there be any potential inconveniences or risks to participants as a consequence of the modifications requested? If YES, outline what they are and specify whether there will be any changes to anonymity and confidentiality assurances given to participants, time commitments and research location. Please explain how you will reduce inconveniences and/or risks to participants.
No.

9. Document amendments and/or additions

New or amended ?	Document	Brief outline of changes made	Attached yes/no
Amended	information sheet	The research students' emails added, and the additional questionnaire included.	y
Amended	letter of introduction	Corrected timeframe needed to complete the games and questionnaires.	y
Amended	questionnaire	Four questions added about game playing, devices used, and year level.	y
New	Additional questionnaire	Additional questionnaire adapted from a validated survey instrument related to learning, e.g. motivation, self-efficacy (the modification to the survey we want to included mainly meant we had to swap the references to 'course' and 'subject' to 'game' and 'medical terms').	y

Note: All new and modified participant documents must be submitted for review and approval



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CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Student

I hold the position of Senior Lecturer in the College of Nursing Health Sciences at Flinders University, along with research students Adam Koschade and Mohammed Bin Jamaan. I am undertaking research leading to publications on the subject of the scope and speed of language learning using computer games.

I would be most grateful if you would volunteer to assist in this project by playing computer games, doing two short tests, and completing a questionnaire for each game. No more than 3 hours over two weeks would be required.

There are two educational games available to you. The first teaches real confusable medication names and hones your listening skills for class. The second game teaches medical abbreviations. In the past, students have reported benefits from these games. This is designed to support your performance on clinical placement. You can choose one, or complete both studies.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Any enquiries you may have concerning this project should be directed to me at the address given above by e-mail amanda.muller@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely Dr
Amanda Muller
Lecturer (English for Specific Purposes)

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (project number 6275). For more information regarding ethical approval of the project the Secretary of the Committee can be contacted by telephone on 8201 5962, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au



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CRICOS Provider No. 00114A

INFORMATION SHEET

Title: 'The scope and speed of language learning using computer games'

Primary Investigator:

Dr Amanda Muller
College of Nursing and Health Sciences Flinders
University
Ph: 8201 3378

Co-investigators:

Research students: Adam Koschade adam.koschade@flinders.edu.au and Mohammed Bin Jamaan
binj0004@flinders.edu.au.

Description of the study:

This study is part of the project entitled '*The scope and speed of language learning using computer games*'. This project will investigate how well students can learn important medical and colloquial language for health-related work.

Purpose of the study:

This project aims to find out if computer games which have been created to teach language actually improve student performance.

What will I be asked to do?

There are three stages of the study: an online pre-test of your skills before the games, the playing of the games online, and an online post-test of your skills after the games (this includes giving your opinion about the games). In summary, the schedule looks like this:

1. 15 minute online pre-test of your ability before playing the games, plus a questionnaire
2. Play each game online for at least 10 minutes a day for 7 days, over a 14 day period
3. minute online post-test of your ability after playing the games, plus a questionnaire

What benefit will I gain from being involved in this study?

The sharing of your experiences will improve the planning and delivery of future programs. We are very keen to deliver a service and resources which are as useful as possible to people.

Will I be identifiable by being involved in this study?

We do not need your name and you will be anonymous. Any identifying information will be removed and the typed-up file stored on a password protected computer that only the researchers will have access to. Your comments will not be linked directly to you.

Are there any risks or discomforts if I am involved?

It is an anonymous study, so the investigator anticipates little risk from your involvement. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

How do I agree to participate?

Participation is voluntary. You may answer 'no comment' or refuse to answer any questions and you are free to withdraw from the study at any time without effect or consequences. A consent form accompanies this information sheet. If you agree to participate please read and sign the form online at this address for the abbreviation game <address> and the medication game <address>.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (6275). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Questionnaire

About You:

Gender (M/F/X/Prefer not to say)
Age
How much time have you spent in Australia?
What country do you come from?
What is your first language?

What year of your course are you currently studying?
First year / Second year / Third year / Fourth year or higher

On average, how many hours per week do you spend playing videogames on any device (such as smartphone, tablet, computer/laptop, console or handheld device)?

Less than 1 hour 1 to 4 hours
5 to 9 hours
10 to 19 hours More than 20 hours

Which of the following devices do you FREQUENTLY use to play videogames? (select all that apply)

A computer device (e.g., desktop, laptop) A mobile device (e.g., smartphone, tablet) A console device (e.g., Playstation, Xbox)
A handheld device (e.g., Gameboy, Nintendo DS) None of the above

What type of videogame player do you consider yourself?

Newbie/novice Casual
Core/intermediate
Hardcore/expert

EFFECTS ON YOU

Familiarity – Do you think the game was effective in making abbreviations more familiar?

Not at all 1 2 3 4 5 6 7 Familiar

Listening – Do you feel more confident that you will understand spoken abbreviations?

Not at all 1 2 3 4 5 6 7 Confident

Effort – Do you think you can recognise abbreviations more easily?

Not at all 1 2 3 4 5 6 7 More easily recognised

Extra help – Did you use any other language resources to help you learn the same things in the game? (circle one or more)

Internet Textbook Friends/tutor None Other

YOUR IDEAS & OPINIONS

What needs to be improved in the game?
What did you think was good about the game?
How can the game help you prepare for clinical placement?
What advice would you give others about playing the game, such as how to best use it?
Should the characters be removed from the game? Why or why not?

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I found this game enjoyable and engaging to play					
I found the game interface and control engaging					
I think navigating inside the game is complex					
I like being able to customize the character					
I think the graphics need to be improved					
The game help information is easy to access when needed					
I don't think the game reflects the real environment					
I felt as though the character could exist in a real environment					
I don't understand the story behind the game					
I was able to understand the game goal					
I think the audio effects and sounds suit the game					
I think that I would like to use this game frequently					
I found the game unnecessarily complex					
I thought the game was easy to use					
I think that I would need the support of a technical person to be able to use this game					
I found the various element of this game well designed (e.g. controls, avatar, levels, audio)					
I thought there was too much inconsistency with this game					
I would imagine that most people would learn how to use this game very quickly					
I found the game very awkward to use					
I felt very confident using the game					
I needed to learn a lot of things before I could get going with this game					

We welcome any other ideas, opinions, or comments

Questionnaire

The following questions ask about your motivation for and attitudes about the topic of this research.

Remember there are no right or wrong answers, just answer as accurately as possible.

Use the scale below to answer the questions.

If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

		1	2	3	4	5	6	7
		Not at all true of me						Very true of me
1.	When learning a topic about medical terms, I prefer games that really challenge me so I can learn new things	1	2	3	4	5	6	7
2.	If I study in appropriate ways, then I will be able to learn the material in this game	1	2	3	4	5	6	7
3.	When I take a test I think about how poorly I am doing compared with other students	1	2	3	4	5	6	7
4.	I think I will be able to use what I learn in this game about medical terms in other courses	1	2	3	4	5	6	7
5.	I believe I can receive excellent scores in tasks related to medical terms	1	2	3	4	5	6	7
6.	I'm certain I can understand the most difficult material related to medical terms.	1	2	3	4	5	6	7
7.	Getting a good score in this game is the most satisfying thing for me right now	1	2	3	4	5	6	7
8.	When I take a test I think about items on other parts of the test I can't answer	1	2	3	4	5	6	7
9.	It is my own fault if I don't learn the material in this game	1	2	3	4	5	6	7
10.	It is important for me to learn medical terms	1	2	3	4	5	6	7
11.	The most important thing for me right now in this game is getting a good score	1	2	3	4	5	6	7
12.	I'm confident I can understand the basic concepts related to medical terms	1	2	3	4	5	6	7
13.	If I can, I want to get better scores in this game than most of the other students	1	2	3	4	5	6	7
14.	When I take tests I think of the consequences of failing	1	2	3	4	5	6	7
15.	I'm confident I can understand the most complex material related to medical terms	1	2	3	4	5	6	7

16.	When learning a topic like medical terms, I prefer games that arouse my curiosity, even if it is difficult to learn	1	2	3	4	5	6	7
17.	I am very interested in medical terms	1	2	3	4	5	6	7
18.	If I try hard enough, then I will understand the game material	1	2	3	4	5	6	7
19.	I have an uneasy, upset feeling when I take an exam	1	2	3	4	5	6	7
20.	I'm confident I can do an excellent job in tasks related to medical terms	1	2	3	4	5	6	7
21.	I expect to do well in tasks using medical terms	1	2	3	4	5	6	7
22.	The most satisfying thing for me in this game is trying to understand the content as thoroughly as possible	1	2	3	4	5	6	7
23.	I think medical terms are useful for me to learn	1	2	3	4	5	6	7
24.	When I have the opportunity in this game, I prefer questions that I can learn from even if they don't guarantee a good score	1	2	3	4	5	6	7
25.	If I don't understand the game material, it is because I didn't try hard enough	1	2	3	4	5	6	7
26.	I like the subject matter of medical terms	1	2	3	4	5	6	7
27.	Understanding medical terms is very important to me	1	2	3	4	5	6	7
28.	I feel my heart beating fast when I take an exam	1	2	3	4	5	6	7
29.	I'm certain I can master the skills related to medical terms	1	2	3	4	5	6	7
30.	I want to do well in this game because it is important to show my ability to my family, friends, employer, or others	1	2	3	4	5	6	7
31.	Considering the difficulty of the subject and my skills, I think I will do well in tasks related to medical terms	1	2	3	4	5	6	7

6275 ETHICS modification No.3 approval notice (9 August 2019)
Human Research Ethics <human.researchethics@flinders.edu.au>
Fri 9/08/2019 11:54 AM
To: AmandaMuller<amanda.muller@flinders.edu.au>; AdamKoschade<adam.koschade@flinders.edu.au>;
Mohannad Fahad N Bin Jamaan<binj0004@flinders.edu.au>

📎 1 attachments (680 KB)
6275 modification request No.3;

Dear Amanda,
The interim Chairperson of the Social and Behavioural Research Ethics Committee (SBREC) at Flinders University has reviewed and approved the modification request that was submitted for project 6275. A modification ethics approval notice can be found below.

MODIFICATION (No. 3) APPROVAL NOTICE

Project Number: 6275

Project Title:

The scope and speed of language learning using computer games

Principal Researcher:

Dr Amanda Muller

Email:

amanda.muller@flinders.edu.au

Ethical Approval Expiry Date 15 December 2021

I am pleased to inform you that the modification request submitted for project 6275 on the 9 August 2019 has been reviewed and approved by the interim Chairperson of the Committee. A summary of the approved modifications are listed below. Any additional information that may be required from you will be listed in the second table shown below called 'Additional Information Required'.

Approved Modifications	
Extension of ethics approval expiry date	
Project title change	
Personnel change	

Approved Modifications		
Research objectives change		
Research method change		
Participants – addition +/- change		
Consent process change	<p>RESPONSIBILITIES OF RESEARCHERS AND SUPERVISORS</p> <p>Participant Documentation</p> <p>Please note that it is the responsibility of researchers and supervisors, in the case of student projects, to ensure that:</p>	
Recruitment process change		
Research tools change		
Document / Information x Changes 1.		
Other (if yes, please specify)		
Additional Information Required		
None.		

all participant documents are checked for spelling, grammatical, numbering and formatting errors. The Committee does not accept any responsibility for the above mentioned errors.

The Flinders University logo is included on all participant documentation (e.g., letters of Introduction, information Sheets, consent forms, debriefing information and questionnaires – with the exception of purchased research tools) and the current Flinders University letterhead is included in the header of all letters of introduction. The Flinders University international logo/letterhead should be used and documentation should contain international dialling codes for all telephone and fax numbers listed for all research to be conducted overseas.

The SBREC contact details, listed below, are included in the footer of all letters of introduction and information sheets.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number 'INSERT PROJECT No. here following approval'). For more information regarding ethics approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au.

2. Annual Progress / Final Reports

In order to comply with the monitoring requirements of the *National Statement on Ethical Conduct in Human Research 2007 (updated 2018)*; please be reminded that; an annual progress report must be submitted each year on the 18 December (approval anniversary date) for the duration of the ethics approval using the report template available from the [Managing Your Ethics Approval](#) web page.

Please note that no data collection can be undertaken after the ethics approval expiry date listed at the top of this notice. If data is collected after expiry, it will not be covered in terms of ethics. It is the responsibility of the researcher to ensure that annual progress reports are submitted on time; and that no data is collected after ethics has expired.

If the project is completed *before* ethics approval has expired please ensure a final report is submitted immediately. If ethics approval for your project expires please either submit (1) a final report; or (2) an extension of time request (using the modification request form).

Next Report Due Date: 18 December 2019

Final Report Due Date: 15 December 2021

Student Projects

For student projects, the SBREC recommends that current ethics approval is maintained until a student's thesis has been submitted, assessed and finalised. This is to protect the student in the event that reviewers recommend that additional data be collected from

3. Modifications to Project

Modifications to the project must not proceed until approval has been obtained from the Ethics Committee. Such proposed changes / modifications include:

- change of project title;
- change to research team (e.g., additions, removals, researchers and supervisors)
- changes to research objectives;
- changes to research protocol;
- changes to participant recruitment methods;
- changes / additions to source(s) of participants;
- changes of procedures used to seek informed consent;
- changes to reimbursements provided to participants;
- changes to information / documents to be given to potential participants;
- changes to research tools (e.g., survey, interview questions, focus group questions etc);
- extensions of time (i.e. to extend the period of ethics approval past current expiry date).

To notify the Committee of any proposed modifications to the project please complete and submit the *Modification Request Form* which is available from the Managing Your Ethics Approval SBREC web page. Download the form from the website every time a new modification request is submitted to ensure that the most recent form is used. Please note that extension of

Change of Contact Details

If the contact details of researchers, listed in the approved application, change please notify the Committee so that the details can be updated in our system. A modification request is not required to change your contact details; but would be if a new researcher needs to be added on to the research / supervisory team.

4. Adverse Events and/or Complaints

Researchers should advise the Executive Officer immediately on 08 8201-3116 or human.researchethics@flinders.edu.au if:

- any complaints regarding the research are received;
- a serious or unexpected adverse event occurs that affects participants;
- an unforeseen event occurs that may affect the ethical acceptability of the project.

Kind regards Andrea
Andrea Mather and Rae Tyler
Executive Officers, Social and Behavioural
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Adelaide, South
Australia, 5001

SBREC 6275 Modification Request 4
MODIFICATION REQUEST

A Modification Request should be submitted for all items listed below:	IMPORTANT
<ol style="list-style-type: none"> 1. proposed changes to the research protocol; 2. proposed changes to participant recruitment methods; 3. amendments to participant documentation and/or research tools' 4. change of project title; 5. extension of the ethics approval expiry date/ extension of time; and 6. personnel changes (e.g., additions, removals, supervisor changes) <p>Submit modification requests to uman.researchethics@flinders.edu.au Typically, the Committee's response will be emailed to you in 1-2 weeks.</p>	<ol style="list-style-type: none"> a) <u>Proposed modifications</u> should <i>not</i> proceed until formal notification of modification approval has been received. b) <u>Annual reports</u> - annual progress reports should be up to date <i>before</i> a modification request is submitted. c) Indigenous peoples – modifications that involve or impact on Indigenous peoples in Australia will also be reviewed by the Flinders University <u>Office of Indigenous Strategy and Engagement (OISE)</u>, which will impact Committee response time. d) <u>Contact Details</u> – email SBREC if details change as Ethics <i>is not</i> linked to Student Two or Human Resources.

1. Project Information

Project Number: 6275
 Project Title: The scope and speed of language learning using computer games
 Ethics Approval Expiry Date: 15/12/2021

Principal Researcher Email address:
 Annual Reports up to date? Next annual report due?

2. Extension of time

2A Extension of Time Requested (if applicable)
 2B Justification

3. Change of Project Title

3A Change of Project Title (if applicable)

Old project title:
 New project title:

3B Participant Document Revisions

Please note: if the project title is changed, copies of all documents to be distributed to potential participants will need to be revised to include the new title (e.g., email text, Letter of introduction, Information Sheet, Consent Form). Please submit copies of the revised documents for review.

4. Change of Personnel

4A Change of Personnel Summary (if applicable)

Add/ remov e	Full name & title	Postal address	Email address

4B Conflicts of Interest

Comment on whether a conflict of interest may exist for any new personnel (e.g., role / relation to participant source). If yes, explain how this will be managed.

4C Participant Document Revisions

Please note that if personnel are added and/or removed from a project that documents to be distributed to potential participants will need to be revised to ensure that a current list of researchers is included (e.g., email text, Letter of Introduction, Information Sheet, Consent Form).

Revised Participant Documents Attached?

5. Modified Research Protocol

5A Revision of Research Protocol Table

Please indicate in table below what type of changes are proposed.

Select Options that Apply	
Research Objectives Revision, or addition to, research objectives (item D1c)	
Research Method <input type="checkbox"/> <u>Revision</u> of approved research method <input type="checkbox"/> <u>Addition</u> to approved research method	
Research Participants <input type="checkbox"/> <u>Addition</u> of new participant group <input type="checkbox"/> <u>Exclusion</u> of participant group already approved by Committee	<input type="checkbox"/> <u>Important Note</u> If you would like to recruit any participants from any organisation that falls under the banner of the Southern Adelaide Local Health Network (SALHN); such as Flinders Medical Centre or Noarlunga Hospital; the committee advises that ethics approval will need to be sought from the Southern Adelaide Clinical Human Research Ethics Committee (SACHREC) instead of this committee.
Consent <input type="checkbox"/> <u>Revised</u> method for seeking informed consent from participants <input type="checkbox"/> <u>New</u> method for seeking consent	
Recruitment Process Change to approved process for participant recruitment	
Research Tools For example, survey, interview questions, focus group discussion topics. <input type="checkbox"/> <u>Revision</u> of approved research tools <input type="checkbox"/> <u>New</u> research tools	
Documents / Information For example, verbal script, email text, Letter of Introduction, Information Sheet, Consent Form <input type="checkbox"/> <u>Revision</u> of existing documents / information <input type="checkbox"/> <u>New</u> documents / information	
Other (if yes, please specify)	

5B Outline of Research Protocol Changes

Provide a clear outline of changes and/or additions to the research protocol are being requested and explain why it is necessary to address the research objectives (e.g. change to research objectives; changes to recruitment process; change to research tools; addition of research tools etc).

The modification requested is an addition to the source of participants (item D1c) to include participants from external universities.

Specifically, in addition to sourcing participants from the School of Nursing and Midwifery at Flinders University as previously requested, participants will also be sourced from Schools of Nursing at other Australian universities.

The participant group recruited will remain the same – it will still be international students enrolled in nursing (e.g., Bachelor of Nursing, in any year level) at university.

All other aspects of recruitment protocol (such as the basis for their recruitment and the anticipated number of participants recruited) will also remain the same.

Permission to recruit participants will be sought from external universities in accordance with their respective university procedures prior to commencing recruitment.

This change is necessary in order to recruit enough participants to the study.

5C Participant Document Revisions

To ensure that informed consent can be obtained changes to the research protocol may need to be reflected in the documents to be distributed to potential participants. (e.g., email text, Letter of Introduction, Information Sheet, Consent Form). Revised documents and/or new participant documents may need to be provided for review.

6. Permissions / Other Ethics Committee Approvals

Please indicate whether any other ethics committee approvals and/or permissions need to be sought that are related to the requested modification. If yes, please either (a) provide a copy of approvals and/or permissions OR (b) confirm that copies will be submitted to the committee on receipt.

Permission to recruit participants from universities other than Flinders University will be sought from external universities in accordance with their respective procedures. This will include seeking permission from the ethics committees (HREC) of other universities. Permission/approval has not been sought at this stage.

However, copies will be submitted to the committee on receipt.

7. Aboriginal and/or Torres Strait Islander peoples

7A Impact and/or involvement of Indigenous peoples

Please indicate whether the *proposed modification* will involve or impact on Australian Indigenous peoples. NO

7B Explanation IF the proposed modification involves or impacts on Australian Indigenous peoples, please explain how.

8. Burdens and/or Risks

Could there be any potential inconveniences or risks to participants as a consequence of the modifications requested? If YES, outline what they are and specify whether there will be any changes to anonymity and confidentiality assurances given to participants, time commitments and research location. Please explain how you will reduce inconveniences and/or risks to participants.

No

9. Document amendments and/or additions

New or amended ?	Document	Brief outline of changes made	Attached yes/no

Note: All new and modified participant documents must be submitted for review and approval

6275 ETHICS modification No.4 approval notice (16 September 2019)

Human Research Ethics <human.researchethics@flinders.edu.au>

Mon 16/09/2019 10:11 AM

To: AmandaMuller<amanda.muller@flinders.edu.au>; AdamKoschade<adam.koschade@flinders.edu.au>;

Mohannad Fahad N Bin Jamaan <binj0004@flinders.edu.au>

Dear Amanda,

The Deputy Chairperson of the [Social and Behavioural Research Ethics Committee \(SBREC\)](#) at Flinders University has reviewed and approved the modification request that was submitted for project 6275. A modification ethics approval notice can be found below.

MODIFICATION (No. 4) APPROVAL NOTICE

Project No: 6275

Project Title:

The scope and speed of language learning using computer games

Principal Researcher:

Dr Amanda Muller

Email:

amanda.muller@flinders.edu.au

Modification Approval Date: 16 September 2019

Ethical Approval Expiry Date: 15 December 2021

I am pleased to inform you that the modification request submitted for project 6275 on the 11 September 2019 has been reviewed and approved by the interim Chairperson of the Committee. A summary of the approved modifications are listed below. Any additional information that may be required from you will be listed in the second table shown below called 'Additional Information Required'.

Approved Modifications	
Extension of ethics approval expiry date	
Project title change	
Personnel change	
Research objectives change	

Approved Modifications	
Research method change	
Participants – addition +/- change	X
Consent process change	
Recruitment process change	
Research tools change	
Document / Information Changes	
Other (if yes, please specify)	
RESPONSIBILITIES OF RESEARCHERS AND SUPERVISORS	
Additional Information Required	
1.	
Permissions Please provide copies of correspondence granting permission to conduct the research from the external Universities. Please ensure that all correspondence clearly outlines the specifics of what permission is being granted. <u>Please note</u> that data collection relating to the modification request should not commence until all relevant permissions have been granted.	

Participant Documentation

Please note that it is the responsibility of researchers and supervisors, in the case of student projects, to ensure that:

- all participant documents are checked for spelling, grammatical, numbering and formatting errors. The Committee does not accept any responsibility for the above mentioned errors.
- the Flinders University logo is included on all participant documentation (e.g., letters of Introduction, information Sheets, consent forms, debriefing information and questionnaires – with the exception of purchased research tools) and the current Flinders University letterhead is included in the header of all letters of introduction. The Flinders University international logo/letterhead should be used and documentation should contain international dialling codes for all telephone and fax numbers listed for all research to be conducted overseas.
- the SBREC contact details, listed below, are included in the footer of all letters of introduction and information sheets.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number 'INSERT PROJECT No. here following approval'). For more information regarding ethics approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au.

Annual Progress / Final Reports

In order to comply with the monitoring requirements of the *National Statement on Ethical Conduct in Human Research 2007 (updated 2018)*; please be reminded that; an annual progress report must be submitted each year on the 18 December (approval anniversary date) for the duration of the ethics approval using the report template available from the [Managing Your Ethics Approval](#) web page.

Please note that no data collection can be undertaken after the ethics approval expiry date listed at the top of this notice. If data is collected after expiry, it will not be covered in terms of ethics. It is the responsibility of

the researcher to ensure that annual progress reports are submitted on time; and that no data is collected after ethics has expired.

If the project is completed *before* ethics approval has expired please ensure a final report is submitted immediately. If ethics approval for your project expires please either submit (1) a final report; or (2) an extension of time request (using the modification request form).

Next Report Due Date:

18 December 2019

Final Report Due Date:

15 December 2021

Student Projects

For student projects, the SBREC recommends that current ethics approval is maintained until a student's thesis has been submitted, assessed and finalised. This is to protect the student in the event that reviewers recommend that additional data be collected from

Modifications to Project

Modifications to the project must not proceed until approval has been obtained from the Ethics Committee.

Such proposed changes / modifications include:

- change of project title;
- change to research team (e.g., additions, removals, researchers and supervisors)
- changes to research objectives;
- changes to research protocol;
- changes to participant recruitment methods;
- changes / additions to source(s) of participants;
- changes of procedures used to seek informed consent;
- changes to reimbursements provided to participants;
- changes to information / documents to be given to potential participants;
- changes to research tools (e.g., survey, interview questions, focus group questions etc);
- extensions of time (i.e. to extend the period of ethics approval past current expiry date).

To notify the Committee of any proposed modifications to the project please complete and submit the *Modification Request Form* which is available from the [Managing Your Ethics Approval SBREC web page](#). Download the form from the website every time a new modification request is submitted to ensure that the most recent form is used. Please note that extension of

Change of Contact Details

If the contact details of researchers, listed in the approved application, change please notify the Committee so that the details can be updated in our system. A modification request is not required to change your contact details; but would be if a new researcher needs to be added on to the research / supervisory team.

3. Adverse Events and/or Complaints

Researchers should advise the Executive Officer immediately on 08 8201-3116 or

human.researchethics@flinders.edu.au if:

- any complaints regarding the research are received;
- a serious or unexpected adverse event occurs that affects participants;
- an unforeseen event occurs that may affect the ethical acceptability of the project.

Kind regards

Rae

Andrea Mather and Rae Tyler (Mon, Wed and Fri morning)

Human Research Ethics Officers (Social and Behavioural Research Ethics Committee) Research Development and Support

Union Basement Building Flinders University

Sturt Road, Bedford Park,

South Australia, 5042 GPO

Box 2100, Adelaide, South

Australia, 5001

P: (+61-8) 8201 3116 | andrea.mather@flinders.edu.au

P: (+61-8) 8201 7938 | rae.tyler@flinders.edu.au

SBREC6275 Modification Request 5
HREC Project Transfer Form

The scope and speed of language learning using computer games
ID:4145 Year:2021 Version:1

Information for Applicants

Please complete this form if your human research project has been approved by the Flinders University's Human Research Ethics Committee before 30 May 2020 and approval will not expire on or before 31 December 2020.

Please note: Projects approved in the new online system before 30 May 2020 do not need to be transferred. Also, projects approved by an external Human Research Ethics Committee have to be uploaded via the Cross-Institutional Approval Form.

About the Project

1. What is the title of the approved project?

The scope and speed of language learning using computer games

2. Please provide the original approval number (e.g. SBREC 1234).

3. Please provide the approval date.

12/09/2013

4. Please provide the expiry date.

15/12/2021

4. Are you a student or staffmember?

Student
Staff member

5. Chief Investigator details

Title Dr

First Name Amanda

Surname Muller

FAN mull0068

Telephone +61 8 8201 3378

Email amanda.muller@flinders.edu.au

6. Please select your College/Portfolio.

College of Nursing and Health Sciences

7.2. Please provide the details of your supervisory panel.

Title Dr

First Name Amanda

Surname Muller

FAN

Phone / Business Hours +61 8 8201 3378

Email amanda.muller@flinders.edu.au

College or Portfolio College of Nursing and Health Sciences

Supervisor Type Principal Supervisor

7.3. Please provide your course of study.


PhD

Project Details - Part 1

8. Does the project involve and/or impact on the following participant categories?

-
- Children
- Indigenous communities
- People in dependent and/or unequal relationships
- People unable to give consent for health or other reasons
- People highly dependent on medical care
- People with cognitive impairment, intellectual disability or mental illness
- Women who are pregnant and the human foetus
- People who are homeless
- People who are incarcerated
- People who may be involved in/or disclose illegal activities
- Victims of crime
-

9. Is the research a clinical trial in accordance with the NHMRC definition of a clinical trial?

 Please see [here](#) for further information.

- Yes
- No

Project Details - Part 2

10. Does the project collect personal health information from a Commonwealth or Private Agency?

-
- Yes

11. Does this project collect data about the health of Aboriginal and/or Torres Strait Islander people?

-
- Yes

12. Please upload all relevant documents, including the original application, any attachments, SBREC approval notice and modification approval notices.

Type	Document Name	Documents File Name	Version Date	Version	Size
Default	6275 Original application form	6275 Original application form.doc			381.5 KB
Default	6275 Conditional approval response form	6275 Conditional approval response form.doc			565.5 KB
Default	6275 Modification request 1 form	6275 Modification request 1 form.doc			91.0 KB
Default	6275 Modification request 2 approval	6275 Modification request 2 approval.pdf			913.4 KB
Default	6275 Modification request 2 form	6275 Modification request 2 form.pdf			165.9 KB
Default	6275 Modification request 2 docs	6275 Modification request 2 docs.pdf			364.3 KB
Default	6275 Modification request 3 approval	6275 Modification request 3 approval.pdf			913.8 KB
Default	6275 Modification request 3 form	6275 Modification request 3 form.pdf			184.4 KB
Default	6275 Modification request 3 docs	6275 Modification request 3 docs.pdf			402.4 KB
Default	6275 Modification request 4 approval	6275 Modification request 4 approval.pdf			922.4 KB
Default	6275 Modification request 4 form	6275 Modification request 4 form.pdf			395.8 KB

Modifications

13. Are modifications to the approved protocol required?



Yes

13.1. Please indicate below what modifications are required.



Change of Chief Investigator



Add Co-Investigators Remove



Co-Investigators



Change to research design / methods



Access to an existing data set Changes to recruitment of participants



Changes to the number of required participants



Changes to participant categories



Changes to the research location
Changes to funding arrangements



Change of project title

Please summarise all changes to the project, including removal of co-investigators, and provide reasons why the changes are necessary.

Remove co-investigator

Removal of co-investigator Mohammed Fahad N Bin Jamaan (binj0004@flinders.edu.au) from the project. This is necessary as Bin Jamaan is no longer a student at Flinders University and is no longer involved in the project.

Changes to approved documents

Updated letter of introduction and information sheet. Changes include:

- 1) Removing the details of the research student Bin Jamaan. This is necessary as he is no longer involved in the project.
- 2) Revised and expanded discussion of the game and potential benefits. This is necessary to improve recruitment because we are having difficulty recruiting participants, and to reflect the fact that the study is being done entirely online, accessible to students who are not studying on-campus (more common at present due to the pandemic).
- 3) Removal of pluralisation of 'games'. This is required for consistent grammar.
- 4) Removal of an old hyperlink. This is required as it is no longer active or being used in the study.
- 5) Changing the contact email address for interested participants to co-investigator Adam Koschade.

Please state whether the modifications could cause any inconveniences or risks to participants, including changes to anonymity and confidentiality assurances given to participants. If so, please specify what they are and how they will be managed/mitigated.

No

Changes to approved documents or new documents (e.g. Information Form, Consent Form, Project Flyers, interview questions, surveys etc).

Please upload any updated and/or new documents.

Type Size	Document Name	File Name	Version Date	Version
Default	6275 Modification request 5 Letter of Introduction	6275 Modification request 5 Letter of Introduction.pdf		445.2 KB
Default	6275 Modification request 5 Information Sheet	6275 Modification request 5 Information Sheet.pdf		427.7 KB

Signature

Declaration

I, as the Chief Investigator or authorised delegate, certify that:

- All information contained in this application is true and accurate.
- I have had access to and read the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018), and that the research will be conducted in accordance with the National Statement and in accordance with the ethical arrangements of the organisations involved.
- I have consulted any relevant legislation and regulations, and the research will be conducted in accordance with these.
- I have, if applicable, provided all collaborators and other persons involved in this research project with access to this application (online or PDF) and will provide them with all future amendments and reports.
- All collaborators and other persons involved in this project are aware of the requirements and conditions and will conduct the research in accordance with these.
- I will immediately report to Research Ethics & Compliance anything which might warrant review of the ethical approval of the proposal. I will inform Research Ethics & Compliance, giving reasons, if the research project is discontinued before the expected date of completion.

I will adhere to the conditions of approval stipulated by the Committee and will cooperate with the Committee's monitoring requirements, including the provision of annual progress reports and final reports as required.



College of Nursing and Health Sciences
GPO Box 2100
Adelaide SA 5001
Tel: 08 8201 3378
amanda.muller@flinders.edu.au
<http://flinders.edu.au/nursing>
CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Student

I hold the position of Senior Lecturer in the College of Nursing Health Sciences at Flinders University, and I work with the research student Adam Koschade. We are undertaking research leading to publications on the subject of the scope and speed of language learning using computer games.

I would be most grateful if you would volunteer to assist in this project by playing computer games, doing two short tests, and completing a questionnaire for the game. No more than 3 hours over two weeks would be required.

Participation in the study will offer students important benefits essential to their classwork and clinical skills.

Students participating in the study will play a multiplatform computer game (playable on laptop/desktop computers and android mobile devices) which teaches real confusable medication names.

The game hones listening skills and teaches valuable medical terminology which nursing students often find difficult. It supports both classroom learning and clinical placement. In particular, this game allows students to familiarise themselves with the sorts of things they will hear and use in patient handovers, while taking patient histories and while reading patient records. Made in Australia, it will also allow students to practice hearing and getting used to Australian accents.

The study and resources are all online. They can be accessed anytime, from anywhere. This would be especially valuable for students who, because of the pandemic, will be beginning their semester offshore and/or studying online by distance. Thus, students can not only participate in the study, but also start to practice and improve their English language skills – even from offshore or before commencing their degree.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Any enquiries you may have concerning this project should be directed to adam.koschade@flinders.edu.au .

Thank you for your attention and assistance. Yours sincerely
Dr Amanda Muller

Lecturer (English for Specific Purposes)

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (project number 6275). For more information regarding ethical approval of the project the Secretary of the Committee can be contacted by telephone on 8201 5962, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au



Dr Amanda Muller
College of Nursing and Health Sciences
Sturt Campus
Flinders Drive, Bedford Park SA 5042
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 8201 3378
amanda.muller@flinders.edu.au
<http://flinders.edu.au/nursing/>
CRICOS Provider No. 00114A

INFORMATION SHEET

Title: 'The scope and speed of language learning using computer games'

Primary Investigator:

Dr Amanda Muller
College of Nursing and Health
Sciences Flinders University
Ph: 8201 3378

Co-investigator:

Research student: Adam Koschade a dam.koschade@flinders.edu.au.

Description of the study:

This study is part of the project entitled '*The scope and speed of language learning using computer games*'. This project will investigate how well students can learn important medical and colloquial language for health-related work.

Purpose of the study:

This project aims to find out if computer games which have been created to teach language actually improve student performance.

What will I be asked to do?

There are three stages of the study: an online pre-test of your skills before the game, the playing of the game online, and an online post-test of your skills after the game (this includes giving your opinion about the game). In summary, the schedule looks like this:

1. 15 minute online pre-test of your ability before playing the game, plus a questionnaire
2. Play the game online for at least 10 minutes a day for 7 days, over a 14 day period
3. 15 minute online post-test of your ability after playing the game, plus a questionnaire

What benefit will I gain from being involved in this study?

The sharing of your experiences will improve the planning and delivery of future programs. We are very keen to deliver a service and resources which are as useful as possible to people.

Participation in the study will offer students important benefits essential to their classwork and clinical skills.

Students participating in the study will play a multiplatform computer game (playable on laptop/desktop computers and android mobile devices) which teaches real confusable medication names.

The game hones listening skills and teaches valuable medical terminology which nursing students often find difficult. It supports both classroom learning and clinical placement. In particular, this resource allows students to familiarise themselves with the sorts of things they will hear and use in patient handovers, while taking patient histories, and while reading patient records.

Made in Australia, this game will also allow students to practice hearing and getting used to Australian

accents. This is particularly helpful at a time when students may be undertaking their degree off-campus.

The study and resources are all online. They can be accessed anytime, from anywhere. This would be especially valuable for students who, because of the pandemic, will be beginning their semester offshore and/or studying online by distance.

First years who have not mastered English as much as later year students may find it particularly helpful. However, students from all year levels would benefit and are welcome to participate in this study.

Thus, students can not only participate in the study, but also start to practice and improve their English language skills – even from offshore or before commencing their degree.

Will I be identifiable by being involved in this study?

We do not need your name and you will be anonymous. Any identifying information will be removed and the typed-up file stored on a password protected computer that only the researchers will have access to. Your comments will not be linked directly to you.

Are there any risks or discomforts if I am involved?

It is an anonymous study, so the investigator anticipates little risk from your involvement. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

How do I agree to participate?

Participation is voluntary. You may answer ‘no comment’ or refuse to answer any questions and you are free to withdraw from the study at any time without effect or consequences. A consent form accompanies this information sheet. If you agree to participate please email a dam.koschade@flinders.edu.au.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (6275). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human_researchethics@flinders.edu.au

Fw: SBREC 6275 Transfer / Transfer Modification Approval
Amanda Muller <amanda.muller@flinders.edu.au 24 February 2021 at 17:52 To: Adam
Koschade <adamkoschade@gmail.com>

Dr Amanda Müller AE
Senior Lecturer
English for Specific Purposes, College of Nursing and Health
Sciences Australian Accredited Editor
Australian Research
Council Assessor
Council Member

Flinders University
(Sturt Campus) GPO
Box 2100 ADELAIDE
SA 5001
+61 8 8201 3378

<http://www.flinders.edu.au/people/amanda.muller>

CRICOS Provider Number 00114A

From: donotreply@infonetica.net <donotreply@infonetica.net>

Sent: Wednesday, 24 February 2021 16:12

To: Amanda Muller <amanda.muller@flinders.edu.au>

Cc: Amanda Muller <amanda.muller@flinders.edu.au>

Subject: SBREC 6275 Transfer / Transfer Modification Approval

Dear Dr Amanda Muller,

We are happy to advise that the transfer of your project SBREC 6275 - The scope and speed of language learning using computer games (ResearchNow Ethics & Biosafety ID "4145") has been approved.

This approval also covers any modifications submitted with the transfer request.

Please note: for all research projects wishing to recruit Flinders University students as participants, approval needs to be sought from Professor Clare Pollock in her capacity as Deputy Vice-Chancellor (Students). To seek approval, please provide a copy of the Ethics approval for the project and a copy of the project application to the Office of the Deputy Vice-Chancellor (Students) via dvcsoffice@dl.flinders.edu.au.

Project ID: SBREC 6275

Project Title: The scope and speed of language learning using computer games

Chief Investigator: Dr Amanda

Muller Original Approval

Date: 12/09/2013 Expiry date:

15/12/2021

Future Modifications

Modifications to the project must not proceed until approval has been obtained from the

Ethics Committee. Such proposed changes / modifications include:

change of project title;

change to research team (e.g., additions, removals, researchers and supervisors) changes to research objectives;

changes to research protocol;

changes to participant recruitment methods;

changes / additions to source(s) of participants;

changes of procedures used to seek informed consent; changes to

reimbursements provided to participants;

changes to information / documents to be given to potential participants;

changes to research tools (e.g., survey, interview questions, focus group questions etc); extensions of time (i.e. to extend the period of ethics approval past current expiry date).

To notify the Committee of any proposed modifications to the project please submit a Modification Request Form.

1.

Annual Reports

In order to comply with the monitoring requirements of the National Statement on Ethical Conduct in Human Research 2007 (updated 2018) an annual progress report must be submitted each year on the approval anniversary date for the duration of the ethics approval. Please submit the HREC

Annual Report Form when the report is due.

2.

Adverse Events and/or Complaints

Researchers must submit the Unexpected Adverse Events form within 24 hours if: a serious or unexpected adverse event occurs that effects participants; an unforeseen event occurs that may affect the ethical acceptability of the project.

Researchers should also contact the Ethics office if any complaints regarding the research have been received.

All the best with your research project. Hendryk Flaegel

Research Development and Support

human.researchethics@flinders.edu.au P: (+61-8) 8201 2543

Flinders University

Sturt Road, Bedford Park, South Australia, 5042 GPO Box 2100, Adelaide, South Australia, 5001

http://www.flinders.edu.au/research/researcher-support/ebi/human-ethics/human-ethics_home.cfm

SBREC6275 Modification Request 6
HREC Project Transfer Form

The scope and speed of language learning using computer games
ID:4145 Year:2022 Version:3

Information for Applicants

Please complete this form if you want to transfer a project that has already been approved by another NHMRC registered Human Research Ethics Committee.

Please note: Following approval of the transfer request, Flinders University will be responsible for the project. Therefore, all future modification requests and reports must be submitted to Flinders University's HREC. To minimise duplication of ethical review, please inform the original Ethics Committee of the transfer so that they can close the project.

Requests for cross-institutional approval must be submitted via the Cross-Institutional Approval Form. Cross-institutional approval means that Flinders University's HREC will accept approval from another NHMRC registered Human Research Ethics Committee but will not take on responsibility for the project. Modification requests and reports must be submitted to the original Ethics Committee.

About the Project

1. What is the title of the approved project?

The scope and speed of language learning using computer games

2. Please provide the original approval number (e.g. HREC 1234).

3. Please provide the approval date.

3. Please provide the expiry date.

The first approval period is limited to five years. However, projects may be extended for another 12 months if evidence can be provided that the project is still ongoing.

15/12/2023

4. Are you a student or staff member?



Student



Staff member

5. Chief Investigator details

Title

Dr

First Name

Amanda

Surname

Muller

FAN

mull0068

Telephone

+61 8 8201 3378

Email

amanda.muller@flinders.edu.au

6. Please select your College/Portfolio.

College of Nursing and Health Sciences

6.1. Please provide the details of your supervisory panel.

Title

Dr

First Name

Amanda

Surname

Muller

FAN

Phone / Business Hours

+61 8 8201 3378

Email

College or Portfolio

Supervisor Type

7.2. Please provide your course of study.

8. Are there any Co-Investigators?



Yes

8.1. Co-Investigators' details

Please provide the details of your Co-Investigators below.

Title

First Name

Surname

FAN

Email

College or Portfolio

9. Does the project involve and/or impact on the following participant categories?

- Children
- Indigenous communities
- People in dependent and/or unequal relationships
- People unable to give consent for health or other reasons People highly dependent on medical care
- People with cognitive impairment, intellectual disability or mental illness Women who are pregnant and the human foetus
- People who are homeless
- People who are incarcerated
- People who may be involved in/or disclose illegal activities Victims of crime
- Migrants, refugees and asylum seekers Minors 16 years and above
- People with cultural and/or religious background People for whom English is a second language Overseas participants
- None of the above
-

Project Details - Part 2

11. Does the project collect personal health information from a Commonwealth or Private Agency?

-
- Yes

12. Does this project collect data about the health of Aboriginal and/or Torres Strait Islander people?

-
- Yes

13. Please upload all relevant documents, including the original application, any attachments, approval and modification approval notices.

Type	Document Name	Documents File Name	Version	Size
Default	6275 Original application form	6275 Original application form.doc		381.5 KB
Default	6275 Conditional approval response form	6275 Conditional approval response form.doc		565.5 KB
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Default	6275 Modification request 2 approval	6275 Modification request 2 approval.pdf		913.4 KB
Default	6275 Modification request 2 form	6275 Modification request 2 form.pdf		165.9 KB
Default	6275 Modification request 2 docs	6275 Modification request 2 docs.pdf		364.3 KB
Default	6275 Modification request 3 approval	6275 Modification request 3 approval.pdf		913.8 KB
Default	6275 Modification request 3 form	6275 Modification request 3 form.pdf		184.4 KB
Default	6275 Modification request 3 docs	6275 Modification request 3 docs.pdf		402.4 KB
Default	6275 Modification request 4 approval	6275 Modification request 4 approval.pdf		922.4 KB
Default	6275 Modification request 4 form	6275 Modification request 4 form.pdf		395.8 KB

Modifications

14. Are modifications to the approved protocol required?

- No
 Yes

14.1. Please indicate below what modifications are required.

- Change of Chief Investigator
 Add Co-Investigators Remove
 Co-Investigators
 Change to research design / methods
 Access to an existing data set Changes to
 recruitment of participants
 Changes to the number of required participants
 Changes to participant categories
 Changes to the research location
 Changes to funding arrangements
 Change of project title

Change of the expiry date

Please update question 4 "Please provide the expiry date" in Section 1 – About the Project.

Signature

Declaration

I, as the Chief Investigator or authorised delegate, certify that:

All information contained in this application is true and accurate.

I have had access to and read the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018), and that the research will be conducted in accordance with the National Statement and in accordance with the ethical arrangements of the organisations involved.

I have consulted any relevant legislation and regulations, and the research will be conducted in accordance with these.

I have, if applicable, provided all collaborators and other persons involved in this research project with access to this application (online or PDF) and will provide them with all future amendments and reports.

All collaborators and other persons involved in this project are aware of the requirements and conditions and will conduct the research in accordance with these.

I will immediately report to Research Ethics & Compliance anything which might warrant review of the ethical approval of the proposal. I will inform Research Ethics & Compliance, giving reasons, if the research project is discontinued before the expected date of completion.

I will adhere to the conditions of approval stipulated by the Committee and will cooperate with the Committee's monitoring requirements, including the provision of annual progress reports and final reports as required.

Signed: This form was signed by Amanda Muller (amanda.muller@flinders.edu.au) on 06/12/2022 12:12 PM