Education for All:

An Investigation into the Inclusivity of Science Teaching and Learning Practices in Schools Providing Inclusive Education in Daerah Istimewa Yogyakarta Indonesia

by

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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.

Jamil Suprihatiningrum

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Dedication

This dissertation is lovingly dedicated to my mother, Umi Kalsum, without whom I would have never pursued the highest levels of education. To my beloved husband Ahmad Yuni Ma'arif, who gives me love, patience, kindness, understanding and prayers every step of my way. To my beloved daughter Aluk Antan Ambawani who was born in the middle of this PhD journey and has fulfilled my day with joys and happiness.

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Abbreviations

ABCD	Audience, Behaviour, Condition, and Degree
AIM	Assessment of Inclusivity Multiculturalism
CAST	Centre for Applied Special Technology
CSIE	Centre for Studies on Inclusive Education
DI	Daerah Istimewa (Special Province)
Dikpora	*Dinas Pendidikan dan Olahraga* (Department of Education and Sport in regional level)
EASPD	European Association of Service Providers for Persons with Disabilities
EFA	Education for All
GPK	*Guru Pendamping Kelas* (Support Teacher/ Special Education Teacher/Special Need Assistant)
ICP™	Inclusive Classroom Profile
IDCT	Indonesia Disability Convention Team
IDEA	Individuals with Disabilities Education Act
IEP	Individual Education Plan
K13	*Kurikulum* 2013 (Curriculum 2013)
KD	*Kompetensi Dasar* (Basic Competency)
KI	*Kompetensi Inti* (Core Competency)
KKM	*Kriteria Ketuntasan Minimal* (Minimum Criteria for the Passing Grade)
LD	Learning Difficulties
MMAE	Multiple Means of Action and Expression
MME	Multiple Means of Engagement
MMR	Multiple Means of Representation
MOEC[1]	Ministry of Education and Culture
MONE	Ministry of National Education
MORA	Ministry of Religious Affairs
MR	Multiple Representation
OECD	Organisation for Economic Co-operation and Development
OM	Orientation and Mobility
QuIEM	Quality of Inclusive Experiences Measure

[1] The Indonesian government has altered the name of ministry education from MONE to MOEC in 2011. MOEC is a ministry that organises education in early childhood, primary and secondary education levels, as well as in community education affairs and the management of culture.

RC	Resource Centre
RPP	*Rencana Pelaksanaan Pembelajaran* (Lesson Planning)
SDG	Sustainable Development Goals
SLC	Students Led Conference
SMART	Specific, Measurable, Achievable, Realistic, and Timely
SPIE	Schools Providing Inclusive Education
SPS	Science Process Skills
SWD	Students with Disabilities
UD	Universal Design
UDL	Universal Design for Learning
UDL-IRN	Universal Design for Learning Implementation and Research Network
UN	*Ujian Nasional* (National Examination)
UN CRPD	United Nations Convention on the Right of Persons with Disabilities
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
ZPD	Zone of Proximal Development

Abstract

Limited understanding towards inclusive education results in educational and learning practises that are not yet fully inclusive, therefore realising the goal of 'Education for All' in Indonesia is challenging. Teachers, as key persons who operate the learning process, are apprehensive about how to include students with disabilities (SWD), more specifically in science teaching and learning. This research, therefore, sought to investigate the nature of inclusivity in science teaching and learning for SWD in schools designated as a 'School Providing Inclusive Education' (SPIE) in Indonesia. The Universal Design for Learning (UDL) was applied as a framework to investigate inclusivity and explore learning goals, pedagogical practices and learning assessments.

A qualitative collective case study approach was selected as the methodology of choice, involving three SPIE: Schools A, B and C in the Province of Daerah Istimewa Yogyakarta that were purposefully selected. Nineteen participants from the three schools were involved in this study and were divided into four categories, namely: science teachers, support teachers, principals and SWD. Participants were questioned about their experiences relating to science teaching and learning that involved the welcoming of SWD into their schools and classrooms. Data were collected by open-ended questionnaires, interview (individual and group), observation of the classrooms and school buildings and document analysis. The data were analysed using Yin's method.

Findings demonstrate that while science teachers in School A applied a model of integration, they did so with limited understanding and resources, so that only the nuance of inclusive-special education could be found. SWD were pulled-out from their science classes to be educated by the support teacher in the designated inclusion room, either individually or together with other peers with disabilities.

School B, although designated as an SPIE, had enrolments largely from individuals with a visual impairment. Unlike Schools A and C, School B had no support teacher in the field of special education to work with science teachers and SWD. Science teachers had a positive attitude towards SWD, however, the philosophy upon which School B was built and around which the school culture developed appeared to be rooted in the principles of special education.

By embracing the concepts of multicultural and inclusive education, School C's teachers and community members' understanding about inclusivity had been fostered. This was evidenced by the adoption of the science 'curriculum for all' concept. Science teachers and support teachers worked side by side throughout the entire instructional process to include and involve SWD and optimise their participation in learning. Indeed, science teachers in School C had adopted a nearly inclusive education model.

The different practices of inclusive education in science classrooms among the three cases reflect that the concept of inclusive education is varied, depending on teachers' understanding and school readiness to adopt inclusive education; while significant barriers still exist. The implications of the study are for science teachers to co-design and co-create more inclusive science classrooms and for the UDL framework to be operationally applied as an effective approach towards enabling accessible and flexible 'learning for all' to arise.

Keywords: inclusivity, inclusive education, students with disabilities, inclusive science teaching and learning, SPIE

Chapter 1
Introduction

This introductory chapter provides an overview of the research focus for this thesis. The chapter begins with the background and statement of the problem, followed by a description of the context of the study in which the issues surrounding an inclusive education (IE) for students with disabilities (SWD) in the Indonesian science curriculum are discussed. The aims of the study together with the research questions, the rational and significance of the study, and definitions of the key terms pertaining to the thesis are also presented. Finally, the structure of the thesis is outlined before summarising the chapter.

1.1 Background to the Study

This thesis focuses on the teaching of SWD within the Indonesian education system, specifically in the field of science education. UNESCO established Education for All (EFA) as an international initiative to bring the benefits of education to "every citizen in every society" (World Bank, 2014, August 4, para. 1) by 2015. The EFA is a sustainable project but the six desirable goals of 2015 have not yet been completed and this project is being continued in UNESCO's 2030 Agenda for Sustainable Development and the Sustainable Development Goal (SDG)-4 for education (UNESCO, 2016). EFA is a global consensus, agreed upon by the international community that is committed to affording excellent basic education for all children, youth and adults, including those with disabilities; while SGD-4 for education focuses on ensuring the inclusive, equitable and lifelong learning EFA goals. As a strategy for achieving EFA, the journey towards IE and its practices in teaching and learning is challenging and encouraging (Forlin et al., 2013; Minou, 2011; UNESCO, 2009b; Wapling, 2016) in many countries. In the US, the importance of teaching SWD in general educational programs within an inclusive setting is accentuated in the Every Student Succeeds Act (ESSA) and the Individuals with Disabilities Education Act (IDEA) (National Council on Disability, 2018; Tomasello & Brand, 2018). The mandate of the IDEA specifies that SWD are to be taught with their peers without disabilities in the Least Restrictive Environment (LRE) (Gargiulo & Metcalf, 2015; Robbins, 2014).

Research into the practices required to develop inclusive settings has emerged since the IDEA was enforced (Abels, 2015; Florian & Black-Hawkins, 2011; Giangreco & Doyle, 2000). Abels (2015) highlighted the fact that when schools claim they provide IE, it does not necessarily mean that lessons are completely inclusive. He added that teachers need to find inclusive pedagogical approaches and to scaffold these carefully. Although teachers face many challenges in practicing inclusive pedagogy, Florian and Black-Hawkins (2011) concluded that teachers' pedagogical approaches can be identified based on their knowledge about inclusion, which affects their belief and perception about how to avoid the negative stigma associated with SWD and to welcome all students based on their differences. The competencies and willingness to care for SWD assist general education teachers to demonstrate inclusive pedagogies and by so doing minimise the negative labelling of SWD (Giangreco & Doyle, 2000).

In Indonesia, the gap between policy and the implementation of IE is a steady challenge, despite support at the decision making level being provided (Handayani & Rahadian, 2013; Tsaputra, 2012). Since the enactment by The Indonesian Ministry of National Education (MONE) of Regulation No. 70/2009 concerning Inclusive Education for Children with Special Needs and for the Talented and Gifted, some provinces through their Department of Education (*Dikpora*) have appointed regular schools as Schools Providing Inclusive Education (SPIE). SPIE has been mandated by the latest regulation No. 13/2020 concerning Appropriate Accommodation for SWD in the areas of budgeting, facilities and infrastructures, teachers and staff, and curriculum. The local government allocates funds for running the SPIE, i.e. for purchasing special educational resources and equipment and for organising teacher training to support SWD. Teachers as key persons who operate the learning process, however, still face many challenges in adopting inclusive practices (Fitria, 2012). For instance, teachers have difficulties in varying teaching methods to suit students' needs. A study by Suprihatiningrum et al. (2016) revealed that teachers of SPIE still held misconceptions about the terminology of IE and lacked awareness about how to provide the most appropriate education for all students. These findings indicate there are barriers to teachers' understanding about what inclusive teaching is and how to implement effective strategies and successful approaches required to meet the needs of all students in furnishing them with access to and participation in learning. The current portrait of teaching areas, i.e.

curriculum, learning strategies, media and assessment for SWD in Indonesia is described as follows.

In Indonesia and particularly in the Province of Daerah Istimewa (DI) Yogyakarta, most curricula are not designed for adjustment to individual variability (Suprihatiningrum, 2016). Teachers face difficulties in modifying curricula (Setianingsih, 2015) because they are mandated by Curriculum 2013 (K13) to adhere strictly to a single approach namely the 'scientific approach' when planning lessons. This rigid curriculum poses science teachers with difficulties in creating flexible learning approaches for SWD, whereas some researchers argue no one method will work best for all learners (Gargiulo & Metcalf, 2015; Shaddock, 2007; Shaddock et al., 2007). Science teachers need to find multiple methods to organise their classrooms, rather than implementing a single learning approach; and "UDL [Universal Design for Learning] can be a resource for possible approaches" (American Chemical Society, 2012, p. 8). Curriculum modification is essential when SWD are placed into the general education setting, to enhance access and for them to make learning progress (Lee et al., 2010). As a curriculum modification benefit for students and teacher behaviour, Lee et al. (2010) suggested teachers should find effective ways to implement curriculum modifications by, for example, teacher training on curriculum modification and collaborative work between teachers and paraprofessionals.

Some teachers in Indonesia have applied a student active learning approach in teaching and learning for science, however Herlianti (2015) found that SWD tended to be passive and teachers needed extra time to teach certain topics, so the lecturing method was preferred. A study by Winarti (2015) mentioned that teachers in Indonesia experienced difficulties in determining appropriate learning methods for SWD, due to the lack of skill for inclusive teaching and because limited training for this skill was offered.

Adaptive and accessible science learning media for SWD are provided on a very limited basis in SPIE in DI Yogyakarta and surrounding areas. Studies by Ni'mah and Utami (2019); Satrio (2016); Yudistia and Winarti (2014); Yuliawati et al. (2013) indicate similar findings, in which science learning media for students with vision impairment (VI) were extremely limited. These studies mentioned that the main media for students with VI was Braille, which is limited, and not all science teachers can read and write in Braille and they have limited access to Braille readers. Students with hearing impairment (HI) are offered very inadequate science learning media (Herlianti, 2015; Kamaludin, 2015; Zakia et al., 2016) because teachers lack competency to adapt and modify appropriate science learning media for students with HI. Some science learning media suitable for students with learning difficulties (LD) that help them deal with difficulties in understanding science concepts are altered textbooks ("hypermedia") (Vavougios et al., 2016, p. 270), animation (Sari & Samawi, 2014) or video (Rovik, 2017). Such media, however, are not yet provided in most SPIE in DI Yogyakarta. It can, therefore, reasonably be argued that science teachers require some adaptive teaching aids and resources to enable the provision of accessible information for all learners.

Indonesian teachers have difficulties in assessing the learning progress of SWD, as they have limited understanding and skills about how to modify learning assessments (Oktorima, 2015; Wibowo, 2015). Oktorima (2015) said teachers could not make appropriate accommodations in the areas of time (no additional time provided), settings (SWD had the same modes as peers without disabilities to do the test) and content (no modification in content). Oktorima (2015) added that teachers were more focused on assessing cognitive and affective domains. In addition, Wibowo (2015) said assessment for SWD should be inclusive, creatively modified, match with students' needs, and portray students' real outcomes in cognitive, affective and psychomotor domains, and also highlighted that additional time should be provided for those who were visually impaired as they need more time to read in Braille and then to understand it.

Progress in achieving EFA and implementing IE needs to be monitored and evaluated. Some scholars have developed tools to examine the practices of IE, such as the Index of Inclusion by the Centre for Studies on Inclusive Education (CSIE), Assessment of Inclusivity Multiculturalism (AIM), the Inclusive Classroom Profile (ICP™), and the Quality of Inclusive Experiences Measure (QuIEM). These tools help teachers shape their ideas about inclusive practices, especially when welcoming SWD into their classes. Another framework to create inclusive learning environments is the UDL, developed by the Centre for Applied Special Technology (CAST). As a framework, UDL has been applied to the design of inclusive learning as mandated in many legislatures (Rao et al., 2016) in North America and Europe. However, the framework is rarely used to develop inclusive teaching and learning practices in Indonesia.

Universal design for learning has been described as follows (Morin, n.d.):

> Universal Design for Learning (UDL) is a way of thinking about teaching and learning that helps give all students an equal opportunity to succeed. This approach offers flexibility in the ways students access material, engage with it and show what they know. Developing lesson plans this way helps all kids, but it may be especially helpful for kids with learning and thinking differences (para. 1).

The principles of UDL were used to drive the conceptual framework of this study to investigate the inclusivity of science teaching and learning practices in DI Yogyakarta Indonesia. In this study, key points for inclusivity were accessibility and flexibility, so students were able to access science materials and express their learning comprehension through flexible instructional materials, techniques, and strategies thus promoting each learner's engagement.

As a framework, UDL has been gaining in popularity as the translation of the social model in practice (Benton-Borghi, 2013) and underpinning its design and conception is something other than individual impairment. UDL adopted the principle of Universal Design (UD) developed by an architect named Ronald Mace (Coombs, 2010; Powell & Pfahl, 2018; Rao et al., 2014; Seel et al., 2017; Sukhai & Mohler, 2017b) to provide accessible instruction for all students. UDL is a framework to design inclusive curriculum that values diversity in order to eliminate barriers to education (Riviou & Kouroupetroglou, 2014; Seel et al., 2017) and it "serves as the vehicle to bring about inclusive education" (Capp, 2017, p. 791). Two features that are essential to UDL are accessible support tools attached to the materials and a flexible presentation of the general curriculum to meet the individual students' needs (Mason & Orkwis, 2005). Learning access (Rao & Meo, 2016; Salzberg et al., 2006), learning flexibility in obtaining learning outcomes, and engaging in learning activities and assessment (Rose et al., 2002) for all students can be gained through this framework. The UDL states that "all students are competent learners" and when they fail in learning, it is because the learning plan and the instruction do not give them the same opportunities to participate as their classmates (Evans, 2020, p. 51).

As all learning and behaviour occurs in the brain, UDL reflects and supports many of the findings of neurological researchers, cognitive-social theorists, educational psychologists and educational researchers (Gargiulo & Metcalf, 2015). An awareness of information and new developments in brain-based research is important for teachers. Experts in the neurosciences examine the structure of the brain and the central nervous system as well as examining related research implications (Meyer et al., 2014). Based on neuroscience research, CAST proposed three tenets for how the brain works, namely recognition, strategic and affective systems (CAST, 2014; Spencer, 2011). According to CAST (2018), incoming sensory information, such as sound or light is received in the recognition networks located at the back of the brain; is organised for response or action in the strategic networks in the frontal lobes; and is processed and transmitted for meaning in the affective networks in the centre of the brain. These three systems are interconnected in the learning process (Meyer et al., 2014). The research also confirms that each learner has a unique way of using these systems, just like having a unique set of fingerprints and DNA (Gargiulo & Metcalf, 2015).

UDL contains three main principles (Rao et al., 2016; Rose & Gravel, 2010): "Multiple Means of Engagement" (MME) is the "why of learning" aligning the affective networks; "Multiple Means of Action and Expression" (MMAE) is the "how of learning" aligning the strategic (skill) networks; and "Multiple Means of Representation" (MMR) is the "what of learning" aligning the recognition (cognitive) networks (CAST, 2011, p. 5). When a course is designed by those principles, students are enabled to make their choices and be more engaged in the learning process because multiple ways to access the content and express their understanding learning are provided (Seel et al., 2017). UDL can also be a reference for developing science curriculum and its practices for SWD (McGinnis, 2013), where some people assume SWD will have difficulty in learning science. Science teaching and learning practices for SWD in this study were examined through the UDL's principles.

1.2 Statement of the Problem

The IE implementation in Indonesia at present, in terms of how it accommodates education for all learners including SWD, does not match the rhetoric. There is a gap between its full meaning and science teachers' understanding of inclusion, affecting how they create inclusive science teaching and learning. Research on IE in Indonesia has focused on the implementation of this concept in schools, including the barriers and challenges, but there has been little work exploring the inclusivity of teaching and learning, particularly in science. It is important to understand how science teachers create inclusivity based on the ways they: establish goals for SWD, practise pedagogies and monitor SWD's academic progress. Other factors that contribute to and hinder inclusivity also need to be investigated. Focusing on science teachers' views and experiences can help develop more robust theories of IE in the Indonesian context, as well as potentially informing future policy objectives.

1.3 Context of the Study

1.3.1 Indonesian Education System for Students with Disabilities

Indonesia has established a dual education system for children with special needs and disabilities, namely Special Education and General Education (designated as SPIE). However, Indonesian teachers have argued that the government has less awareness about IE implementation and its sustainability (Tarnoto, 2016). It does not deliver modified curriculum or adequate training for teachers and neither does it provide specialist teachers to cooperate with and support classroom teachers in providing inclusive settings.

Although IE continues to be introduced and developed as an ideal educational process, the government is correspondingly increasing the number of special schools as places to cater for SWD. Data from the MOEC in 2016 noted the total number of all middle high schools in Indonesia was 40,141 with only 3,817 designated as SPIE (2,465 public schools and 1,352 private schools serving SWD, and 15,590 students attending public schools and 9,395 attending private schools). The number of special schools also experienced a significant expansion from 2016 to 2018, escalating 396% from 565 to 2236 schools (MOEC, 2018). DI Yogyakarta is one of the provinces concerned about IE, declaring a regulation on The Implementation of IE through the Decree of Governor of DI Yogyakarta No. 21/2013. By 2019, the Department of Education of DI Yogyakarta had appointed 50 out of 443 middle schools within five districts as SPIE (MOEC, 2020), including Schools A, B and C which are the cases investigated in this study.

1.3.2 Indonesian Science Curriculum

The newest curriculum for basic and secondary education in Indonesia is Curriculum 2013, known as K13; that has been adopted gradually, replacing Curriculum 2006. The differences between K13 and 2006 are displayed in Appendix 1. All schools should have adopted K13 by the academic year of 2019/2020 (Article 4 of MD No. 160/2014).

The K13 science document mentioned that learning science in the middle years of schooling should be carried out in an integrated fashion and be developed as an integrated science subject rather than as a sole discipline. Integrated science incorporates aspects of physics, biology, chemistry, astronomy, and environmental studies (Susilowati, 2014). Science is also an applicative-oriented subject in order to develop thinking skills, learning abilities, curiosity, caring and responsibility towards the natural and social environment (MOEC, 2013). Through science learning, all students are expected to learn the big ideas of science and more importantly, learn the science process skills. By doing hands on activities as well as minds on activity-based science processes, students can understand, experience and find answers to problems they encounter in their daily lives.

The Common Core Standard underpins the Indonesian schooling system, namely Core Competency/KI (for K13) and Standard Competency/SK (for Curriculum 2006). It contains Basic Competency/KD, which is the minimum knowledge, skills and attitudes that must be achieved by students to show they have mastered the set KI (MOEC, 2016c). KI and KD do not specify how the goals might be achieved, however, they serve as an important guide for teachers to think about what learning goals should be established and how these goals could be made flexible enough for all learners to meet and achieve them. Learning goals are divided into learning objectives (statements of program or course goals) and learning outcomes (for more specific goals that should be followed and attained by students) (Hartel & Foegeding, 2004; Wittmann-Price & Fasolka, 2010). The goals contain three domains: cognitive (knowledge), psychomotor (skill) and affective (attitude). In the brain networks by CAST (Rose et al., 2002), these domains are stated as a recognition goal, a strategic goal, and an affective goal respectively.

Learning objectives are determined by reframing the standards and listing these as objectives in the lesson plan (or *Rencana Pelaksanaan Pembelajaran*/RPP). In reframing the standards, the brain networks give guidance to the consideration of the correct wording, highlighting the real purpose of the standards. Knowing the real purpose of standards helps teachers to identify what critical aspects should be held constant for all learners, determine flexible options and provide scaffolds that do not remove challenges (Rose et al., 2002). Two strategies used to establish learning objectives are ABCD and SMART.

In the ABCD strategy, A is the "Audience" (the student), B is the "Behaviour" or the action verb, C is the "Condition" to obtain the objective and D is the "Degree" of achievement or criteria (Howell, 2014, p. 410). The ABCD strategy offers an effective way to break standards down into smaller units called behavioural objectives which are measurable and observable, in order to obtain more comprehensive and complicated long-term goals (Anderman & Anderman, 2009). When science teachers establish measurable and observable behavioural objectives, it will help students understand when they need to adjust and/or modify their ways to achieve their goals and outcomes (Anderman & Anderman, 2009).

In the SMART goal strategy, an original idea of Doran (1981) in the field of business stated that an objective should be:

> Specific (target a specific area for improvement), Measurable (quantify or at least suggest an indicator of progress), Assignable (specify who will do it), Realistic (state what results can realistically be achieved, given available resources), Time-related (specify when the result(s) can be achieved) (p. 36).

Since it is a clear and simple framework for establishing goals and objectives, the SMART strategy has become popular in many areas, including education. SMART stands for Specific, Measurable, Achievable, Relevant and Timely (Hughes, 2017; MacLeod, 2012; Tofade et al., 2012). In relation to education: Specific refers to what exactly the students will be able to do, Measurable refers to what can be observed by the end of the lesson, Achievable means who will do what within the planned time frame and setting, Relevant refers to meeting the needs of the students, and Timely/time-frame/time-bound refers to a certain period within which the result is achievable by the end of the lesson. Chatterjee and Corral (2017) stated that the SMART strategy helps teachers to determine what their intention towards teaching should be as well as assisting with the identification of assessment needs and the provision of feedback to students. The SMART strategy assists students' engagement and offers clear ways to achieve the intended purposes in the teaching and learning process (Hughes, 2017). It is also claimed (Chatterjee & Corral, 2017) that the SMART strategy assists with organising the scope of the learning, the methods of teaching and the processes of assessment.

Guidelines within which science teachers are to implement K13, however, have not been provided, especially those which mention or consider the needs of SWD. Consequently, the science achievement of Indonesian students have not been met (Fenanlampir et al.,

2019) and data in science achievement for SWD are not available. The Programme for International Student Assessment (PISA) indicates scoring of Indonesian students in 2018 being lower than the average of the OECD countries (scored at 396 for Indonesia compared with 489 for the average) (OECD, 2019) and ranked among the ten lowest of 65 countries. In addition, the results of the Trends in International Mathematics and Science Study (TIMSS) for Indonesia in 2015 was scored at 397 compared with a score of 500 for the TIMSS 's scale centerpoint (Martin et al., 2015). The TIMSS result shows that Indonesian students are ranked very low in ability to: understand complex information; understand theory, analyse and problem solve; use tools, procedures and problem solving; and conduct investigations (MOEC, 2013).

1.4 Aim and Research Questions

Research on examining and investigating the inclusivity of science teaching and learning practices in the Province of DI Yogyakarta within Indonesia is very limited. Hence, the primary purpose of this study was to use qualitative collective case study research in three SPIE in DI Yogyakarta to describe the nature of the phenomenon of inclusivity with respect to science teachers practising the idea of inclusion in their science teaching and learning. Studying science teachers in their natural environment while seeking to understand their perspectives and practices on IE using the UDL as a framework for investigation was the main purpose of this study.

Consequently, this study aimed to investigate and analyse science teachers' experiences in:

1. establishing expectations, goals, objectives and the passing grade for SWD;
2. selecting and adapting the pedagogy (learning strategies) when teaching SWD;
3. selecting varied and accessible learning media; and
4. using multiple forms of assessment to monitor and assess SWD's academic performances.

Furthermore, this research sought to identify:

1. the key factors that contribute to and hinder inclusive science teaching and learning practices and
2. the supports, challenges and barriers experienced by science teachers when planning instruction and practising it within inclusive principles.

The main research question in this study is: "**How inclusive are science teaching and learning practices in Schools Providing Inclusive Education (SPIE) in Daerah Istimewa (DI) Yogyakarta Indonesia?**". The following sub-research questions were used to guide this study:

1. How do science teachers set goals for SWD?
   a. How do science teachers hold expectations towards SWD?
   b. How do science teachers reframe standards into learning objectives?
   c. How do science teachers modify individual learning objectives for SWD?
   d. How do science teachers establish minimum criteria for the passing grade for SWD?
2. How do science teachers practise pedagogy (approach to teaching) for SWD?
   a. How do science teachers practise pedagogy for SWD to support recognition (cognitive) learning?
   b. How do science teachers practise pedagogy for SWD to support strategic (skill) learning?
   c. How do science teachers practise pedagogy for SWD to support affective learning?
3. How do science teachers monitor and assess SWD's learning progress?
   a. How do science teachers monitor and assess SWD learning progress in recognition (cognitive) learning?
   b. How do science teachers monitor and assess SWD learning progress in strategic (skill) learning?
   c. How do science teachers monitor and assess SWD learning progress in affective learning?
4. How do other factors contribute to and hinder science teachers in creating classrooms that are inclusive for all?

1.5 Rationale and Significance of the Study

Successful IE needs support and collaboration from members of the whole school community, notably the principal, teachers, students, parents, staff and local government (Bunch, 2008). Resources that are used as frameworks to guide the process of developing IE are: 'Inclusion in education: A step towards social justice' (Booth & Ainscow, 2002) published by the CSIE; AIM designed by the National Association of Independent Schools (NAIS) (Franklin & Barnes, 2014); ICP™ (Soukakou et al., 2018); QuIEM (Dugan et al., 2005); and the UDL, a pedagogical framework grounded in logically based research (Basham et al., 2016). These varied resources indicated that conducting research which measured the inclusivity of the education system and/or practices in schools and classrooms was essential. It would force schools to speculate on their own characterisation of inclusion based on policy, curriculum, pedagogy, teaching quality, assessment, access, and support; and thus to use this to evaluate their own so-called inclusive practices (Forlin et al., 2013). Information about the use of the UDL approach in the Indonesian context for developing science curricula, implementing it, and even for measuring its inclusivity is remarkably limited. Therefore, by applying UDL as a framework for investigating science teaching and learning in this study, a deeper understanding of how well the science teaching and learning practices operating within Indonesian classrooms are inclusive would be gained, expanding the theory of IE for the Indonesian context.

Little research exists that reports on the inclusivity of teaching and learning practices in science in Indonesia. To better understand how inclusivity is created within SPIE, this study was approached using a qualitative collective case study methodology. This methodology assists the researcher to describe and understand what is being studied (Merriam & Tisdell, 2016) and the complex issues (Crowe et al., 2011; Yin, 2014) in inclusive science education for SWD. Therefore, this study has significant value in establishing the current state of qualitative research on inclusive science teaching and learning.

A significant gap still exists in the literature relating to inclusive practices in science teaching and learning in Indonesia, particularly in DI Yogyakarta, although much research has been conducted to investigate the inclusion of SWD in regular schools. Examining the inclusivity of science teaching in the SPIE in DI Yogyakarta has the potential to impact on school's stakeholders (principals, teachers, staff) and society regarding their understanding and view of IE leading to positive ways to welcome, accept and treat SWD. It can also uncover the current situations of teachers in setting learning goals, modifying curricula, practising pedagogies and accommodating assessments for SWD.

Research in the field of inclusion—in Australia reported by Konza (2008), in Bhutan by Chhetri (2015), in Jordan by Al-Zyoudi (2006), and in the Netherlands by Leeuwen et al. (n.d.)—has identified that teachers experience challenges when instructing SWD, as professional specialist support is essential to running the inclusive programs successfully. This issue also exists in the Indonesian context. By investigating the inclusivity of science teaching and learning, barriers and challenges faced by teachers related to the competency and skills they need to prepare and practise inclusive teaching can be identified; which will produce valuable input for educational decision makers.

In addition, this research contributes to the scholarly literature in uncovering critical areas in the educational process not addressed by many researchers in Indonesia. Finally, the results of the study can be used by teachers and educational practitioners in:

1. promoting EFA and creating an inclusive culture and inclusive society among practitioners (in line with the DI Yogyakarta vision and mission);
2. eliminating barriers in the design of the learning environment;
3. creating science curricula that are accessible to all;
4. providing guidelines to enable teachers to produce adaptive curricula to guide science learning and facilitate inclusive pedagogy and practices in the inclusive setting;
5. offering practical guidance to science teachers in using assistive technologies, specific learning strategies, as well as a variety of assessment forms to better guarantee that all learners have their access and entitlement to learning and education met.

Moreover, research evidence collected on the teaching and learning practices within inclusive classrooms in Indonesia will raise government awareness about the situation, leading to better support for schools and teachers to promote and implement inclusive practices, and minimise exclusion. It will also identify strengths and weaknesses concerning what needs to change to lead to better access to and participation in science learning for SWD.

1.6 Definition of Terms

Some terms used in this thesis and their definitions are:

Education for All (EFA): an international initiative to bring the benefits of education to every citizen in every society that guides government and educational services in designing and implementing policies and strategies to improve basic education services (UNESCO, 1990).

Inclusion: a process of welcoming and serving students with all their needs to increase their participation in learning and the social community (Ainscow, 2007; Ainscow & Kaplan, 2005; Heijnen-Maathuis, 2016; Kappen, 2010). The inclusion of SWD is emphasised, leading to its perception as an alternative to the concept of special education (Haug, 2016).

Inclusive Education (IE): a system of teaching and learning that ensures that all students can access the education material, participate and learn alongside their peers in a friendly and supportive learning environment (Loreman, 2010).

Inclusivity: celebrating diversity among students and promoting a positive welcoming culture in schools and ensuring participation for all students so that they are valued and feel that they are being included (Gargiulo & Metcalf, 2015). For purposes of this study, inclusivity is defined through the Universal Design for Learning (UDL) framework and its four pillars of curriculum i.e. setting expectations, goals, learning objectives and the passing grade; instructional methods; learning media; and assessment.

School Providing Inclusive Education (SPIE): a regular school that welcomes, supports and provides services for students with special needs and disabilities (The Indonesian Ministry of National Education (MONE) of Regulation No. 70/2009 concerning Inclusive Education for Children with Special Needs and for the Talented and Gifted).

Students with special needs and/or disabilities (SWD): children who require additional support for their physical, emotional and/or social advancement (Kauffman et al., 2018; Westwood, 2018). In this study, SWD include students with hearing impairment, visual impairment and learning difficulties.

Student with a Hearing Impairment (HI): a student who has a hearing loss ranging from mild loss to profound deafness, which produces issues in learning, language development and socialisation (Westwood, 2009).

Student with a Visual Impairment (VI): a student who has a vision loss ranging from small to total blindness that cannot be corrected with spectacles (Westwood, 2009).

Student with Learning Difficulties (LD): a student who has learning problems and difficulties that might be caused by "socio-cultural disadvantage, limited opportunities to learn, a lack of support from home, an inappropriate curriculum, or insufficient teaching in the early years" (Westwood, 2008b, p. 2).

Universal Design for Learning (UDL): an approach that considers the needs of all learners from the beginning in providing adaptable teaching that empowers and engages students in learning (Rose et al., 2002). It contains two main aspects, accessibility (a setting that can maximise participation by people with disabilities) and flexibility (King-Sears, 2009). UDL consists of three principles: multiple means of representation (providing various accessible learning media), multiple means of action and expression (offering various ways that students can demonstrate what they have learned), and multiple means of engagement (providing various opportunities for students to be involved in learning) (CAST, 2011, 2014, 2015). The terms recognition, strategic and affective in the UDL relate to cognitive, psychomotor and affective learning respectively.

Qualitative collective case study: a research strategy and approach aiming to seek information concerning phenomenon being studied; to understand, interpret and clarify the boundary between the case and the contexts from multiple sites (Mills et al., 2010).

1.7 Structure of the Thesis

This thesis is structured into nine core chapters.

Chapter 1 comprises the background to the study, the Indonesian education system context for SWD and science teaching and learning, statement of the problem, aim and research questions, rationale and significance of the study, together with a definition of terms, an overview of the structure of the thesis and summary.

Chapter 2 presents the study's theoretical framework using various literature sources with which to elaborate upon IE policies and practices, SWD in science teaching and learning, inclusivity of science teaching and learning and the UDL. It also describes the application of the UDL framework to science teaching and learning inclusivity, including the four pillars of curriculum. The chapter focuses on identifying the gaps in knowledge to justify the research area and ends with developing the conceptual framework guiding this research.

Chapter 3 reviews the research methodology, including the research paradigm, methods used to conduct the study and ethical considerations.

Chapters 4, 5 and 6 provide the analyses of Schools A, B and C respectively as individual cases.

These are followed by Chapter 7 which presents a cross-case analysis of the three cases of Schools A, B and C to examine the similarities and differences within the findings. Four themes emerge from these analyses. These are Theme 1: goal-setting for students with disabilities; Theme 2: pedagogical practices for students with disabilities; Theme 3: assessing and monitoring the progress of students with disabilities; Theme 4: factors that contribute to and hinder the way science teachers create a science classroom inclusive for all.

Chapter 8 discusses the key findings distilled from the cross-case analysis and interprets it.

Finally, Chapter 9 contains the conclusions, limitations, implications and recommendations.

1.8 Summary

The Introduction Chapter has covered the opening statement of the thesis, introduced the key issues related to the study and offered explanation of the importance and relevance of this study. The main components of this chapter are the background to this study and the main problem being addressed, together with the context and significance of the findings obtained. This chapter has also offered a short description on how this thesis will fill a gap in the current literature and knowledge.

Chapter 2
Literature Review

The aim of this study was to examine the extent to which science teaching and learning practices were inclusive of students with disabilities (SWD) in Schools Providing Inclusive Education (SPIE) in the Province of Daerah Istimewa (DI) Yogyakarta. This Chapter presents a critical review of the current literature from journal articles, research studies, white papers, national reviews and the outcomes of legislation; to find the gaps in knowledge that would enable the researcher to refine the research question and justify the choice of the research domain and framework to guide the research. This literature review aimed to discover and interpret knowledge relevant to what was known about inclusive educational practices with SWD learning in science classrooms from international and Indonesian research studies. It also examined how the Universal Design for Learning (UDL) guiding instructor could be used to develop accessible flexible curricula to accommodate diverse learners and be applied as a framework to investigate how inclusive teaching and learning practices are in science classrooms. Closing this chapter is an explanation of how the examined literature drew together the conceptual framework for this study.

2.1 Inclusive Education Policies and Its Practices

This section gives a picture of the inclusive education (IE) agenda and initiatives that have been made at the international level and how Indonesia, and particularly DI Yogyakarta, has adapted the initiatives into policies and practices. This picture is important to obtain deeper understanding of IE issues that are relevant to this study. The origin of the IE definition is also presented to better understand how this definition has been translated around the globe, and then in the Indonesian context based on the results of this study.

2.1.1 International Agenda and Initiatives on Inclusive Education

Moving towards IE in general education systems for marginalised learners, including SWD is not only a legal obligation but a philosophical movement (UNESCO, 2005) and an opportunity to improve the quality of education itself. Internationally, many agenda and initiatives have resulted in the development of policies and legislation leading to Education for All (EFA) and IE (Hayes & Bulat, 2017; United Nation, 2018) as described in Figure 2.1.

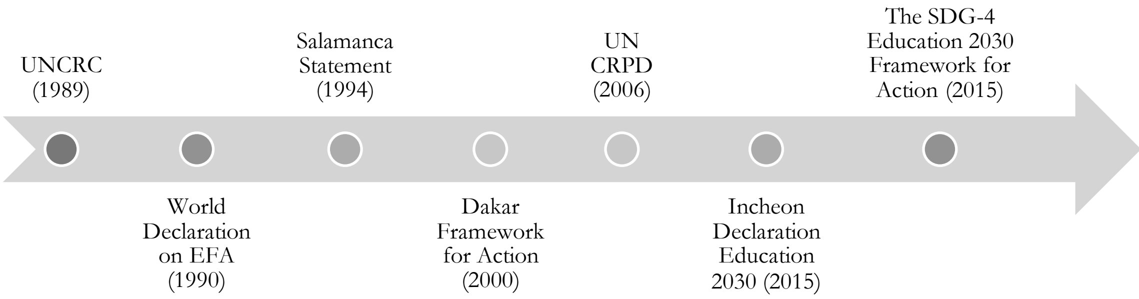


Figure 2.1 International agenda and initiatives as foundations to generate IE policies

Adopted in 1989, a rights-based initiative named the United Nations Convention on the Rights of the Child (UNCRC) was produced as a ratification of a human rights treaty (Lindkvist, 2018) and it was thought it "might appear to be a culmination of a century-long concern with children, their protection and their rights" (Holzscheiter, 2010, p. 141). A year after the UNCRC was enacted, a 'World Conference on Education for All (EFA): Meeting Basic Learning Needs' was held in Jomtien Thailand, where delegates committed to provide basic education and access for all children (UNESCO, 1990). Hayes and Bulat (2017) argued that this conference was the first stepping stone in supporting and spreading the idea of IE to the world.

Another initiative came from the global community in 1994, namely the Salamanca Statement and Framework for Action on Special Needs Education. The Salamanca Statement did not focus on IE (Ainscow et al., 2019), rather it called on the global society to endorse the idea of inclusive schooling and support the advancement of education for special needs students as part of all education programmes. The Salamanca Statement has been claimed as the most important written document for children's rights in education and is used to guide countries in formulating legal acknowledgement of IE (Pappas et al., 2018). In April 2000, the World Education Forum in Dakar reaffirmed the vision of the Jomtien Declaration of EFA and adopted the 21 commitments of the Dakar Framework for Action (UNESCO, 2000). The implementation of IE for all children including children with disabilities arose from this forum (OECD/Asian Development Bank, 2015). The first goal of the Dakar Framework was the expansion and improvement of education (especially for early childhood and vulnerable children) and Indonesian educational strategies are in line with this goal (Hawadi, 2015).

The world's efforts to better humanise persons with disabilities were stated in the United Nations Convention on the Right of Persons with Disabilities (UN CRPD), which included the most comprehensive international disability humanitarian pact (UN General Assembly, 2006). Article 24 emphasised the obligation of a country to guarantee the right of education for people with disabilities and the fulfilment of inclusive learning facilities without any discrimination (Arduin, 2015; De Beco, 2014; Ferri, 2017; Nock, 2011; Powell et al., 2015). In 2016, the Committee on the CRPD released General Comment No. 4, offering governments guidance in providing IE for people with disabilities. The Indonesia Disability Convention Team (IDCT, 2017) reported that Indonesia spent four years in the UN CRPD ratification process which was subsequently passed into law as National Law No. 19/2011.

In 2015, The Incheon Declaration for Education 2030 was adopted at the World Education Forum, which committed to achieving the 2030 Agenda for Sustainable Development and the SDG-4 for education (UNESCO, 2016). Another forum in Paris finalised the guidance for countries to implement the SDG-4, called the SDG-4 Education 2030 Framework for Action (UNESCO, 2016).

2.1.2 Defining Inclusive Education

As education development comprises "complex social processes" (Ainscow & Miles, 2008, p. 31), different researchers have described inclusion in education in different ways (D'Alessio & Watkins, 2009; Lauchlan & Greig, 2015; Wah, 2010). Some scholars (Ainscow & Miles, 2008; Nilholm & Alm, 2010; Pappas et al., 2018) have portrayed IE as a way to simply educate SWD or students with special education needs in general schools, however others (Odom et al., 2011; Simpson et al., 2013) have viewed IE more broadly as a matter of instructional practices and social integration. IE means "more than physical integration" (Peters, 2007, p. 99), "more than just teaching practices and procedures" (Scribner & Cartier, 2019, p. 44), welcoming SWD into the school's society and ensuring they can gain access to and participate in learning alongside their peers in a regular classroom (Loreman, 2010). When instructions in the classroom do not fully engage and offer opportunities for SWD to access the instruction, SWD still find themselves marginalised (Scribner & Cartier, 2019). Consequently, principals, teachers, parents, community members and other policymakers must be involved in the process of inclusion (Obiakor et al., 2012).

Inclusion does have many positive outcomes despite continuing debates about its applicability and practicality. Inclusion is not only a special education reform (Haug, 2016) but is a process of: removing barriers for all students to achieve, increasing student participation in the greater school community, reducing exclusion from local cultures, curricula and communities (Ainscow, 2007; Ainscow & Kaplan, 2005; Heijnen-Maathuis, 2016; Kappen, 2010) and potentially contributing meaningfully to learning for every child irrespective of their diversity, especially for SWD (Santoso, 2012). IE is a "dynamic process to strengthen the capacity of the education system to reach all students and thus be understood as a key strategy" (UNESCO, 2009b, p. 8) and a solution for eliminating the exclusion of vulnerable and disadvantaged groups (including those with disabilities) (Ainscow & César, 2006) in achieving the EFA agenda. Inclusion is for all children, not only for those with a disability label (Scribner & Cartier, 2019).

2.1.3 Inclusive Education Practices in Western and Southeast Asian Countries

The meaning of inclusion is determined based on the context, philosophy and operational approach of each country (Makoelle, 2014), which has produced a lack of agreement that has impacted on its implementation (Heijnen-Maathuis, 2016). This lack has been caused by multifarious interfaces among issues such as the "education background, social class, economic status, religious and cultural beliefs" (Kamenopoulou, 2018, p. 131); "the developmental phase of the country" (Srivastava et al., 2015, p. 180); and the language used by the donor agency provider (Carrington et al., 2019). Walton (2018) mentioned that IE in developed countries was established from a strong foundation of a special education approach that had been applied in a well-maintained basic education system, whereas in developing countries, Srivastava et al. (2015) highlighted that other factors and actors (e.g. regulation, funding, support system, teacher, and parents) might play a vital role in translating and implementing IE.

The implementation of IE should be specific and based on the social-political, economic and geographic context of each country (Strogilos & Avramidis, 2017); and needs to "be understood in the context of an approach to the 'problems' of social diversity in societies that are highly diversified internally and yet globally interconnected" (Armstrong et al., 2011, p. 30). The implementation of IE in Western countries (e.g. represented by the US, the UK and Australia) and Southeast Asian countries is described as follows.

Although the term inclusion was not stated in US legislation (Hossain, 2012), this country has widely offered appropriate public education at no cost to all students regardless of disability (Hossain, 2012; Koh & Shin, 2017). In this country, all students have the right to be accepted and be supported appropriately through inclusion and special education practices (Hossain, 2012). As a pluralistic country, policies on IE and its implementation vary across the states (Westling, 2019), and overall it has taken decades for the movement to introduce appropriate education for SWD (Hossain, 2012).

Koh and Shin (2017) argued that "the dual educational systems of general education and special education" (p. 1) in the US were more effective than IE in the way they generated academic and social success for students, with general and special education teachers collaborating to ensure appropriate education support for SWD (Hossain, 2012; Mackey, 2014) and for other students (Koh & Shin, 2017). Mackey's (2014) study, however indicated that general teachers did not have adequate pre-service training for working with and supporting SWD, although teachers held positive attitudes towards SWD.

In the UK, "special educational needs and disability policy and practice are caught up in more powerful political and economic dynamics" (Norwich, 2014, p. 422). The 2011 Green Paper for special educational needs children and The Special Educational Needs and Disability Regulation 2014 emphasised that the policy direction was on increasing the achievement of students with special education needs eliminating a culture of low expectations towards these students (Glazzard, 2014). Glazzard (2013) and Robertson et al. (2018) however stated that such regulations were not increasing access to mainstream education. Moreover, Lauchlan and Greig (2015) mentioned that mainstream education had not been fully evidenced as a place to generate an inclusive environment, effectively providing high quality academic and social learning experiences for all students. Lauchlan and Greig (2015) added that the partial segregation model, which claimed to support the individual needs of a student, was applied to support SWD in the general education system and resulted in these students feeling "excluded" (p. 80). Further, Lindsay (2018) mentioned that mainstream schools in the UK provided a specialist provision (called a "unit" in the past) which resulted in blurriness between mainstream and special schools (p. 370).

A recent quantitative study by Black (2019) found the UK was progressing towards inclusion as indicated by a gradual reduction in the number of special schools, a falling number of SWD and an increasing number of students attending schools. Although teachers in the UK fully accepted the theory of inclusion, they interpreted it in a narrow way so it became little more than an exercise where social presence covered educational absence (Alexiadou & Essex, 2015; Hodkinson, 2013). Kyriacou et al. (2013) suggested teachers needed to pay attention to the conditions required for the successful inclusion of SWD into the academic and social pattern of the school. Teachers working in mainstream schools face significant challenges when they are responsible for raising academic standards while at the same time responding to various needs of students (Glazzard, 2014).

As a country which has ratified the UN CRPD, "Australia is committed and legally obliged to respect, protect and fulfil the rights articulated within this treaty, including the right to inclusive education" (Cologon, 2019, p. 20). Anderson and Boyle (2015, p. 4) stated that "while no overarching definition under which inclusive education operates in [Australia]", this term has been defined as the way to include SWD in the public education system and provide a high-quality EFA. The notion of IE is stated in national curriculum documents (Petriwskyj, 2014). Australian schools adopted the IE system within the 2010–2020 National Disability Strategy (Hardy & Woodcock, 2014) and practise inclusion through Differentiated Instruction and UDL (van Kraayenoord, 2007).

Although IE has featured in the policy for over 25 years, Australia faces challenges (Anderson & Boyle, 2019) and barriers (Anderson & Boyle, 2015) to achieving EFA. These challenges and barriers involve the lack of a clear definition of IE and its understanding, a national commitment to IE, support for SWD and the facilitation of IE, monitoring and evaluation processes of IE, training and carrier development in IE for teachers, and positive attitudes of teachers. A study by Anderson and Boyle (2019) indicated that although these barriers have been reducing, Australia needs to "recommit to the principles of the Salamanca Statement" (p. 806) and work towards achieving EFA. Australia also has ensured that segregated settings in any element of education are not presented, and has transformed the parallel dual model of special and mainstream into inclusive settings (Cologon, 2019).

Southeast Asian countries—i.e. Malaysia as mentioned by Jelas and Mohd Ali (2014) and Indonesia as mentioned by Kurniawati et al. (2012)—have committed to IE, although it is still problematic, ineffective and far from reaching EFA. Some Southeast Asian countries have struggled to implement this idea within their context of cultural and ethnic backgrounds, education systems and finances (Nishio et al., 2017). A review by Nishio et al. (2017) of IE studies in Southeast Asian countries from 1995-2015 showed that: IE was not a topic of focus for researchers in education in some countries; positive attitudes towards IE were growing, although this growth was inconsistent; and IE was evaluated within the context of the effectiveness of teaching SWD, which was showing a positive trend. It was argued that the slow movement of IE in Southeast Asia was mainly due to teachers' negative attitudes (Sibagariang, 2017), inadequate teacher training and limited teacher education on inclusion (Sharma et al., 2013). Nevertheless, the number of schools providing inclusive education had gradually increased (Sibagariang, 2017).

Malaysia and Thailand are two Southeast Asian countries that appear to have similar educational pictures to those of Indonesia. Malaysia introduced the concept of IE in the Malaysian Education Act 1996 (Bailey et al., 2015; Jelas & Mohd Ali, 2014). To cater for SWD, Malaysia has three types of special education program, i.e. "special schools, the Special Education Integrated Program (SEIP), and the inclusive program" (Khairuddin et al., 2016, p. 909). In the journey towards IE, the Ministry of Education's Malaysia Education Blueprint 2013-2025 stated it would increase the number of children with special needs in IE (National Academies of Sciences, Engineering, and Medicine, 2015). However, to be educated in the mainstream setting, SWD should meet the eligibility criteria of "educability" (Jelas & Mohd Ali, 2014, p. 995). This indicates the interpretation of the IE concept was narrow and rigid, although Bailey et al. (2015) asserted that Malaysian teachers demonstrated positive views towards IE. A survey of 300 Malaysian primary teachers by Bailey et al. (2015) concluded that the training of teachers in supporting SWD was not adequate and that the belief that special schools were a better place for SWD was strongly held in teachers' understanding. In the Malaysian context, Khairuddin et al. (2016) contended that the limited collaborative work occurring between general and special education teachers led to barriers in IE, while the content and approach to inclusive teacher training and IE policies had not taken place.

Thailand initiated IE in 2008 by passing the Education Provision for People with Disabilities Act in order to transition their special education practices to inclusive education ones (Vorapanya & Dunlap, 2014). SWD in Thailand have been welcomed into mainstream classes in three ways: inclusive schools, special schools and special centres (e.g. hospital and at home) (Vorapanya & Dunlap, 2014). Similar to Malaysia, a study by Sukbunpant et al. (2013, p. 1114) demonstrated that Thai (preschool) teachers perceived that they had insufficient training to teach and manage classrooms with students containing diverse needs and believed special education teachers were a better option for SWD. Vorapanya and Dunlap (2014) listed some issues regarding the implementation of IE in Thailand: a cultural belief that viewed disability as being shameful, a limited understanding of the practices of IE, and a lack of teacher training and appropriate curriculum for teaching SWD. In addition, Bualar (2016) noted other issues such as "institutional barriers" between government regulations and political situations being implemented at the school level (p. 160), the high cost of pre-service teacher programs involving universal design, the idea that inclusive schools were not better at supporting SWD, and the low numbers of trained teachers to educate SWD. Grimes (2013) argued that to develop more inclusive practices in the Thailand context, teachers needed not only professional training but also to work collaboratively with other staff, receiving support from the school principal to develop new ideas in teaching that connected with cultural beliefs and tradition, and having space to create their own practice in a way that genuinely involved inclusion.

2.1.4 Moving Towards Inclusive Education in Indonesia

Indonesia's move towards IE has been adopted in some areas since 2001 and this initiative was formally declared on 11th August 2004 in Bandung (Bakhri et al., 2017). Since 2001, the government has been pioneering inclusive schools in the Province of DI Yogyakarta (Rasmitadila et al., 2019) involving 12 schools in the Gunung Kidul District and 35 schools in the Province of *Daerah Khusus Ibukota* (DKI) Jakarta (Bakhri et al., 2017).

Although the Law No. 20/2003 that drives the National Education System has guaranteed education for all, in fact, there are still numbers of children who do not attend school (IDCT, 2017). This information has been confirmed by The UN Flagship Report on

Disability and Development (2018), reporting that Indonesia was one of ten countries that had a big gap between the number of SWD and the number of students without disabilities who attended school (53% of SWD compared to 98% of students without disabilities). MOEC (2016a) reported Indonesia had around 1.6 million children with special needs, but only 18% had access to IE. Nevertheless, the Indonesian government has commenced increasing the number of SWD being educated in school (regular and special) by: enacting several regulations at the national and regional levels (see Appendix 2) and building new special schools and developing existing inclusive schools across the region (Djone & Suryani, 2019); preparing teachers to teach in the Special Education field (Yusuf et al., 2017); improving the capability of teachers, principals, and supervisors through pre and in-service training, and preparing a guidance manual for IE (UNESCO, 2009a). This guidance was called *Pedoman Umum Penyelenggaraan Pendidikan Inklusif* by the Directorate of Special School of MONE and published in 2011 and *Panduan Penyelenggaraan Pendidikan Inklusif di Madrasah* by MORA published in 2017.

The Indonesian regulations for IE have not been fully addressed in the concept of IE (Handayani & Rahadian, 2013) and in several departments and agencies, the special education term has been directly replaced with the term IE without any actual change in policy and practice. Consequently, these adopted policies have brought different perspectives, assumptions and beliefs about IE for teachers in Indonesia. Their understandings and interpretations of the definition of inclusion in education were diverse, and resulted in a broad ranging variety of practices in the IE concept among Indonesian teachers (Nurhayati, 2012).

The inclusion of SWD has been emphasised, leading to its perception as an alternative to special education. It shows that educational policies have been directly borrowed and transferred from Western culture (Mukhopadhyay, 2015) whereas micro and macro systems have not been taken into account by policymakers. Praptiningrum (2010); Triyanto and Permatasari (2016) argued that the Indonesian government needs to pay serious attention to the implementation of IE, so that the number of students with special needs who have not received an education can receive their entitlement to services based on their needs. As mentioned by Ainscow et al. (2012), national policies should be articulated in appropriate ways to enable and provide support at the local level.

IE in Indonesia has several purposes. It: offers children with disabilities the opportunity to interact with each other in accordance with the demands of daily life in society and to have their educational needs met (Prastiyono, 2013); is the most effective strategy to achieve success for children with special needs in the nine years of compulsory basic education (UNESCO, 2009a; Utina, 2014); and helps improve the quality of basic education by reducing the number of grade failures and school dropout rates and by creating an education system that values diversity, not discrimination (Ikrom et al., 2015).

The implementation of IE in some provinces in Indonesia has achieved some success, although it has also faced some barriers.

First, an investigation by Bakhri et al. (2017) and a report by USAID (2013) revealed that in the Indonesian context, social norms were often the biggest barrier to inclusion; while Fitriatun and Nopita (2017) claimed that the undesirable attitude of educators in accepting SWD still occurred. Many schools—and policymakers and teachers—had no adequate understanding of the concept of IE and how to implement it (Lubis, 2016; Murniarti & Anastasia, 2016; Sulistyadi, 2014; Sunardi & Sunaryo, 2011; UNESCO, 2009a; USAID, 2013). Teachers and educational providers in Indonesia still carried a misconception towards the genuine concept of IE. Sunanto (cited in Kamaludin (2015, p. 261)) stated: "People often interpret IE as simple as welcoming children with special needs into regular schools, regardless of how they can provide access and support for those students".

Second, a rigid curriculum that is not flexible enough to be modified could be a major barrier for diverse students and to inclusion (Meo, 2008). Science teachers in Indonesia have tended to adhere strictly to the mandated curriculum, prepared by stakeholders at a higher level (UNESCO, 2004) such as government, without making any modifications or adjustments to meet the needs of specific students (not only SWD). UNESCO (2009a) reported that teachers and staff in SPIE in Indonesia had difficulty in modifying curriculum and assessment for SWD.

The *third* barrier to the success of IE has been the large number of untrained or unenthusiastic teachers working with SWD (Bhatnagar & Das, 2014), leading to a major barrier towards IE (Cawley et al., 2002). Teachers in Indonesia have lacked training in how to implement IE (Sartica & Ismanto, 2016) with the result that its implementation has been deemed not to be running as it should, with organised learning based solely on typical children regardless of the abilities and needs of SWD attending the school. UNESCO (2009a) reported that the number of visiting special counsellors/teachers in SPIE in Indonesia was limited, resulting in a lack of response to meeting the needs of SWD. Some schools (though designated for SPIE) have tended to refuse SWD because they have not had a necessary support teacher (IDCT, 2017).

The *fourth* barrier has involved the physical environment that limits the accessibility of SWD. Many schools in Indonesia have not been equipped appropriately and do not meet the building standards required for the accessibility and accommodation of SWD because the local governments lack adequate budgeting for school infrastructure (Bakhri et al., 2017; Muazza et al., 2018; Sartica & Ismanto, 2016). SPIE are mostly located in urban areas, whereas more SWD live in rural areas (Miftakhuddin, 2018), meaning schools are too far away for children to be able to attend.

The *fifth* structural barrier to inclusion is the gap between policy and practice. Indonesia has enacted several policies on IE, however, not all provinces or regencies/cities in Indonesia have a law/special circular on the implementation of IE, and there is a lack of local government commitment to the implementation of IE (UNESCO, 2009a). The implementation of those regulations at the school level seems not to have been satisfied, meaning that teacher leaders for students' pathways have faced challenges and have struggled to fulfil the requirements of IE (Anzari et al., 2018; Nurhayati, 2012; Rifani, 2016; Setianingsih, 2017; Yasa & Julianto, 2017). Some barriers faced by schools in implementing IE are a lack of accurate data on the number of SWD; no quota for SWD in the enrolment system; and limited active roles of the School Committee, professional organisations and universities in supporting the implementation of IE (UNESCO, 2009a).

The transition process towards real IE in Indonesia is indicated by SWD placement in the school system, which Andriana and Evans (2017) noted was based on school readiness. Some schools ready to include SWD had SWD attending regular classes on a full-time basis and were classified as full-inclusion schools. Schools with SWD attending in special groups in regular classes, SWD in regular classes but sometimes withdrawn to a resource room, or SWD in special classes while occasionally participating in regular classes in specific subjects, were classified as cluster-instruction/integration. Schools who enrolled students full-time in special classes in regular schools were classified as individualised-instruction/segregation schools (*Direktorat Pembinaan Sekolah Luar Biasa*, 2007; Gunarhadi, 2017; Ikrom et al., 2015). Suwaryani (2008) in her study claimed that at least SWD were included in the system (even if in a special school), which reflected the way Indonesia was moving towards IE. Suwaryani (2008) added that, when considering the implementation of IE in Indonesia, it might be ineffective to enact the language of IE in the way Western countries had or the policies of IE as they had been implemented.

2.1.5 Inclusive Education Practices in the Province of Daerah Istimewa Yogyakarta

The regulation states that education for SWD in DI Yogyakarta is operated in inclusive and special education systems (Article 6, DI Yogyakarta Governor Regulation No. 4/2012 of Protection and Meeting Rights for People with Disabilities) and "every education unit must accept students with special needs" (Article 3, DI Yogyakarta Governor Regulation No. 21/2013 of the Implementation of IE). In 2014, the Governor of DI Yogyakarta declared that the province was committed to IE. A year later, in 2015, The Department of Education (Dikpora) of DI Yogyakarta released its IE Action Plan to fulfil the mandate of the MONE regulation No. 70/2009 and UN CRPD. The action plan stated that SWD could be accepted into regular schools with some exceptions. Students with mild disabilities were advised to attend SPIE or any regular school, whereas children with severe disabilities such as intellectual, emotional and behavioural disabilities were expected to enrol in special schools (Dikpora, 2015). These considerations indicated that the DI Yogyakarta government did not understand nor commit to the implementation of genuine inclusion.

The action plan also reflected that SPIE and special schools were expected to work together in educating SWD. Some special schools were appointed as a resource centre, a place for the SPIE to consult in dealing with SWD and some teachers from special schools were appointed by the Dikpora to help SPIE in running the education of SWD (Hanjarwati & Aminah, 2014; Nurhayati, 2012), e.g. as portrayed by School A in this study. These schools, however are unable to fully accommodate the needs of SWD and some schools that are labelled as SPIE even tend to reject the SWD (Hanjarwati & Aminah, 2014). This situation implies that IE in DI Yogyakarta is concerned with the placement of SWD as an act of integration rather than that of an inclusive system.

The Wartomo (2016) study indicated that schools in DI Yogyakarta faced some challenges to the implementation of the IE system. Most SPIE in DI Yogyakarta have a licence from The Dikpora to be assigned as SPIE and each school has an Inclusion Program Management group. To adopt the IE system, SPIE involve Special Schools and collaborate with other agencies, such as universities, practitioners/doctors, psychologists, and Non-Government Organisations (NGO). Each SWD is offered an Individual Education Plan (IEP) based on the initial assessment and parents are involved in the process of instructional planning and evaluation. Each SPIE has a quota of a minimum of one SWD in each classroom. Nevertheless, some SPIE in DI Yogyakarta have faced barriers to implementing the inclusive system, i.e. a limited number of support teachers with limited expertise in addressing student needs for those with visual and hearing impairment, no tools to diagnose SWD in the enrolment process, no regular monitoring and evaluation of the implementation of IE, and buildings that are not accessible.

The implementation of IE in Bantul is underpinned by District Regulation (*Perda*) Bantul No. 11/2015 of The Fulfilment of The Rights of People with Disabilities, which states that SWD are educated in an inclusive school system (Article 5). In Yogyakarta Municipality, it is under the Mayor Regulation No. 47/2008 on the SPIE (Hanjarwati & Aminah, 2014; Lubis, 2016). Since the enactment of this regulation, IE was implemented intensively in Yogyakarta Municipality, as evident by the number of SPIE in Yogyakarta Municipality increasing significantly by as much as 163 at the primary and 57 at the secondary levels (Dikpora, 2016), while no precise data are available from other districts.

To sum up, UNESCO and other international bodies commit to continuing the journey towards IE and encourage more countries to be aware of and work to create inclusive practices toward people with disabilities, remove barriers, focus on participation in education and against discrimination to people with disabilities, by including protections in their constitutions, laws or policies (United Nation, 2018). Although IE has gained significant currency internationally and in the academic literature, no country has yet succeeded in implementing the “ideal inclusion” (Haug, 2016, p. 206) and many countries are still struggling to make schools more inclusive (Donohue & Bornman, 2014), including Indonesia. Much research has been conducted in the area of IE, however the literature indicates a lack of attention to the area of teaching and learning, especially in science and in the Indonesian context. To fill this gap, the present study has investigated how science teachers create science classrooms that are inclusive for all, including for SWD. This is important because including the SWD in classrooms will affect the benefit of science to the quality of life and help achieve the EFA agenda.

2.2 Students with Disabilities in Science Teaching and Learning

As limited research has been conducted in science teaching and learning for SWD, particularly in Indonesia, this section elaborates some theories and prior research relevant to the aim of this study. In teaching and learning practices, Kauffman et al. (2018) highlighted that individuals with disabilities may have difficulties and issues in various areas. These are: cognition, focus and attention, emotion and behavioural recognition and its control, communication, seeing, hearing, physical movement and its well-being, where some of these conditions are visible and some are not.

2.2.1 The Terminology of People with Disabilities – Indonesian Context

Referring to Article 4 Paragraph 1, Law No. 8/2016 (Kementerian Hukum dan Hak Asasi Manusia Republik Indonesia, 2016) concerning People with Disabilities, they are classified into four groups, i.e. physical, intellectual, mental and sensory disabilities. To name exceptional students, three terminologies are used, i.e. *siswa penyandang disabilitas* (students with disabilities), *siswa difabel* (difable students) and *Anak Berkebutuhan Khusus*/ABK (children with special needs) (Maftuhin, 2016; Suharto et al., 2016). Studies by Suharto et al. (2016) and Maftuhin (2016) revealed that the term people with disabilities was used mostly in national and regional regulations, but when it came to social construction and/or agreement, the word *difable* (different able) people was preferable, whereas educational areas frequently used the term ABK.

2.2.2 Defining Students with Disabilities

Kauffman et al. (2018, pp. 40-41) stated that to define a student's disability, a "professional judgment" is needed, based on a proof that a student: "(a) needs to learn something other than the standard general education curriculum or (b) needs instruction in the general education curriculum other than that received by students without disabilities, or (c) both". SWD are classified into two groups (Kauffman et al., 2018; Westwood, 2018), i.e. high-incidence disabilities, such as intellectual disabilities or emotional and behavioural disorders; and low-incidence (sensory) disabilities, such as blindness, deafness, deaf-blindness. McGinnis and Stefanich (2007) and Kahn, Wild, et al. (2014), on the other hand, divided SWD into two categories, namely physical impairment and cognitive disabilities, including social-personal and intellectual.

SWD for this present study are identified as students with hearing impairment (HI), visual impairment (VI) and learning difficulties (LD).

2.2.2.1 Students with Hearing Impairment

"The term hearing impairment is a generic term used to describe all hearing loss" (Davies, 2018, p. 34), ranging from mild loss to profound deafness (Westwood, 2009). At the international level, the terms hard of hearing, deaf (with a lower case d) and Deaf (with a capital D) are commonly used in education and the community areas (Hyde, 2013). According to the Canadian Association of the Deaf (2015, 3 July), the first term is the most common for hearing loss ranging from mild to severe permanent. The person who is hard of hearing or partially hearing is someone who is able to successfully process information through hearing with hearing aids (Westwood, 2008a). The second term, a deaf person, is for a person who is "unable to detect speech from others and if their own spoken language is affected" (Westwood, 2009, p. 68). The third term is Deaf, usually used by the Deaf community (Easterbrooks, 1999; Fox, 2018; Hyde, 2013; Zamfirov & Saeva, 2013). This community has its own sign language and, according to Kemmery and Compton (2014), does not address the identity of students with hearing loss who communicate with oral-aural modes and who are educated in general schools.

Hearing loss and an inability to hear "restricts access to some or all of the acoustic features of speech" (Gravel & O'Gara, 2003, p. 243); "impairs a child's ability to process verbal input, and reduces the amount of information available from the environment" (Hyde, 2013, p. 256); and places a child at serious risk of delay in many important areas in learning (Westwood, 2008a). These areas include voice acquisition, literacy skill, speech skill, social development and relationship understanding. Hearing loss students typically demonstrate "inattentiveness, frequent requests for repetition, inappropriate responses to instructions or questions, confusion of similar-sounding words, and social withdrawal" (Dodd-murphy & Mamlin, 2002, p. 88). Many students with hearing loss also have limited vocabulary and this results in their limited understanding of what is being talked about in the classroom and slows down their ability to learn to read and spell (Westwood, 2008a).

The communication process for people with hearing loss is complex and it depends on the type and degree of hearing impairment a person has. To communicate, students with mild to moderate hearing loss use "oral-aural" approaches, such as residual hearing, speech-training and augmented lip-reading and those with severe to profound hearing loss usually rely on "sign language, gesture, cued speech and finger-spelling" (Westwood, 2008c, p. 51; 2009, pp. 70-71). For more effective ways of communication, students with HI can combine a range of approaches, called "Total Communication" (Westwood, 2008c, p. 51). In Indonesia, the oral-aural approach is more popular for use in schools and communities. Westwood (2009), however argued that this approach is problematic as lip-reading shows inaccuracy when interpreting the communication of others. The deficit communication leads children to mild delays in reading and in language-based subjects (Brackett, 1997).

2.2.2.2 Students with Visual Impairment

The term visually impaired is used to describe any kind of vision loss, from a partial loss of vision where some things are seen to a total loss of vision (Westwood, 2008a). IDEA (2006, 14 August) defined visual impairment (VI) as "an impairment in vision that, even with correction, adversely affects a child's educational performance. … includes both partial sight and blindness". The International Classification of Diseases, 10th revision (ICD-10) classifies VI into four levels, i.e. mild or no VI, moderate VI, severe VI and blindness (Naipal & Rampersad, 2018). Loss in vision distorts and limits sight input which affects the development of "cognitive, interpersonal, orientation and mobility, and incidental learning" (Palmer, 2013, p. 234) and contributes to learning difficulties (Westwood, 2008a). However, students' independence and academic progress are likely to be hindered unless and until they become proficient in reading and writing Braille and learning how to orient themselves in a physical environment and get around safely in it (Yanoff, 2006); therefore they must learn orientation and mobility skills to be independent (Westwood, 2008a).

Vision impaired students have a serious vision defect that cannot be remedied by wearing spectacles (Westwood, 2008a); they need corrective lenses, special lighting, and/or large print (Kauffman et al., 2018). However, those who are legally blind can't use printed material and usually use Braille (Kauffman et al., 2018) or screen reader software for reading and writing. A vision impaired student can also be assisted with "low tech" equipment, i.e. a desk that can be adjusted so the top on which to put materials can be brought closer to the student's eyes or a lamp with adjustable illumination (Westwood, 2008a, pp. 35-36).

2.2.2.3 Students with Learning Difficulties

Learning difficulty is "a complicated concept" (Inglis, 2013, p. 423), "a very general term, used widely and without much precision" (Westwood, 2008b, p. 2) and often applied under a single "label" without considering abilities and needs (Inglis, 2013, p. 424). Every country defines learning difficulty differently (Westwood, 2008b). A review study by Agrawal et al. (2019) confirmed that the learning difficulty term adopted in the UK is similar to the learning disability term used in the US. In the US, students of "at least average intelligence" who show "serious difficulties in acquiring literacy and numeracy skills, and who might also have problems in areas such as perception, coordination, memory and information processing", are categorised as students with Learning Disabilities (Westwood, 2008b, p. 11). In the UK, that definition is reserved for learning difficulty. In Australia, the label of children with learning difficulties is applied to all children "who are experiencing difficulty with learning because of a variety of reasons (e.g. disability, living in out-of-home care) and who are unable to access the curriculum through high-quality instruction alone" (Department of Education and Training State of Victoria, 2019, p. 5). However, most countries identify students with learning difficulties as those who are not making adequate progress in the areas of literacy and numeracy (Westwood, 2004) and who also demonstrate communication problems, poor reasoning ability and deficiencies in memory (Bancroft, 2002).

Children who fall within the criteria of having a learning difficulty do not necessarily have weaknesses in visual, auditory, sensory-motor, or cognitive areas, although some of them have somewhat below-average intelligence (Westwood, 2008b). In the past, students with learning difficulties were seen as low achievers or slow learners (Okanlawon, 2017). Dettori and Ott (2006) believed that teachers see students with LD and low achiever as a similar group with common needs and characteristics. Moreover, secondary school teachers might often express negative attitudes towards students with LD and provide minimal support for them (Watson & Boman, 2005; Watson & Bond, 2007).

There is variance across schools and countries in the number of students identified with LD (Westwood, 2004). In Indonesia, especially in DI Yogyakarta, children with LD comprise the largest group of SWD attending general schools (Dikpora, 2016). The students are diverse and tend to achieve at a low level in academic subjects for a range of different reasons (Graham & Bailey, 2007). These reasons are classified into two categories (Westwood, 2008a, p. 6): child-focused (e.g. "detrimental attitude or emotional state, frequent absences from school, child's inefficient approach to learning, specific learning disability, attention deficit disorder") and learning environment focused (curriculum and teaching method). Schools have often failed to support these students learning needs, and consequently they have left school with no basic "literacy, numeracy and social skills" that they can use in their essential daily lives (Westwood, 2008b, p. v).

2.2.3 Science for Students with Disabilities

Legal documents related to science education reform and that explicitly mention that SWD have the right to be included in science learning are provided in the US, i.e. Science for All in 1990, the National Science Education Standards (NSES) in 1996 (Aydeniz et al., 2012) and The Next Generation Science Standards (NGSS)—specifically Appendix D, *All Standards, All Students*—in 2010. No such documentation is provided in Indonesia. "The notion of 'science for all' suggests that all students—irrespective of achievement and ability—should engage in opportunities to understand the practice and discourse of science" (Villanueva & Hand, 2011, p. 233).

Because legislation acknowledges SWD are to be included in a general education setting, the number of SWD who learn science has escalated (Bargerhuff et al., 2010; Mutch-Jones et al., 2012). Science teachers are required to create "a caring, positive learning environment by modeling sensitivity to differences and using a variety of instructional approaches and interaction styles" (Stefanich et al., 2001, p. 115) to teach SWD in the science classroom. Many scholars (Kahn, Wild, et al., 2014; Mastropieri & Scruggs, 1992; Mastropieri et al., 2006; Scruggs et al., 1998) have argued that SWD can be successful in science learning, including in laboratory activities (Sukhai & Mohler, 2017a), when they are offered effective teaching strategies that let them actively participate throughout the lesson. "Creativity and an open mind" are needed to reduce barriers to participation for SWD in laboratory activities, while "preparation and planning" are the key to opening full access to laboratory activities for SWD (Sukhai & Mohler, 2017a, p. 205).

For individuals with HI, low achievement in science is mostly caused by poor literacy, not poor cognitive ability (Im & Kim, 2014). For students with HI, learning science alongside their peers in a regular placement is advantageous. Besides making for better social interactions, the regular placement increases the need and motivation for a hearing impaired student to communicate—leading to more accurate language models (Westwood, 2008a) and to literacy. The regular placement also lets the deaf student learn "the standards of the hearing world" and comprehend the nature of a hearing community (Sisk, 2019, p. 50). Teachers may learn some signs, particularly if a deaf student is in their classroom (Yanoff, 2006). Kurz et al. (2015), however suggested direct instruction was a better approach for acquiring new science information even if the interpreter was highly qualified.

Research on providing appropriate strategies for students with HI to learn science is limited, however Kahn, Feldman, et al. (2014) suggested teachers apply an inquiry approach while gradually reducing scaffolding to increase the autonomy of students with HI. Similarly, Im and Kim (2014) recommended an inquiry approach focused on written expression. Im and Kim argued this strategy was not only beneficial to improve science academic achievement of students with HI, but also their language competence. A literature study by Atika et al. (2018) mentioned that Science, Technology, and Society (STS) can be applied to increase the understanding of science concepts for students with HI. Atika et al. (2018) added that, within STS, "students not only memorize the science concepts, … [but are also able to] analyse scientific information as well as to apply it in their real-life situations, and set them on a path of life-long learning in science" (p. 19). Kahn, Wild, et al. (2014) highlighted some accommodations for students with HI in science classrooms, e.g. providing an interpreter or hearing aids, allowing wait time for students to catch up on information, previewing material for conceptual and new vocabulary understanding, providing visual materials and sequencing it into smaller information. Moreover, Borders et al. (2010) mentioned some key instructional options for students with HI, i.e. offering: opportunities to practise skill, repeated directions to engage in routines, visual and physical prompts, and clues when moving to another activity.

Science for students with VI is possible (Ediyanto & Kawai, 2019) as they have a similar range in cognitive abilities as their sighted peers (Kumar et al., 2001). Collaboration and specific adaptation in both science classrooms and laboratories are two ways to make science more accessible for students with VI (Kızılaslan et al., 2019). Science curriculum should be designed to allow students with VI to access and participate while high expectations and challenges are also offered (Westwood, 2008a). The student's participation in science learning might be affected by a science teacher, a teacher with training specific to blind and visual impairment students, and parents (Supalo et al., 2014), where encouragement is important to gain students' participation. For example, Wild and Paul (2012) indicated that the special teacher for visual impaired students and the science teachers had collaborative work to do in making adaptive lesson plans, choosing assistive technology and communicating with parents.

To master science concepts, students with VI require "appropriate adaptations and individual instructional design" (Kızılaslan, 2019b, p. 56); and "more tactual and audio experiences than visual instruction" (Sahin & Yorek, 2009, p. 19). To cope with print (e.g. many science concepts are presented graphically) and problems described using visuals (i.e. many concepts cannot be explored by touch and are conveyed through visual observation) when accessing learning, students can be supported with assistive technologies (Westwood, 2008a), such as audio-recording, tactile materials and 3D models.

Laboratory activities are also visual, and Koehler and Wild (2019) reported that VI students did not fully participate in experiment activities. Traditionally, students with VI were helped by a sighted assistant working in a laboratory describing what was happening with the experiment (Supalo, 2013; Supalo et al., 2014), due to safety issues. To increase students' engagement in a laboratory, assistive technologies (low and high-tech laboratory devices) can now be offered. Low-cost modified laboratory equipment such as talking thermometers, talking balances (Supalo et al., 2008), Braille metric rulers, Braille periodic tables, talking scientific calculators, and colour identifiers (Koehler & Wild, 2019) are already available. Several computer-based and tactile adaptive technologies for science laboratories have also been developed, i.e. *Logger Pro*, *Pasco, LabView* (Supalo & Mallouk, 2007), *Vernier Software & Technology LabQuest* (Supalo, 2012), and *Sci-Voice Talking LabQuest* (Kroes et al., 2016; Supalo et al., 2014), which demonstrate improvements for the capacity and participation of students with VI in science activities.

Students with LD also present in huge numbers in the science classroom and modifications are needed to fulfil their learning needs. For instance, a project by Gebbels et al. (2010) which adapted science teaching strategies for students with LD, i.e. fieldwork, enquiry-based and cross-curricular, demonstrated that students had motivation to learn science, were prouder of their achievements and had increased participation leading to making friendships. Modifications in the form of differentiated programs of literacy and numeracy were also beneficial in boosting teaching for students with LD, along with "focusing on essentials, using process-oriented praise, peer tutoring, and regular communication with parents" (Loizou, 2016, p. 371). Okanlawon (2017) emphasised that adaptive instruction was the best approach to teaching science (e.g. chemistry) to students with LD. In addition, according to Harish et al. (2013), Information and Communication Technology (ICT) was advantageous for students with LD, together with developing special tutors, using metaphors as instructions, and applying cross-curricular methods and providing cognitive engagement and individual instructional tools. Harish et al. (2013) asserted the cognitive load on the working memory of students was reduced, and motivation meant the students were more focused on the same task with ICT in science classrooms. Science materials could also be adjusted based on the student's need. Bancroft (2002) highlighted two ways of providing science materials to students with LD, i.e. adapting the existing resources and developing new resources.

In summary, SWD, whether physical, cognitive or emotional in nature, respond to the science curriculum differently from other students. To teach science for SWD, an individual's unique set of strength-based strategies need to be identified, not merely his or her disabilities. SWD may need modified strategies such as advanced and graphic organisers, modified learning media, additional time to complete assignments and tests. Without specific modifications, the standard science curricular materials can be insufficient for SWD and too frequently they can "find themselves blocked from access to essential aspects" of the science curriculum (Buxton & Provenzo, 2010, p. 96). Hence, this study has sought the nature of inclusivity based on rich descriptions of how science teachers present materials, practise pedagogy and assess SWD's learning progress to break down barriers and maximise access to learning science. It has also provided research on science subjects in Indonesia which, to date, has been limited and under-explored, especially when focused on SWD.

2.3 Inclusivity of Science Teaching and Learning

The literature highlights that inclusivity is defined as practice or policy that guides teachers to create and maintain a learning environment which engages and respects all students (Gargiulo & Metcalf, 2015) rather than labelling some of them as "special" and involving specialist teachers to educate them (Grimes, 2014, p. 8). In this study, the science teachers' teaching and learning practices are described comprehensively in order to understand the nature of the inclusivity phenomenon. The literature underpinning inclusivity is described as follows.

2.3.1 Creating Inclusive Science Classrooms

The increasing number of SWD being placed in science classrooms has meant science teachers have been more challenged to be responsible for creating inclusive classrooms (Stefanich et al., 2001). As there is no dual program for science special education teachers or special science education teachers (Vannest et al., 2009), collaboration is important for implementing and maintaining IE (Pellegrino et al., 2015; Scribner & Cartier, 2019). Teacher need to work effectively and efficiently as collaborative (Villa & Thousand, 2003) and consultative (Obiakor et al., 2012) teams. Therefore, an inclusive science classroom is a collaborative endeavour which incorporates co-teachers—a science teacher and one special education teacher—to work with SWD, with collaborative actions to connect the two domains of science and special education (Haskell, 2000). Bauwens (cited in McGinnis (2013, p. 45)) mentioned three models of collaborative actions: teacher assistance teams consisting of teachers, counsellors, administrators, and parents working together in supporting classroom teachers in teaching SWD; collaborative consultation places for co-teachers to share their expertise to solve issues related to teaching SWD; and cooperative teaching (co-teaching) consisting of co-teachers working together in a classroom in integrated settings.

Although collaboration has not been authorised by inclusion regulations (viz: the No Child Left Behind (NCLB) and IDEA (Hernandez, 2013)), it has been recommended for inclusive classrooms (Austin, 2001) and has become an option for offering educational services to SWD in general classrooms (Damore & Murray, 2009). Further, support from co-teachers is believed to be a way to carry out the regulations of IE to advantage all children (Seeley, 2015). In addition, co-teacher support is highly significant for student achievement (Gebhardt et al., 2015), making teaching and learning more focused and presumably enhancing student outcomes (Sweigart & Landrum, 2015).

Co-teaching is not a new teaching approach for SWD (Scruggs & Mastropieri, 2017), is not obligatory for inclusion to occur (Friend, 2016a) and can be run with or without extra support of a special education teacher (Solis et al., 2012). Little evidence exists about how this approach is working in a country which is in an initial state of IE implementation (Khairuddin et al., 2016), such as Malaysia and Indonesia. Nevertheless, co-teaching is popular in many schools as a way to promote inclusive practices (Courey et al., 2012; Strogilos & Avramidis, 2016; Venianaki & Zervakis, 2015). Co-teaching can possibly assist SWD (Murawski, 2005), helping to ensure that SWD benefit from "content instruction taught by content specialists in general education classrooms" (Kloo & Zigmond, 2008, p. 13), to improve SWD outcomes (van Garderen et al., 2012) and for successful relationships in inclusive classrooms (Atkins, 2008).

"Identifying optimal roles to best meet the needs of … [SWD] within the context of a co-taught classroom is the key to effective co-teaching" (Scruggs & Mastropieri, 2017, p. 285). In the co-teaching models where "one teach-one observe, one teach-one assist, alternative teaching, teaming, station teaching and parallel teaching" (Scruggs & Mastropieri, 2007, pp. 392-393), the special educator provides a "specially designed instruction" to accommodate and facilitate student's needs and ensure they reach their goals (Friend, 2016b, p. 17). Scruggs et al. (2007) defined the typical role and responsibility of the general teacher as instructing the entire class with the special education teacher assisting; whereas Kloo and Zigmond (2008) emphasised the general teacher as the person with understanding on "structure, content, and pacing" of the general curriculum and the special education teacher identifying and supporting the need of SWD (p. 13). These mutual roles and responsibilities between co-teachers imply that "interdependence in co-teaching is essential" (Petrick, 2015, p. 90) and become "a new evolution of co-teaching partnership" (Lava, 2012, p. 21).

2.3.2 Science Learning Adaptations for Students with Disabilities

An inclusive classroom is a challenging issue for teachers in the way they adapt and modify teaching and learning activities, materials and assignments to meet the students' needs

(Simpson et al., 2013). To support SWD in science, McGinnis (2013) suggested teachers make adaptations in their practices in the form of alterations made to the curriculum, instruction, assessment, or learning environment based on an individual student's strengths and needs in order for a student to be a successful learner in a general education setting (Simpson et al., 2013). Adaptations include accommodations and modifications.

To accommodate SWD with appropriate adaptations, the Indonesian government enacted Regulation No. 13/2020 concerning Appropriate Accommodation for SWD which included four areas, i.e. budgeting, facilities and infrastructures, teachers and staffing, and curriculum (Article 4). Accommodation can be defined as the way schools change their practices by placing SWD in the same standard as their peers without disabilities, while offering supports to SWD to overcome the impact of their disability in accessing the general curriculum (Harrison et al., 2013). The practice alterations are in the areas of curriculum, instruction, materials and environment (Simpson et al., 2013), including content, teaching methods and activities, assessments and assignments, learning circumstances, timing and schedules, and communication techniques (Blackburn & Witzel, 2014), and in the forms of presentation, response, timing and setting (Harrison et al., 2013).

An accommodation does not essentially change the standards, however a modification according to Harrison et al. (2013) is an alteration to teaching and learning practices, including lowering and reducing SWD expectations to compensate for disability. Similarly, Blackburn and Witzel (2014) said "a modification is a change in the content of curricular standards, whereas an accommodation is a tool to help one reach the standard" (p. 96).

Although no official guideline in modifying curriculum has been provided by the Indonesian government (Salim, 2010), teachers can modify the regular curriculum through strategy, learning media, types of assessment and reporting, as well as other additional programs (Sukadari, 2019). The modified curriculum is then evaluated by the school's curriculum development team, such as principals, homeroom teachers, subject teachers, special education teachers, counsellors, psychologists and related experts (Adhi & Seniwati, 2017). Teachers in Indonesia, however have claimed they face difficulties in modifying curricula (Setianingsih, 2015), therefore most science curricula have not been designed to be adapted to individual variability. The government strongly recommended a single approach in developing curriculum, namely a scientific approach (to be specific, 5M or

Mengamati/Observing, *Menanya*/Questioning, *Mencoba*/Applying, *Menalar*/Reasoning, *Mengkomunikasikan*/Communicating) (Nuzulia et al., 2017). This policy meant teachers could not easily modify science learning when they welcomed SWD.

2.3.3 Issues and Challenges in Creating Inclusive Science Teaching and Learning

"The focus on science for all has highlighted the disparities in student engagement, participation and achievement" (Cowie et al., 2011, p. 347). When students are in a general classroom, it does not mean they are guaranteed access to science learning (Mutch-Jones et al., 2012) resulting in academic achievement. Lynch et al. (2007) mentioned in their study that science academic achievement for SWD (including students with learning disabilities as noted by Grumbine and Alden (2006); Ofiesh (2007); Therrien et al. (2011)) is poorer than for their classmates without disabilities. On the US national standardised science assessments, scores for science over several years and for multiple grades of SWD are predicted to be consistently lower than for their peers without disabilities (Taylor et al., 2018).

For science, difficulty with 'scientific reasoning' (Mastropieri et al., 2001; Mastropieri et al., 1997), new vocabulary and science terminology (Scruggs et al., 1993) has caused SWD to perform less well than their peers without disabilities. The causes of science poor performance of SWD are also indicated by how science teachers carry out science instructions (Taylor et al., 2018). Langley-Turnbaugh et al. (2009); Lee (2005) mentioned that science teachers frequently do not offer learning activities that support SWD's needs and give them equal opportunities to learn science, and this lack is caused by the absence of clear descriptions to assist teachers to establish "developmental rates and specific achievement or personal-social needs" of SWD (Cawley et al., 2003, p. 161) and the ability of teachers to modify the instruction (Villanueva et al., 2012).

2.3.4 Frameworks to Measure Inclusivity

The practices of IE and its inclusivity can be measured and assessed through several instruments, i.e. the Index of Inclusion, Assessment of Inclusivity and Multiculturalism (AIM), Inclusive Classroom Profile (ICP™), Quality of Inclusive Experiences Measure (QuIEM) and UDL.

The Index for Inclusion is a far-reaching asset intended to bolster inclusivity in schools and help educators work out how to enhance schools to increase student participation (including those who were marginalised) (Ainscow et al., 2006) by managing a procedure of self-investigation, developing collective cooperation and upgrading the teaching and learning practices (Booth & Ainscow, 2002). This Index has been utilised and altered broadly into no less than 22 distinct dialects (Forlin et al., 2013) and can be changed for a particular area context and adjusted to address the issues of individual organisations (EASPD, 2012).

AIM is aimed at evaluating inclusivity and multiculturalism through a survey and focus groups among groups of students, teachers, staff, parents, alumni and government. AIM helps schools achieve what they do best, engaging learning communities to achieve the highest level of achievement and performance from all involved (Franklin & Barnes, 2014).

Focused on the early childhood setting, the ICP™ is a systematised observation rating scale which is designed to assess the quality of daily provisions and classroom activities supporting the needs of children with disabilities (Lundqvist & Larsdotter Bodin, 2018; Soukakou et al., 2018; Soukakou et al., 2012; Soukakou, 2012; Soukakou et al., 2015). Some aspects included in this rating scale are how classroom activities: are purposefully adapted to the environment; urge the students to access and participate; and make adjustments specific to one or another child. The IE concept within ICP embodies the idea of individualisation, focusing on how teachers can accommodate each individual's needs (Soukakou et al., 2012).

Another instrument is the QuIEM, a systematic assessment to evaluate the instructional supports for SWD (Soukakou et al., 2015), especially at early childhood education level (Spiker et al., 2011). These supports include: "program goals and purposes, staff support and perceptions, accessibility and adequacy of the physical environment, individualisation, children's participation and engagement, adult–child contacts and relationships, and child–child contacts and interactions" (Fyssa & Vlachou, 2015, p. 191).

With a specific end goal of addressing the issue of IE, a generally utilised guideline, the UDL (Rao et al., 2016; Smith, 2012), has been created to give particular instructive plan rules to guarantee availability of learning conditions for all types of learners (CAST, 2011;

Hall & Meyer, 2012; Navarro et al., 2016). Offering learners choices, collaborative opportunities and motivational strategies is the aim of UDL (Meyer et al., 2014). Although UDL is not a framework to measure inclusivity, this study applied this framework to investigate how inclusive were the teaching and learning practices in science classrooms, based on the views and experiences of the participants.

2.4 Universal Design for Learning (UDL)

The research literature has demonstrated that the UDL has been applied widely to guide instructors on how to develop flexible curricula that are accessible and accommodate diverse learners (Rose et al. (2002), quoted in Simmonet and Modrick (2010, p. 5)) in light of research in the learning sciences, including intellectual neuroscience (Benton-Borghi, 2013; Coombs, 2010; Gargiulo & Metcalf, 2015; Hall et al., 2004). "UDL holds promise for teachers who are struggling with creating lessons that allow all students access to and engagement with the general science curriculum" (Kurtts et al., 2009, p. 151). This section describes how to better understand the UDL as a learning framework, and one that in this present study was applied as the framework to investigate the inclusivity of science teaching and learning practices.

2.4.1 The History of UDL

The original concept of UDL was grounded on the notion of Universal Design (UD), which was established in the 1980s and is often applied in architecture areas (Bernacchio & Mullen, 2007; Burton et al., 2010). Ronald Mace and his colleagues were the architects behind the seven principles of UD (Coombs, 2010; Powell & Pfahl, 2018; Seel et al., 2017). The original UD model aimed to provide a physical environment that was more accessible to people with and without disabilities (Coombs, 2010; Rao et al., 2014). A building with a ramp for people with physical movement disorders or for wheelchairs users to access buildings is a conspicuous example of the UD concept (Rose et al., 2002). The UD term then began to spread and made people realise that building structures and designs could accommodate various needs of different people while also offering artistic attraction (Young, 2013). It then became an inspiration for educators to apply in classrooms (Sukhai & Mohler, 2017b) and for other educational experts who proposed fully accessible learning for all and initiated IE (Seel et al., 2017). Mace's vision and inclusive design invention inspired the Centre for Applied Special Technology (CAST) to extend the UD concept to a framework for learning, focusing on curriculum and instruction (Edyburn, 2010). CAST as the originator of the UDL has been offering this framework since 1984 to help teachers create inclusive lessons for a wide-range of students (CAST, 2015).

2.4.2 The Development of UDL

Related to the investigation of the inclusivity of science teaching and learning practices in this study are some theories that are closely related to and support the UDL system as follows.

2.4.2.1 Brain Research

Neuroscientists have conducted research into the relationship between the human brain and learning and behaviour (Bransford et al., 2000; Bransford et al., 2008). UDL is the result of cognitive neurological research (Nelson, 2014; Rose et al., 2005; Rose et al., 2002), playing a fundamental role in educational settings by providing numerous pathways for students to learn not merely one simple approach to teaching students. How brains can respond to diverse tasks during the learning process (Bransford et al., 2006; Driscoll, 2005) is aligned with UDL. Rose (2005) proposed three brain areas related to learning, i.e. recognition, strategic and affective systems.

Recognition systems are located in the posterior cortex, which is responsible for recognising patterns and objects through the “visual, auditory, tactile and olfactory stimuli” (Rose, 2005, p. 30), and by which we learn to know a specific object. Rose added that damage to the posterior cortex affects the brain’s recognition of objects, symbols or signs, even though this problem was not only caused by neurological perspectives (p. 31). About the term recognition, Rose (2005, p. 31) stated, “re-cognition” clearly emphasises that ability to re-cognise (to recall and restructure a previously known pattern) plays important roles in perceiving, remembering, understanding spoken or written language and imagining problem solving. Recognition is only one feature of cognition but “re-cognition is a key” feature of any cognition and any learning (Rose, 2005, p. 31).

Strategic systems are located in the frontal lobes which are “responsible for knowing how to do things” (Rose, 2005, p. 31). Rose added, in term of learning, all tasks are highly patterned activities that require the frontal lobes systems to produce patterns to do the task effectively. It means frontal systems are important in information processing and acts of cognition.

Affective systems are located in the core of the brain (limbic system) which are "responsible for emotion and affect" (Rose, 2005, p. 32). This system is not so important in knowing patterns or how to do things, rather it is important for patterns and strategies to achieve them. As a result, this system helps students to prioritise goals, build confidence, develop preferences, care about learning and persist in the face of difficulty (Rose, 2005). Any damages to the limbic system can affect the affective factors that are a critical part of any act of cognition (Rose, 2005).

CAST underpinned their study, where each learner had "neuro-variability" (CAST, 2018, p. 1), as being the product of the uniqueness of interconnected neurons in the brain. As a consequence, each student has their own path to interacting with the environment, meaning there are variabilities in learning. CAST (2018); Meyer et al. (2014); Rose and Meyer (1999) emphasised that student variability can be predicted and organised across three proposed brain networks, i.e. recognition, strategic and affective. Understanding how the brain works and its flexibility is important for teachers to help them recognise that "learning is a constant growth process constructed over time" (CAST, 2018, p. 2), as the brain grows and changes with use. As there is no single mechanism by which a brain perceives, engages with or executes a function, therefore variability among students and contexts should be considered (CAST, 2018). When teachers proactively design learning by promoting variability, they anticipate and appreciate their learners' diversity and strengths (Meyer et al., 2014). The mechanism of human learning consists of three expanding knowledges which are: learning alters the physical structure of the brain, which alters the brain's functional organisation and, finally, "different parts of the brain may be ready to learn at different times" (Bransford et al., 2008, p. 90).

2.4.2.2 Constructivist Theory of Learning

UDL appears to be compatible with constructivist learning theory which was contributed by three philosophers, John Dewey, Jean Piaget and Lev Vygotsky. These three constructivists underpinned their theories by noting that "students arrive in any learning situation with a range of prior knowledge and experience that influences how they respond to new information" (Hyslop-Margison & Strobel, 2007, p. 78).

Dewey's Social Learning Theory. Dewey proposed that education "must be continually interpreted and translated into terms of their social equivalents" (Cox, 2018, p. 30). Dewey introduced the terminology that school is a "learning laboratory" (Foote et al., 2013, p. 13), a place for experiential learning (Mooney, 2013), in which students engage and demonstrate their knowledge and affective experiences and enrich the educational environment through a mixed range of interactions among students and teachers (Cunningham & Breault, 2017). Dewey believed that "students thrive in an environment where they are allowed to experience and interact with the curriculum" (Talebi, 2015, p. 4) and they "must act to learn, from his or her own standpoint" (Cox, 2018, p. 38). As a consequence, learning will be more meaningful and encourage students to think proactively and be able to discover solutions to problems.

Piaget's Cognitive Development Theory (individual constructivism). "Piaget believed that all humans are born with cognitive structures for organising and processing information, and that they use these same structures throughout their lives" (Foote et al., 2013, p. 17). Piaget offered a theory that stated children develop through four stages (i.e. "sensorimotor and progressing to preoperational, concrete operational, and formal operational thinking"), which reflect the qualitative differences in their cognitive skills (Waite-Stupiansky, 2017, p. 4); and children cannot be taught a specific cognitive task before they have reached a certain development stage. Piaget expanded this theory to make clear how new information is shaped to suit learners' existing knowledge and modified to cater to the new information (Harlow et al., 2006; Waite-Stupiansky, 2017) and to interaction with the environment (Mooney, 2013). The major concepts in this cognitive process (Foote et al., 2013; Harlow et al., 2006) include: assimilation (a process to recognise new objects to be consolidated with existing knowledge); accommodation (a modification process of existing knowledge with new information/experience); equilibration (a developmental process, encompassing both assimilation and accommodation). According to Piaget, learning was not a passive assimilation of given knowledge (Harlow et al., 2006) but a process in which learners constructed their own knowledge by doing (Mooney, 2013).

Vygotsky's Zone of Proximal Development (social constructivism). Vygotsky highlighted that students have three levels of knowing: already known without assistance, can be fully comprehended with assistance and known beyond without assistance (Foote et al., 2013; Murphy, 1997). Vygotsky believed that learning occurs within the 'Zone of Proximal Development' (ZPD) (Bodrova & Leong, 2017; Foote et al., 2013; Mooney, 2013). Within the ZPD, learners can master concepts and ideas they are unable to understand on their own with help by grownups or children who are a lot more advanced (Applefield et al., 2000; Shabani et al., 2010). To help students accomplish tasks within their ZPD, some researchers (Morgan & Brooks, 2011; Quintana et al., 2004) suggested a strategy namely scaffolding. "Research has consistently shown that regulative scaffolding has a positive impact on learning outcomes" (Manlove et al., 2009, p. 106). Therefore, it is important that students become aware of the scaffolding process because, by internalising this process, students learn to build knowledge or solve problems without the teacher's assistance in the future.

The basic principle underlying the philosophy of constructivism is that all knowledge is constructed by experiences (Applefield et al., 2000; Bächtold, 2013; Murphy, 1997; Simpson, 2002) and not directly perceived by the senses (smell, touch, hearing, touch, etc.) (Supardan, 2016). Therefore, to understand and apply information competently, students need to engage with that information (Applefield et al., 2000; Flynn et al., 2013). In addition, to cater for diverse learners, Fiume (2005) highlighted that information can be acquired through two constructivist principles of "co-construction and collaborative relationship" (p. 62); which means knowledge is constructed by the relationships among learners and teacher.

A common misinterpretation of constructivism is that students must always be allowed to build their knowledge for themselves and the teacher must not tell any student directly (Applefield et al., 2000; Bransford et al., 2000; Sewell, 2002). This is actually confusing a theory of pedagogy (teaching) and a theory of knowing (epistemology) (Murphy, 1997; Simpson, 2002). Constructivism (in learning) assumes that all knowledge is formed from the student's prior knowledge, regardless of how it is obtained (Garbett, 2011; Sewell, 2002), thus, even listening to a lecture comprises active efforts to construct new knowledge (Bransford et al., 2000). In more detail, Bächtold (2013) said that constructivism can be considered as a theory of teaching when it follows two stages: drawing out what students think they already know, and then challenging that with new ideas and knowledge. In Indonesia, although K13 is underpinned by the Constructivist Theory of Learning

(Waseso, 2018), in fact teachers face difficulties when implementing constructivism into teaching and learning (Palobo & Tembang, 2019).

2.4.2.3 Bloom's Taxonomy of Educational Objectives

Bloom's Taxonomy is a hierarchical structure that categorises thinking skills from low to high levels (Adams, 2015; Effendi, 2017; Munzenmaier & Rubin, 2013), however, it "is not a list of thinking skills" (Crossland, 2015, p. 34). Many studies have indicated that students can sometimes achieve higher levels without having mastered lower levels (Soozandehfar & Adeli, 2016). Although many practitioners have associated Bloom's Taxonomy with behaviouristic psychology, it is an incorrect assumption that this taxonomy is only tied to behaviourism (Soozandehfar & Adeli, 2016), yet observable behaviours can be based on many theories of learning, such as constructivism.

Bloom's Taxonomy originally consisted of two parts, namely the cognitive domain and the affective domain, but Simpson and Harrow added the psychomotor domain to complement these (Munzenmaier & Rubin, 2013). The three domains are also known as "knowledge, skills and attitudes" (Pickard, 2007, p. 46). The Cognitive Domain includes "mental skills to produce knowledge" (Chandio et al., 2016, pp. 206-207), i.e. "processing information, constructing understanding, applying knowledge, solving problems, and conducting research" (Hoque, 2016, p. 46). The Affective Domain covers behaviours that emphasise feelings and emotional aspects (Brett et al., 2003; Hoque, 2016), such as "social adjustment, interests, values, self-attitudes" (Mertler, 2017, p. 277). The Cognitive and Affective Domains are complementary (Lynch et al., 2009; Wu et al., 2019), with cognitive outcomes emphasising what students have learned and affective outcomes highlighting the value of what they learn. The Psychomotor Domain comprises behaviours that emphasise motor skill features (Chandio et al., 2016) and "those specific to discreet physical functions, reflex actions and interpretive movements" (Hoque, 2016, p. 50).

In 2001, Krathwohl and cognitive psychologists revised Bloom's Taxonomy (Munzenmaier & Rubin, 2013), providing a new version of the cognitive domain with the dimension of cognitive processes and dimensions of cognitive knowledge (Adams, 2015; Anderson & Krathwohl, 2001; Darwazeh, 2017; Krau, 2011). While the Revised Bloom Taxonomy (RBT) has some flaws (Darwazeh, 2017), it is still relevant to current educational situations (Munzenmaier & Rubin, 2013). RBT has many functions for teachers in: developing curriculum and lesson planning (Crossland, 2015), understanding "cognitive demand" of learning objectives (Lee et al., 2017, p. 15), constructing learning outcomes (Howell, 2014) and varying the cognitive, affective and psychomotor outcome levels (Crossland, 2015). The RBT is the most widely used method of creating learning objectives in Indonesia and six cognitive levels, C1 to C6 (remembering, understanding, applying, analysing, evaluating and creating) are often used in formulating learning objectives. Teachers then use the taxonomy table to make alignment between objectives, learning activities, material and assessment as suggested by Anderson (2002).

2.4.2.4 Multiple Intelligences and Learning Preferences

Intelligence is the ability to problem-solve and generate outcomes in a variety of settings and in real situations (Gardner cited in Suparno (2004)) or "one's ability to learn from experience and to adapt to, shape, and select environments" (Sternberg, 2012, p. 19). Gardner found at least nine intelligences possessed by students: "linguistic, logical-mathematical, spatial, bodily-kinaesthetic, musical, interpersonal, intrapersonal, naturalist, and existential" (Chan, 2005, pp. 187-188; Dunn et al., 2001, p. 9; Picciano, 2009, p. 13; Sahli et al., 2011, p. 1577; Sternberg, 2012, pp. 20-21). These are found in everyone, but the levels are not always the same (Sahli et al., 2011).

As students are diverse, they will more easily understand the lesson if the material is presented in accordance with their prominent intelligence and learning preferences (Gargiulo & Metcalf, 2015). The four most commonly known learning preferences are visual/verbal, visual/nonverbal, auditory/verbal, tactile/kinaesthetic (Fleming cited in Biscardi et al. (2019)). Most people learn through all modalities but have certain strengths and weaknesses in specific modalities. Some students have the same tendency for more than one style, which is referred to as a multimodal style. ~~After a student's learning preferences have been determined, accommodations can be made to enhance academic achievement and creativity, and to improve attitudes towards learning.~~ Neuroscience study reveals that the use of verbal and visual multi-modes can increase learning significantly (Fadel, 2008).

2.4.3 UDL as a Framework of Learning

"The UDL framework provides guidance for creating flexible curricula and instructional environments, and for using technology to maximize success for all students, including those with physical and/or psychiatric disabilities" (Bernacchio & Mullen, 2007, p. 167). Alongside the three CAST principles—Multiple Means of Representation (MMR), Multiple Means of Action and Expression (MMAE) and Multiple Means of Engagement (MME)—UDL presents nine guidelines and 31 checkpoints, specifying how to overcome the limitations found in most educational programs and giving reasons for working with alternatives and for the adaptability that is important to improve learning chances for students with various needs (CAST, 2011, 2014, 2015).

"Representation refers to designing instructional materials that make content accessible to the greatest number of diverse learners" (Courey et al., 2012, p. 10). However, "[t]he use of the terms 'multiple representations' and 'multimodal' in the research literature is somewhat confusing because it is often indiscriminately applied to different ideas" (McDermott & Hand, 2012, p. 220). In this study, "[t]he term 'representation' refers to something that stands for something else, and the term MRs refers to the use of more than one representation" (Nieminen et al., 2017, p. 164). Representations are categorised into external and internal (Dilworth, 2004). External representations manifest in the physical world as symbols and images, including diagrams, drawings, graphs, mathematical equations, photographs, or tables beside text (Zhang, 1997), whereas internal representations refer to "a mental model" (Opfermann et al., 2017, p. 2) or "the knowledge and structure in memory, as propositions, productions, schemas, neural networks, or other forms" (Zhang, 1997, p. 180).

Action and expression refer to how students demonstrate what they have learned (Courey et al., 2012). Each student has a different way of navigating the learning environment and expressing what they know. Providing MMAE alludes to enabling students to show learning in various configurations (e.g. for VI students, Braille, large print, auditory and tactile) using a variety of approaches. UDL urges teachers to give students an expansive scope of other options to exhibit their understanding (Spencer, 2011) regardless of their learning challenges (CAST, 2011; Rose et al., 2002). There is no one way of action and expression that will be optimal for all students; therefore it is important to provide options for action and expression (Hall et al., 2004).

MME refers to various opportunities for student to be involved in learning (La et al., 2018) and how they feel about the classroom and the material they are learning (Spencer, 2011). This principle reflects the idea that students have different motivations for engaging in learning (Meyer et al., 2014). In fact, there is no single way of engagement that will be optimal for all students in all contexts; therefore it is very important to offer many options for engagement (Rose & Meyer, 1999) e.g. through discussion, demonstration, simulation, interactive activities, hands-on activities, and projects. When students are given choices it allows them to engage in the ways they like, with their interests or abilities, while also challenging them to learn in different ways to make the learning experience more comprehensive (Picciano, 2009).

UDL offers flexibility and accessibility. This flexibility means students' abilities and preferences can be accommodated (King-Sears, 2009) in the ways material is offered, in the ways students react or express learning and abilities, and in the ways students are included (Bernacchio & Mullen, 2007; King-Sears et al., 2015). In terms of a flexible curriculum, UDL "helps teachers maintain educational integrity and maximize consistency of instructional goals and methods, while still individualizing learning" (Hitchcock et al., 2002, p. 9). Curriculum and instruction flexibility could expand the interaction and communication among students and also between students and teacher (Bernacchio & Mullen, 2007). UDL creates accessible and student-centred learning environments (Izzo & Bauer, 2013), increases meaningful access and reduce barriers to learning (Israel et al., 2014), and help teachers in providing "equal access, quality programs, and appropriate services" (Brand et al., 2012, p. 139) for SWD.

As the goal of all effective teaching is to promote real learning, understanding the unique contributions of UDL to effective teaching is critical. UDL includes the proactive utilisation of education plan ideas, pedagogical content knowledge and innovation in creating accessible learning experiences and engaging learners with diverse needs (Basham et al., 2010). By clarifying learning intentions and providing flexible instructional environments, the UDL framework can be used to identify and address pupils' difficulties in learning (King-Sears, 2009; King-Sears et al., 2015; Spencer, 2011). Smith (2012) proposed UDL can assist school personnel in designing courses because UDL shows how to align learning objectives and practises so that a positive relationship between student interest and involvement in the course can occur. UDL enables teachers to approach each individual student (whether disabled or not), offer a pathway for each to access the curriculum, apply alternative instruction, adjust learning pace, and provide multiples ways to demonstrate student comprehension (Mason & Orkwis, 2005).

2.4.4 The Important Elements of UDL

UDL has four key features i.e. "clear goals, flexible planning for diverse learners, flexible methods and media, and timely progress monitoring" (UDL-IRN, 2011a). UDL enables teachers to set clear goals to meet learners' variability and their individual needs. UDL helps teachers develop clear goals that "align with meaningful and attainable objectives" (Smith, 2012, p. 33). Clear goals help students choose suitable pathways to reach the goals (Rose et al., 2002), and teachers should offer a variety of content and methods to enable students to reach the goals. As learners are diverse, intentional proactive planning should be considered by providing options for methods, materials and other supports (UDL-IRN, 2011a). To involve students in obtaining different information and to improve their knowledge in many ways, various materials and methods must be offered to them (Nelson, 2014). The choice of materials and flexible methods provides choices and opportunities for students to demonstrate their knowledge. Student's understanding can be monitored through various formative and summative assessments (Nelson & Basham, 2014). These assessments should accurately measure learning outcomes as well as individual learning goals, while support and accommodations can also be provided (Bernacchio & Mullen, 2007). Therefore, teachers who implement UDL must consider five steps in the teaching planning process: establishing clear results, anticipating student variability, determining measurable assessment plans, establishing various learning experiences, and reflecting learning and new understanding (Nelson & Basham, 2014; UDL-IRN, 2011b).

2.4.5 Rationale for Applying UDL as a Framework in the Investigation

The teaching and learning process is often conducted by using goals that are not clear, material that might not be accessible and single assessment procedures (Israel et al., 2014). In contrast, by using the UDL, goals, methods, materials and assessments can be developed in a flexible manner, resulting in greater accessibility for all students (Meo, 2008). UDL is not a guideline (Rose et al., 2006) but a framework which allows the transition from designs that are not accessible to designs that are universally accessible (Edyburn, 2010; Rose & Meyer, 1999). The focus of UDL is to incorporate an element of flexibility into learning activities, modalities and assessments by offering various ways of representation, expression and engagement (Hall & Meyer, 2012; Rose et al., 2002). The main purpose of UDL is to enable various ways for students to acquire, express and apply technological knowledge (Biancarosa & Griffiths, 2012). The work of Rose et al. (2002) helps to outline the conceptual framework of UDL and its role in helping to identify emerging trends about cognitive and learning issues. UDL allows all students (including those with disabilities) to engage in learning experiences (Post & Rainville, 2011). This is a recognition of inclusivity as an important element that enables students with various levels and skills to improve their achievements (Meyer & Rose, 2005). Many studies have applied the UDL as a framework to develop adaptive curriculum, assistive high-technologies and online courses but there are limited studies that have practically examined the UDL as an approach to investigate the inclusivity of teaching and learning practices. Hence, this study has applied the UDL framework as an investigative tool.

2.5 The UDL Framework applied to Science Teaching and Learning

The investigation of inclusivity in science teaching and learning in this study has focused on science teachers experiencing science teaching and learning based on four pillars of curriculum: goals and objectives, teaching approach, materials and assessments. Beaudoin (2013) wrote that to create inclusive teaching, teachers may apply four strategies: considering goals, learning needs and teaching method that would be used; varying teaching methods and applying active learning; offering choices of evaluations; and offering online materials. However, teachers expressed difficulties in applying these strategies (Buxton & Provenzo, 2010). The UDL framework assists teachers to design instruction that is inclusive when pondering on the four curricular pillars (Israel et al., 2014).

There has been no comprehensive single study conducted on inclusivity that focuses on the four pillars of the curriculum in science. More specifically, research on science subjects in Indonesia appears to be limited and under-explored, especially any focused on SWD. The present study sought to address this gap in previous research by investigating science teaching and learning practices for SWD that might contribute to creating inclusivity. The four pillars necessary to create inclusive science classrooms are described as follows.

2.5.1 Goal-setting for Students with Disabilities

Goal-setting is essential to any learning. Goal-setting is "the process of establishing clear and usable targets, or objectives, for learning" (Moeller et al., 2012, p. 153), and the ability of students to determine desired academic or social outcomes and engage in behaviour in line with the achievement of predetermined goals (Duckworth et al., 2011). Nelson (2014) stated that goals play a basic role as directions for teacher and students in the way they engage in a lesson. Students with a high level of engagement can participate in classroom activities that are cognitively challenging and enable them to achieve academic success (Marks, 2000). From the neuroscientist perspective, "a clear goal enables the nervous system to direct energy purposefully to build relevance, perceive information, and act strategically" (CAST, 2018, p. 2). Goal setting helps motivate students to engage in learning and strategically manage themselves to reach the goals (Cumming et al., 2018; Duckworth et al., 2011). Westling and Fox (2009) noted that providing clear directions and holding appropriately high expectations are evidence of good teaching for all students.

For effective teaching, teachers should let students know the academic and social expectations so they understand what is expected and can attempt to achieve it (Downing & Ryndak, 2010). Previous research has shown teachers' expectations are derived from beliefs about the academic ability of students and the subsequent level of achievement (Peterson et al., 2016). Peterson et al. (2016) emphasised that different expectations of students are essential because these can influence the way teachers subjectively judge their students' abilities and grades and may offer different strategies for teaching, supporting and engaging them. Some factors which influence teachers' views towards students are pre-existing achievement, social and economic status, gender, ethnicity, and labelling based on student diagnostics (Li, 2016; Peterson et al., 2016). Research has shown that teachers' expectations significantly affect student achievement (Jussim et al., 1994; Papageorge et al., 2016), influence student behaviour (Marzano et al., 2005; Wang et al., 2018) and opportunity to learn and lead to different instruction (Hornstra et al., 2018; Peterson et al., 2016; Rubie-Davies, 2009). In other words, students who are expected to learn more or do better generally do so, while those for whom lower expectations are held usually achieve less (Rubie-Davies, 2015). Rubie-Davies et al. (2014) and Rubie-Davies et al. (2015), however claimed the relationship between teachers' expectations and increasing student achievement had not been empirically verified.

UDL encourages teachers to set high expectations for all students including those with disabilities (Cole et al., 2008). The concept of high expectations is based on philosophical and pedagogical beliefs where student achievement tends to rise or fall in relation to the expectations placed on them (Jussim et al., 1994). "Teachers who express high expectations convey the belief that their students have the ability to succeed in demanding activities" (Cole et al., 2008, p. 49). The belief that high expectations can improve student achievement implies that teachers are flexible enough to alter their expectations because present expectations are not high enough for all students (Rubie-Davies et al., 2015). Challenges should be given to all students although they might not learn the same amount of content or in the same ways (Downing & Ryndak, 2010).

2.5.2 Science Instructional Strategies for Students with Disabilities

The definition of instruction has shifted from a traditional view of transferring knowledge and information by a sequenced procedure to "new beliefs about how learning occurs, and the optimum conditions under which it takes place" (Westwood, 2008c, p. 1). Teachers have a vital and challenging role in organising their instruction (Newton et al., 2014). In some ways, teachers do not need to create special methods for teaching SWD but, in other ways, modification and adjustment are required. Although Westwood (2008c) stated that an appropriate teaching method for SWD is very dependent on the disability type and level of severity the student has, Doran (2015) noted that each student's strengths and potential barriers also should be identified in order to plan learning. Therefore, before serving SWD, teachers and staff need to thoroughly analyse their needs (Kratochvílová, 2015).

Because each child has a unique intelligence system in learning, a teacher can use brain networks systems theory to make teaching methods and curriculum materials flexible to accommodate multiple ways of learning (Rose et al., 2002). A good science teacher with appropriate preparation, equipment and teaching methods can support each student including those with disabilities, to get involved directly in science learning (Buxton & Provenzo, 2010). Certain teaching techniques are very effective in supporting students when they are involved in recognition learning; other techniques are more suitable for supporting students when they learn strategic skills or when they build engagement with learning (Rose et al., 2002). For instance, students with HI have difficulty in auditory teaching modes—including inaccuracy in sentence structures, verb tenses, plurals and singular, and pronunciations—therefore, language-based instructional strategies would be beneficial to encourage cognitive and social skills in engaging students to learn, while "careful attention must be given to explicit teaching of reading and spelling skills" (Westwood, 2008c, p. 50). As major difficulties faced by students with VI are visual modes, both tactile and audio-based learning are more appropriate for them for recognition learning. In teaching students with LD, "[i]t is generally not necessary to seek totally different or 'special' methods for these students because the answer mainly lies in using existing instructional approaches with greater intensity and precision" (Westwood, 2008c, p. 45).

In the Indonesian context, students learn science in two areas, i.e. product of science (facts, concepts, principles, laws) and Science Process Skills (SPS). The K13 proposed scientific approach is 5M (*Mengamati*/Observing, *Menanya*/Questioning, *Mencoba*/Applying, *Menalar*/Reasoning, *Mengkomunikasikan*/Communicating) to learn science (MOEC, 2016b; Nuzulia et al., 2017). In many countries, SPS have become an essential component of the science curriculum at all levels as well as being one of the newest approaches in science education (Ratnasari et al., 2018). SPS consist of basic science process skills (e.g. "observing, classifying, measuring and predicting") and integrated science process skills (e.g. "identifying and defining variables, collecting and transforming data, constructing tables of data and graphs, describing relationships between variables, interpreting data, manipulating materials, formulating hypotheses, designing investigations, drawing conclusions and generalising information") (Beaumont-Walters & Soyibo, 2010, pp. 133-134). "SPSs are acquired during the learning process" (Tosun, 2019, p. 162) and "need to be implanted, practiced and owned by students" (Wahyuni et al., 2017, p. 166). Teaching SPS for SWD is possible as long as they are supported by appropriate, efficient, and effective learning instruments (Hadis & Nurhayati, 2018; Kızılaslan, 2019a; Rooks-Ellis, 2014).

A review study by Vavougios et al. (2016) on teaching science to SWD demonstrated some effective strategies applied by researchers including discovery/inquiry learning, hands-on activities, problem-based learning, and exploratory learning; under the constructivist paradigm. Steele (2007) and Westwood (2006) proposed some strategies including: explicit instruction, thematic lesson, interactive teaching, collaborative and cooperative working groups, peer tutoring, projects, laboratory work, computer-assisted learning, computer simulations, previewing key concepts or vocabularies, graphic organisers, video and visual representations. However, to select from these strategies, teachers should think about the students' cognitive levels, learning characteristics and learning objectives (Westwood, 2006), because teaching science concepts might need different methods from teaching SPS.

2.5.3 Science Instructional Media for Students with Disabilities

Instructional media are modes that can be used to transfer messages and information about learning materials so students learn in the process of achieving their goals. Modes comprise visual, linguistic or actional representations, containing written and verbal words, numbers, images and 3D models (Nixon et al., 2015). The media include: text, pictures, audio and video (Huang et al., 2019); text, audio, visuals, motion, manipulations and people (Smaldino et al., 2005). According to Schnotz and Lowe (2003), media are divided into three levels: "technical level" which carries the signs/patterns (i.e. computers, displays, networks); "semiotic level", meaning the formats of signs/patterns (i.e. texts, sounds, images) which are represented; "sensory level", meaning the signs/patterns received through the senses (i.e. visual or auditory) (p. 117). All instruction requires the selection and use of at least one medium to deliver instruction, and offering multiple modes of information enables students to choose their preferences to enhance their learning (Opfermann et al., 2017).

As SWD have various ways of accessing information based on their disability, specialised presentation formats and/or presentation supports are essentially needed. Some students may require alternative formats to print as they are unable to use or read printed material or they need presentation support that facilitates them reading, listening or observing in the classroom. Beech (2010) listed specialised presentation formats for SWD, i.e. visual formats: large print, sign language interpreters, video recordings and descriptive video; tactile formats: Braille, embossed graphic images, real objects, 3D objects; and auditory formats: recorded books, a text aloud reader, a screen reader and other equipment with auditory output. In addition to specialised presentation media, SWD may require presentation supports, with media that assist SWD in teaching and learning while they use standard printing and graphic materials or verbal language (Beech, 2010).

Science is better presented using multiple sources of information, because science contains abstract content which needs visualisation and some sciences (e.g. physics and chemistry) use "mathematical modelling to describe phenomena and to explain relations between variables" (Opfermann et al., 2017, p. 2). Presenting information in more than one format refers to the UDL principle, MMR. This principle guides science teachers to apply multiple approaches to explain a science concept. "[R]epresentations are constructed from collections of signs" (Linder, 2013, p. 43). In a discipline such as science, these signs are multimodal representations, including external or internal representations (Opfermann et al., 2017). Teachers need to understand the potential of various representations in order to use them in the best ways (Linder, 2013).

Ferreira and Lawrie (2019) highlighted that representations presented in various modes can involve students in multisensory experiences, especially using multimedia such as video or animation, which can involve visual and verbal representations in parallel. Multimedia "caters for a range of different modal preferences and provides students with a choice in how they can access key content, and thus may be considered a more inclusive response … to the needs [of] non-traditional learners" (Sankey et al., 2010, p. 854).

2.5.4 Assessment for Students with Disabilities in Science Learning

An assessment is a process of collecting, synthesising and interpreting information about students and their progress in learning that helps teachers make decisions, monitor the teaching and learning process, understand their students, and build an effective classroom environment (Tomlinson & Moon, 2013). Assessments can be used for many purposes, i.e. developing final grades and judging student's academic performance, diagnosing student problems, developing teaching plans, measuring student progress to achieve the learning goals as a form of feedback that demonstrates the strengths and weaknesses of students related to learning (Abell et al., 2010), and monitoring teaching and learning improvement (Bell & Cowie, 2001). The assessment can also be used for "monitoring the system and school accountability" (Cowie, 2012, p. 679), "auditing of schools, national monitoring, school leaver documentation, awarding of national qualifications, appraisal of teachers, curriculum evaluation" (Bell & Cowie, 2001, p. 537), and evaluating individual performance to compare the performance of teachers, schools and local educational agencies (Gargiulo & Metcalf, 2015; Rose et al., 2002).

As individuals learn differently, teachers should consider different ways to assess them. Operating the same assessment administrations and instruments for all students is not fair and equal (Suskie, 2000, May), leading to inaccurate results. Fair assessments require that "task contexts be sufficiently familiar, appropriate, and accessible to all students" (Mislevy et al., 2013, p. 137), are tailored to the individual needs (Lam, 1995) and test results are based on scores that have equivalent meaning for all students (Beddow, 2018; Stone & Cook, 2018). To accurately assess SWD learning progress and outcomes is not simple and easy, particularly if the whole class sits for the same test, as occurs in Indonesia. Indonesian teachers mostly use a traditional assessment, and according to Rose et al. (2002) this type of assessment has flaws related to individual learning differences, lack of integration with curriculum, media constraints and lack of appropriate supports.

Because students in science classrooms are diverse, offering them various modalities of assessments might help to meet their learning needs (Cowie, Moreland, Jones and Otrel-Cass (2008), cited in Cowie (2012)). It is important for teachers to understand that assessment that addresses students' needs is the most useful and teachers can make differentiated assessments based on the students' needs. Waterman (2013) mentioned that before teachers differentiate the assessment, they should ponder three aspects, i.e. "students' readiness, interests, and learning or thinking styles" (p. 4). In addition, accommodation is preferable to modifying testing for students and teachers (Polloway et al., 2010). However, making accommodations in assessment can lead to controversy, where some people interpret that modifications reflect alterations in the test administration which might affect standardization, thus changing the comparability of scores and changing the content of what students are expected to learn and demonstrate (Bowen & Rude, 2006).

2.6 The Conceptual Framework

Figure 2.2 illustrates the inter-related nature of the multifaceted concept of inclusivity in science teaching and learning practices. The diagram represents the conceptual framework for inclusivity grounded in the three principles of UDL, namely MMR, MMAE, MME and the four pillars of curriculum, viz. goals, methods, media and assessments.

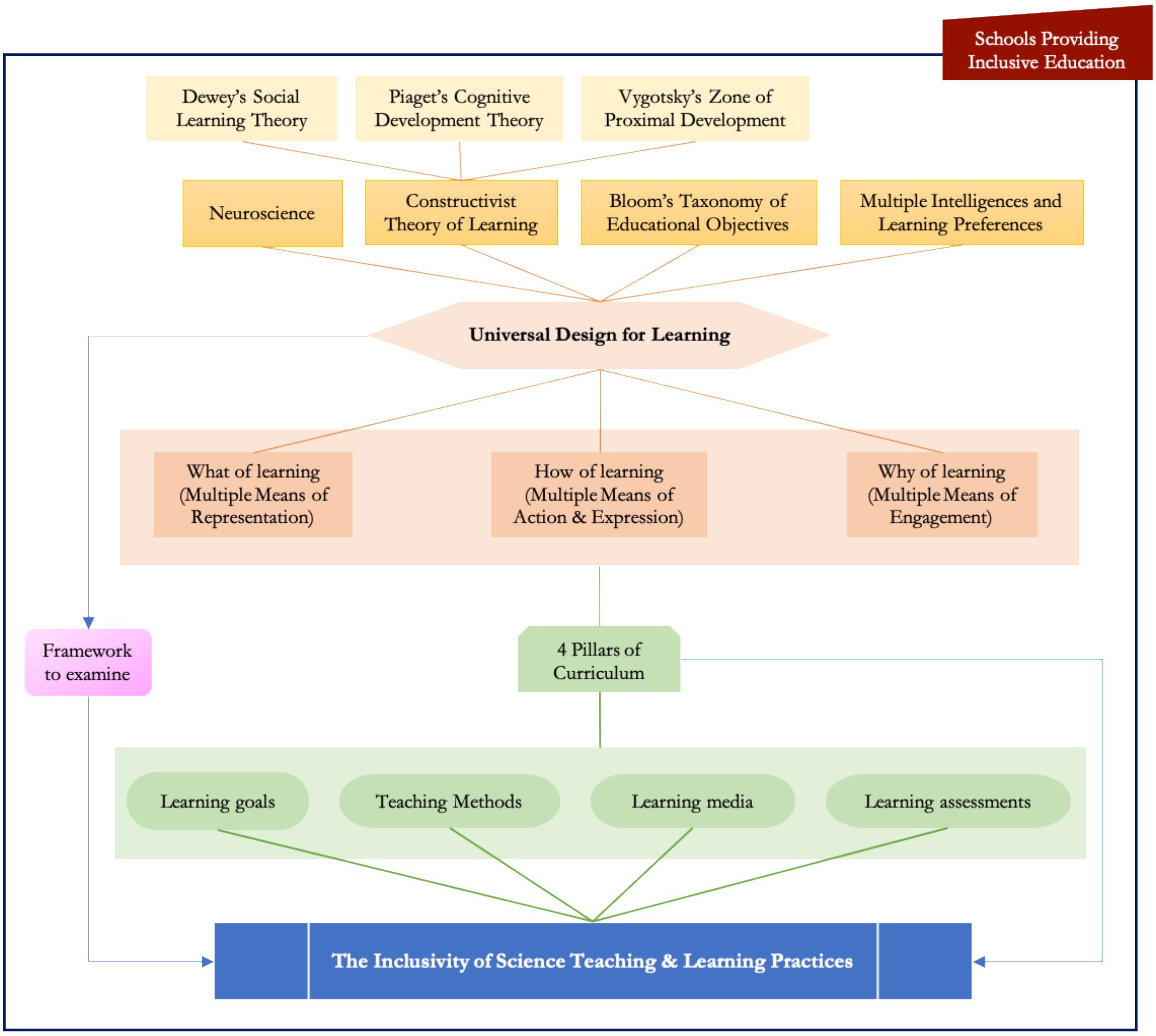


Figure 2.2. Conceptual framework of study

2.7 Summary

The theories and previous research findings related to the aim of this study have been critically reviewed in this chapter. The chapter began with a picture of IE practices around the globe, including in Southeast Asian countries, to lead the reader's understanding of the practices of IE in Indonesia. A brief definition of SWD (i.e. students with HI, VI and LD) and how they were supported in science classrooms was also provided. The previous studies indicated that SWD may be successful in science learning when science teachers offer accessible and flexible teaching approaches.

A review of the literature has demonstrated that the inclusivity of science teaching and learning practices can be investigated through the UDL framework. Many studies have found UDL can be beneficial for teachers, staff, and all students (including SWD) because UDL offers a wide range of best-practices teaching methods that can be adapted into science teaching and learning practices. It also provides some advice on how teachers can develop curriculum and apply it and use assistive technology for all learners to participate and achieve. The UDL principles can be potentially used as a conceptual framework to examine the inclusivity of science and teaching practices where research in this area has not been previously conducted in some countries, including in Indonesia.

Chapter 3
Methodology

Chapter Three details the research design and methodology, data collection and data analysis procedures, and ethical considerations in this study. This chapter is organised into five main sub-chapters: *First*, the research paradigm, which includes the research method, methodology, theoretical perspective and epistemology; *Second*, a more detailed account of the research methods including case selection, participant recruitment, data collection procedures and techniques and data analysis; *Third*, the evaluation of the methodology, namely trustworthiness covering credibility, transferability, dependability and confirmability; *Fourth*, the ethical issues and professional conduct employed during data collection, explicitly risk, consent, deception, privacy and confidentiality of data. The final sub-chapter explains how the data were kept and stored in a secure and safe place.

3.1 Research Paradigm

This study aimed to understand the nature of the phenomenon of inclusivity by examining the Inclusive Education (IE) practices of science teachers in teaching and learning activities for Students with Disabilities (SWD) in three schools designated as a School Providing Inclusive Education (SPIE) in the Province of Daerah Istimewa (DI) Yogyakarta. To achieve this aim the researcher carefully considered four basic elements of the research process as proposed by Crotty (1998): the method, methodology, theoretical perspective and epistemology. Some scholars, according to Weaver and Olson (2006), include these four basic elements as a research paradigm or the "patterns of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames and processes through which investigation is accomplished" (p. 460); in other words, the assumptions of ontology, epistemology, methodology and methods (Rehman & Alharthi, 2016; Scotland, 2012). In this study, however, the ontology and epistemology issues tended to arise together informing the theoretical perspective, as mentioned by Crotty (1998) who stated: "… each theoretical perspective embodies a certain way of understanding *what is* (ontology) as well as a certain way of understanding *what it means to know* (epistemology)" (p. 10).

In order to answer the research question, a qualitative case study methodology was selected and four research methods (questionnaire responses, individual and group interview, observation, and document analysis) were implemented. The theoretical perspective and the epistemology underpinning this qualitative case study were interpretive and constructionist. The selection process of the research paradigm of this study is presented in Figure 3.1.

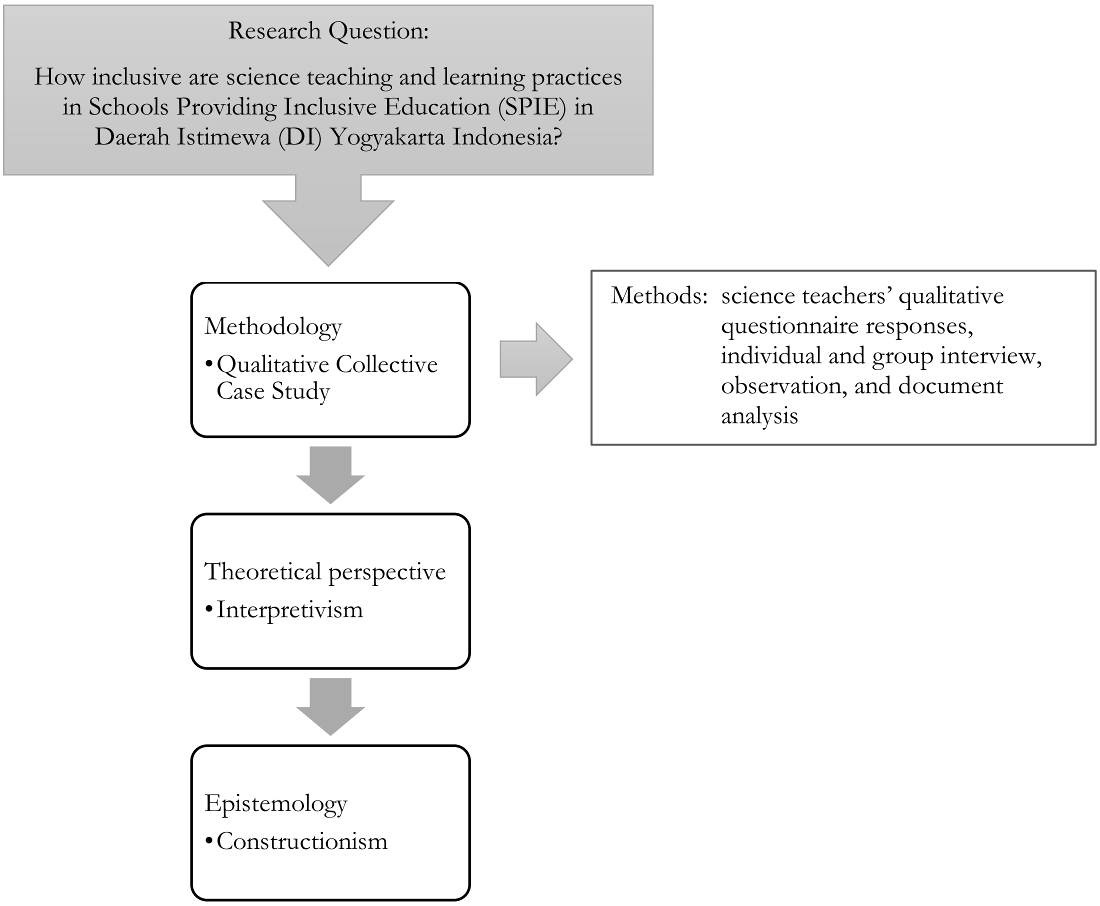


Figure 3.1 The selection process of the research paradigm of this study (adapted from Crotty (2003))

3.1.1 Research Methodology – Qualitative Collective Case Study

The research methodology, according to Crotty (1998) refers to "the strategy, plan of action or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes" (p. 3). To study the phenomenon of inclusivity as it occurs in science teaching and learning involving SWD, a qualitative case study was selected as the strategy to gain deeper understanding of this phenomenon. The investigation towards "the meaning that people have constructed of their world" (Merriam

& Tisdell, 2016, p. 6) can be explored using a qualitative approach. This approach also includes an "intersubjectivity" concept, which

> indicates that all of people's actions, behaviours, intentions, and experiences are constitutive of this lifeworld and cannot be separated from it or that all of human action (in the broad sense) at once constitutes and at the same time is constituted through these intersubjective fields of meaning (Unger, 2005, p. 52).

Denzin and Lincoln (2011) stated that qualitative researchers, in general, interpret and contextualise the meaning of people's beliefs and practices because of their assumption that social reality is a human creation.

A case study research is a common way of approaching qualitative inquiry (Stake, 2006) and this design has now become popular as an effective method (Harrison et al., 2017) to investigate and understand complex issues in real world settings (Crowe et al., 2011; Dooley, 2002). Case study also helps the inquirer to describe happenings (Stake, 1995) and to expand the reader's understanding of what is being studied (Merriam & Tisdell, 2016). To understand the complexity of a case, Yin (2014) stressed the advantage of case study design, which consolidates an assortment of data gathering systems and sources of proof from the advancement of the underlying theoretical framework to the data collection and its analyses. According to Punch (2014b), case studies involve four main characteristics: a) the case is a bounded system (i.e. the boundaries are identified and described, e.g. bounded by time, space and activity—this study was bounded by SPIE); b) the case was clearly identified; c) an explicit attempt was made to maintain the completeness to preserve the wholeness of the case; and d) multiple sources of data and data collection methods were used.

Although a case study research is widely used in academic areas, some scholars (Barratt et al., 2011; Dooley, 2002; Flyvbjerg, 2006; Gerring, 2004) have asserted that this methodology is not well understood and is problematic. The considerable time, resource requirements, and validity of findings can be negative consequences of case study research (Baškarada, 2014). Flyvbjerg (2006) pointed out five misunderstandings about case study research, observing that: "theoretical knowledge is more valuable than practical knowledge"; the findings cannot be generalised, meaning that "the single-case study cannot contribute to scientific development"; "the case study is most useful for generating hypotheses, whereas other methods are more suitable for hypotheses testing and theory building"; "the case study contains a bias toward verification"; and "it is often difficult to summarize specific case studies" (p. 219). Barratt et al. (2011) asserted that even though the evidence can be cross-checked using a triangulation technique, a case study only justifies its research ideas, may not clearly state its unit of analysis and finally it offers some insight but fails to advance new propositions or theories. They further cited Dooley (2002) who stated that there is no clarity in how a case study can build a theory. On the other hand, Gerring (2004) clearly asserted that a case study is "a particular way of defining cases, not a way of analysing cases or a way of modelling casual relations" (p. 341).

This study can be regarded as a collective case study as proposed by Stake (1995) because it examined three cases to obtain clearer understandings of the nature of the phenomenon under investigation (Houghton et al., 2013; Punch, 2014a, 2014b; Remenyi, 2012). Multi-cases from three different SPIE in DI Yogyakarta were described and compared to provide insight (Stake, 1995, cited in Creswell (2012, p. 465)) into the particular phenomenon of inclusivity in science teaching and learning. The collective case study assisted the researcher to examine the phenomenon from different perspectives (Creswell, 2007) by using the same protocol for each case as suggested by Yin (2014) and Miles et al. (2014). Despite the name, the "common theme" among collective case studies is that they look at a similar research question(s) inside a few settings, utilising identical techniques for data gathering and its analysis (Mills et al., 2010, p. 163).

A number of reasons underlie the rationale for the qualitative collective case study approach employed in this study. *First*, the research was intended to identify, investigate, and clarify the similarities and differences between the three cases using multiple sources of evidence and replication procedures. *Second*, this design allowed the researcher to gain a deeper understanding of participants' total experiences through generalising from specific instances. *Third*, the comprehensive understanding enabled the researcher to synthesise the findings and develop a model to better understand the phenomena. *Fourth*, several scholars have advocated for the use of this research design in educational settings (Harrison et al., 2017; Mills et al., 2010; Yin, 2009; Zucker, 2009).

3.1.2 Theoretical Perspective – Interpretivism

"The theoretical perspective provides a context for the process involved and a basis for its logic and its criteria" (Crotty, 1998, p. 66). Interpretivism is the theoretical perspective that lies behind the selection of a qualitative case study as the method used in this research, as this study aimed to understand how individuals or groups of people perceived their environment (Fraenkel & Wallen, 2003) and their "social reality" (Crotty, 1998, p. 66). Knowledge is delivered by investigating and understanding the social world of the general population being considered and concentrating on their "meaning and interpretation" (Creswell, 2013, pp. 24-25; Denzin & Lincoln, 2003, p. 33; Ormston et al., 2013, p. 12). In other words, "[m]eanings are constructed by people as they engage with the world they are interpreting" (Flood, 2010, p. 8).

This study focused on the participants' views, beliefs and understandings about inclusivity in science teaching and learning, therefore, an interpretivist approach was appropriate. The interpretivist approach "looks for culturally derived and historically situated interpretations of the social life-world" (Crotty, 1998, p. 67). The phenomenon of inclusivity in this study is revealed by paying attention to the details arising from participants, which may be visible but sometimes invisible in many aspects; and where the researcher adopted the participants' perspective to create meaning (Sadala & Adorno, 2002).

3.1.3 Research Epistemology – Constructionism

Epistemology is the foundation of knowledge (Cohen et al., 2013), "the theory of knowledge embedded in the theoretical perspective and thereby in the methodology" (Crotty, 1998, p. 3). "Epistemology has its aetiology in Greek where the word episteme, means knowledge" (Kivunja & Kuyini, 2017, p. 27). Gray (2013) affirmed that having an epistemological stance is essential to help the researcher clarify issues in the research design, i.e. gathering data, interpreting the findings, and recognising which design will best achieve the research objectives.

The theory of knowledge embedded in interpretivism is constructionism, and this study attempted to understand the collectively generated meaning of the phenomenon. Constructionism was believed to be the most suited as the epistemology, because inclusivity in this study was an approach to working with SWD that was "constructed by human beings as they engage with the world they are interpreting" Crotty (1998, p. 43). Constructionism "asserts that social phenomena and their meanings are continually being accomplished by social actors" (Bryman, 2016, p. 33). Refuting the idea that there is one truth that can be known, constructionists believe that "reality … is completely subjective and need not be something that can be shared by anyone else but at the same time it is independent of the person living it" (Darlaston-Jones, 2007, p. 19) and therefore the meaning of inclusivity needs to be interpreted and constructed based on the participants' perspectives and views.

3.2 Method: Case Selection, Recruitment, Data Collection and Analysis

The present study was conducted in three SPIE in DI Yogyakarta, Indonesia. The following section details case selection (Schools A, B and C) procedures, participant recruitment, data collection and data analysis techniques.

3.2.1 Case Selection Procedures

Qualitative research, unlike quantitative research, does not require a standard sample size to obtain deep information about a smaller number of people and cases (Byrne, 2001; Marshall, 1996). In a qualitative study, according to Luborsky and Rubinstein (1995), participants as meaning makers and carriers are more valuable than the size and variability of the sample. Luborsky and Rubinstein (1995, p. 105) added that for one qualitative study, 12 to 26 persons as participants is an appropriate sample size. Marshall (1996), moreover, asserted that another aspect that indicated the appropriateness of sample size for a qualitative study was data saturation, when no further categories, themes or explanations could be gathered from the data.

A sampling strategy that is often employed in qualitative research is non-probability sampling, particularly using a purposeful sampling technique. Non-probability sampling is usually used in small-scale but in-depth studies where generalisation of the findings is not the focus (Cohen et al., 2013) but rather the focus is on "the exploration and interpretation of experiences and perceptions". Creswell (2007) defined purposeful sampling as a strategy where the "inquirer selects individuals and sites for study because they can purposefully inform an understanding of the research problem and central phenomenon in the study" (p. 125). Lodico et al. (2006) emphasised that a purposeful sampling technique was used to identify "key informants: persons who have some specific knowledge about the topic being investigated" (p. 140) rather than using large and representative samples.

When a case study is selected as the research methodology, two levels of purposeful sampling are conducted (see Figure 3.2). The first level is to select the case(s), such as "an institution, a program, or an intervention" and continue with the second level, selecting the participants (Merriam, 2009, p. 267). In this study, the first level involved selecting inclusive schools as the cases and at the second level selecting participants: science teachers, support teachers, principals, the head of the inclusion program and SWD. The selection of both cases and participants was based on several predetermined criteria (see Table 3.1), which were derived from the purpose of the study. These criteria then guided the selection process of "information-rich cases" suitable for the study (Patton, 2015, p. 53).

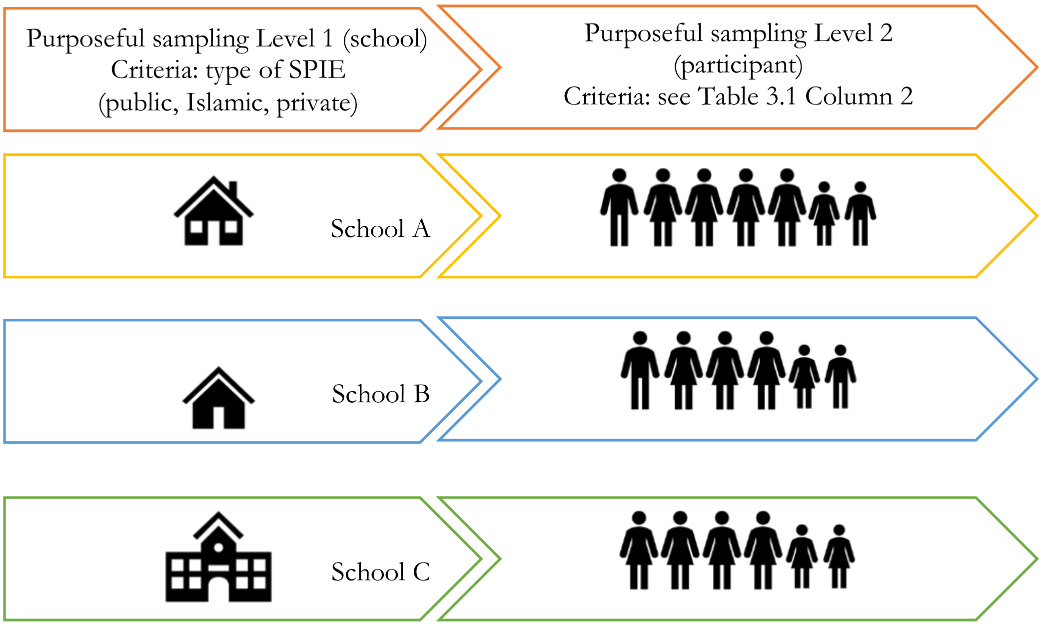


Figure 3.2 Two levels of purposeful sampling

This study was conducted in three SPIE Grade 7-9 located in DI Yogyakarta, Indonesia: School A (a public school), School B (a private Islamic school) and School C (a private school). As stated in the Ministerial Regulation No. 70/2009, a School Providing Inclusive Education (SPIE) is defined as a regular school that welcomes students with special needs and provides an education service system tailored to their needs (MONE, 2009).

3.2.2 Participants and Recruitment of Participants

The careful selection of participants is crucial because they are required to respond clearly to each research question to build a comprehensive understanding about the issue under investigation (Bryman, 2016). Participants were selected purposefully from three SPIE in

DI Yogyakarta. To recruit potential participants (see Figure 3.3), The Department of Education, Youth and Sports (Dikpora) of DI Yogyakarta was invited to act as the gatekeeper as data for all SPIE are kept in this department. Mailed letters were sent to all participants through the gatekeeper and included: an invitation to participate; a brief description of the study and its aims; an information sheet indicating what participants would be asked to do; a consent form; and ways (letter, email, telephone or SMS) to contact the researcher for more information and to indicate interest.

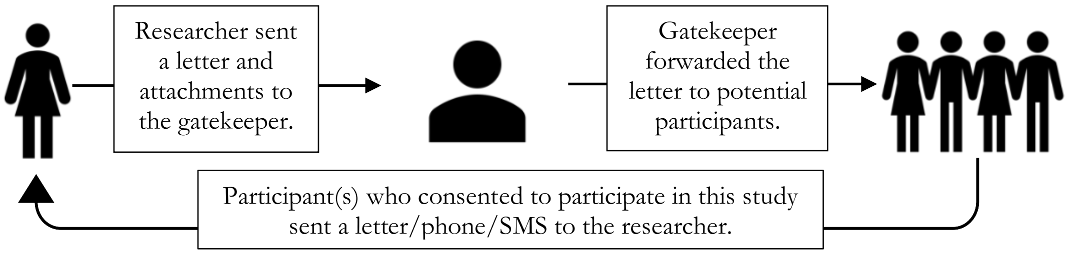


Figure 3.3 Recruitment process of participants

Because this study involved SWD, a different method of selection of these participants was conducted. Potential student participants were chosen by their science teachers as they had a greater understanding about meeting the criteria for SWD requested by the researcher. The research administration documents such as the invitation letter for participation, the brief description and aims of the study, information sheet, and consent form to be signed by parent and student, were given to the parents via their children and, when signed, they were returned to the science teacher and then to the researcher.

Nineteen participants from the three schools were involved in this study and were divided into four categories, namely: science teacher, support teacher, principal, and SWD. School A provided one additional participant, The Head of the Inclusion Program, which was recommended by the principal as she was considered to be one of the key actors who had better understanding, knowledge and experience regarding the practice of inclusive education in School A. The demographics of the participants in this study can be seen in Table 3.1.

Table 3.1 Demographics of participants

Type of participant	Criteria of selection	School	Type of School	Name	Sex	Age (years)	Experience in accompanying SWD (years)	Teaching Grade/Grade
Science teacher	Minimum three years of experiences	A	Public	Melissa	Female	31 – 40	> 15	8, 9
		A	Public	Susan	Female	41– 50	> 5	7
		B	Islamic private	Shirley	Female	31 – 40	> 5	9
		B	Islamic private	Tiffany	Female	31 – 40	> 5	7, 8
		C	Private	Ann	Female	21 – 30	> 5	7, 8, 10, 11
		C	Private	Sarah	Female	31 – 40	> 5	8, 9, 11, 12
Support teacher	Minimum three years of experiences	A	Public	Julie	Female	51 – 60	> 30	7, 8, 9
		B	Islamic private	Irene	Female	31 – 40	> 5	7, 8, 9
		C	Private	Donna	Female	31 – 40	> 10	7, 8, 9, 10, 11, 12
Principal	No criteria	A	Public	Harry	Male	51 – 60	< 2	
		B	Islamic private	Arthur	Male	41 – 50	> 15	
		C	Private	Linda	Female	41 – 50	< 2	
Head of Inclusion Program	Principal's recommendation	A	Public	Lilly	Female	41 – 50	> 20	
Students with disabilities	Student with hearing impairment	A	Public	Alex	Male	13 – 15		Grade 8
		A	Public	Angie	Female	13 – 15		Grade 7
	Student with visual impairment	B	Islamic private	Nanda	Male	13 – 15		Grade 8
		B	Islamic private	Amy	Female	13 – 15		Grade 9
	Student with learning difficulties	C	Private	Ben	Male	13 – 15		Grade 7
		C	Private	Felix	Male	13 – 15		Grade 8

The 19 selected participants indicated their willingness to participate and answer questions about the practices of learning and teaching in science classes. The science teacher participants were all female and had worked teaching SWD for more than five years. Likewise, all support teachers were female and experienced in assisting SWD for more than five years. Two support teachers (Julie and Donna) had a Special Education background. Julie was a teacher from another Special School who had been assigned as an itinerant support teacher for School A by the Dikpora from the time School A had welcomed SWD in 1984. Donna, the support teacher in School C, was a Coordinator of Student Affairs and responsible for the Development of the Inclusive Learning Programs. The support teacher in School B, Irene, was not an official support teacher but she was asked by the school to assist SWD with entrepreneurship-related subjects and her educational background was science at the secondary school level.

Harry, the Principal of School A, acknowledged that he had only served School A for two years so he admitted that he did not understand deeply the ins and outs of inclusive education practices in School A and delegated all his authority to the Head of the Inclusion Program, who he recommended for interviewing. Likewise Linda, the principal of School C, had only accepted the position of principal less than two years before these data were collected, even though she had previously been a Javanese Language teacher for more than five years in the same school. Arthur, on the other hand, had served School B for more than 15 years.

The SWD participants were recommended by their science teachers because they were considered to match the characteristics of the participants desired by the researcher. Alex was a hearing-impaired student from School A who was able to hear from a distance of five metres. He was in Grade 8 when the interview was conducted. Alex could still communicate orally but he could not use sign language. Angie was also a hearing-impaired student in School A. She had very little hearing and used sign language. She was in Grade 7 at the time of the interview. Nanda was a boy with low vision in School B. He could distinguish objects from five metres and was in Grade 8. Amy, a female-year-nine student of School B, was totally blind. Both Nanda and Amy had good mobility skills and used long white canes for independent travel around school and in the wider environment. Ben, a Grade 7 student, and Felix, a Grade 8 student, both had learning difficulties and attended School C.

3.2.3 Data Collection Procedures

The data were collected through procedures of case study protocol as follows.

3.2.3.1 Informed Consent

Informed consent (see Appendix 3 for all documents referred to in this section) was acquired from each participant before data were collected. All potential participants were provided with an official letter of introduction from the principal supervisors of the project; an information sheet that explained the study's purpose, its voluntary nature, confidentiality and anonymity assurances, potential risks, benefits, data use and storage; and a consent form. For SWD, the parental consent form requested parents' as well as their children's signatures. The Letter of Introduction from the researcher's principal supervisor provided information on how this study (as partial fulfilment of the researcher's Doctoral program) would be conducted. The information sheet provided a description and outlined the purpose of the study, what participants would be asked to do, the risks and benefits, a confidentiality statement, compensation and contact information. The consent form informed the participants that participation was voluntary and that he or she was free to leave the study at any point. All participants signed the form indicating their willingness to participate. The researcher also signed the consent form, which was required before the interviews were conducted, and both researcher and participant were given a signed copy to keep.

After receiving the information kit, participants were encouraged to contact the researcher or supervisors if they had questions. Before the interview, the researcher reminded participants that, despite signing the consent form, they could withdraw from the study at any time and their data would then be destroyed. All participants were given a telephone number for free counselling services should the interview raise issues of concern to them. The researcher was also sensitive to signs of distress during interviews. Data provided by participants used in this study were de-identified and a pseudonym given to each participant.

3.2.3.2 Questionnaire Distribution

Six science teachers were sent the qualitative questionnaire to be completed at a place and time of their choice and returned to the researcher directly. Once submitted, the participants were contacted via WhatsApp (WA) or telephone to set a time for the interview.

3.2.3.3 Interview Guide

The researcher conducted individual interviews at a time convenient to the participants. Interviews were conducted in private to ensure confidentiality, which contributed to the validity of this study. The interview guide used was divided into six sections (Appendix 4). Section One, the introduction, was designed to determine how participants felt about welcoming SWD into their science classes. The second to fifth sections addressed research questions one to four. The last section explored the strengths and hindrances of the inclusive education practices in the participants' schools. Additional probes delved further into some questions. All interviews were recorded then directly transferred to the researcher's personal computer to be transcribed and uploaded to the NVivo software for analysis.

3.2.3.4 Classroom Observation

Times for classroom observation were negotiated with the participant science teachers. Once the schedules were established, the researcher conducted each observation in a position that would not disturb the class. Before the observation began, the science teacher introduced the researcher and the purpose of the observation to the students.

3.2.3.5 Documents Collection

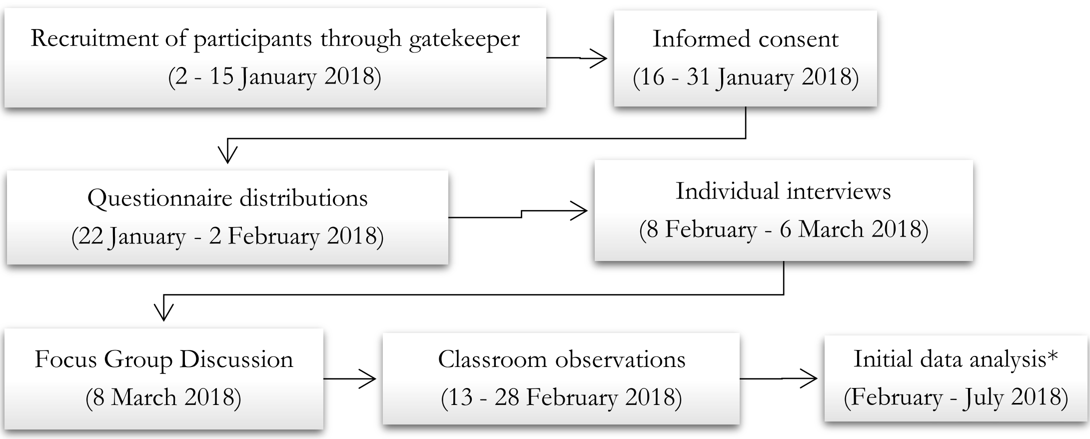
The researcher provided a list of documents to the science teacher participants, such as the syllabi, lesson plans, teaching materials and assessments sheets that were relevant to this study. When ready, the science teachers notified the researcher who collected the documents.

3.2.3.6 Study Closure

After completing data collection, participants received a letter expressing gratitude for their participation and participants were notified that a summary of the research would be communicated to them, either verbally by telephone or by mail, when the final results had been compiled. Each teacher participant, upon completion of their input, received an incentive of IDR250,000 and a book voucher to the value of IDR100,000 was given to the student participants.

3.2.3.7 Timeline

The timeline required for data collection was seven months (see Figure 3.4), starting from recruiting participants to distributing questionnaires, interviewing, collecting documents, observing in classrooms and the school environment, and including initial data analysis.



* tabulating questionnaires, transcribing interviews, tabulating observation field notes

Figure 3.4 Data collection timeline

3.2.4 Data Collection Techniques

Generally, qualitative studies focus on "what", "why" and "how" questions rather than on "how many", and the research designs are more flexible than quantitative inquiries (Ormston et al., 2013, p. 3). Braun and Clarke (2013) asserted that qualitative research data often focus on words rather than numbers, that the volume and richness of these data are often emphasised, as are the distinctive approaches of researchers to analysing, interpreting and deriving the findings. "In case study research, the researcher collects extensive data on the individual(s), program(s), or event(s) on which the investigator is focused" (Leedy & Ormrod, 2016, p. 149).

Four techniques (questionnaires, interviews, observations and document analyses) in data collection enabled the researcher to explore multiple sources of evidence (Yin, 2014) and assisted the researcher to deal with the issue of trustworthiness (Shenton, 2004). Having decided on the most appropriate data collection techniques, the researcher mapped out which methods were to be used to answer each sub-research question (see Figure 3.5).

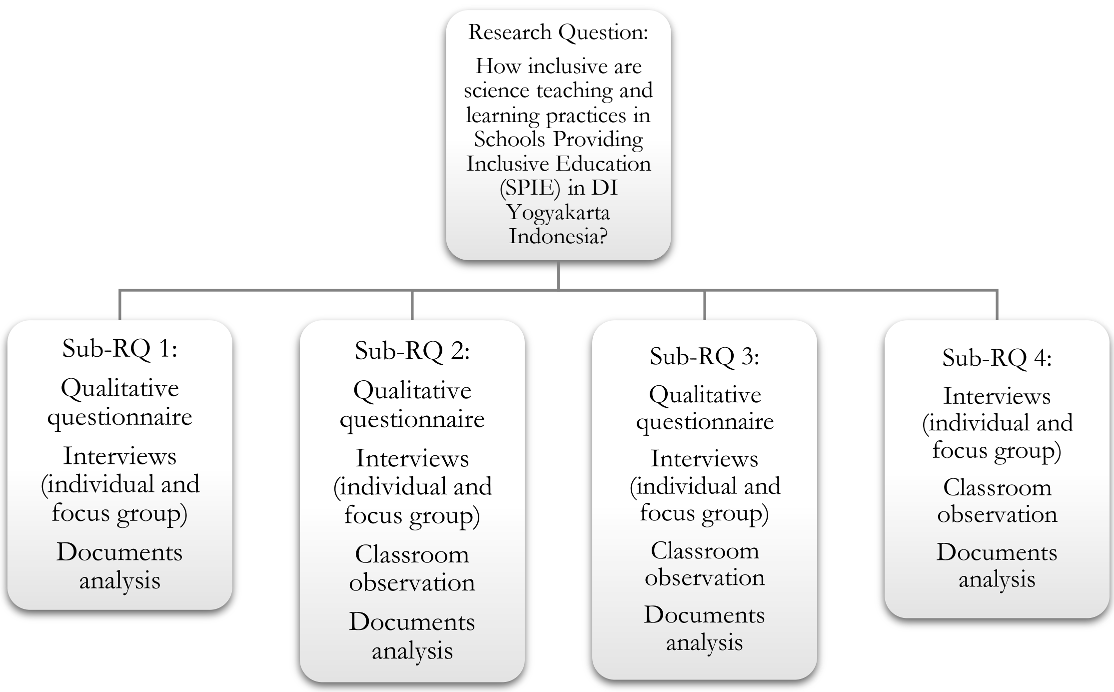


Figure 3.5 Mapping of the sub-research questions and data collection techniques

Data collection techniques for this qualitative collective case study involved participants in four activities, namely, providing responses to the open-ended qualitative questionnaire for the science teachers, individual interviews with all participants, science classroom observations and instructional documents analysis. After the individual interviews with six science teachers, a focus group was conducted with them.

3.2.4.1 Qualitative Questionnaire for Science Teachers

According to Yin (2009), questionnaires in a qualitative case study are considered useful to answer the 'what' and 'how' questions. As a preliminary analysis, a questionnaire (Appendix 5) was used to capture the science teachers' existing experiences in setting learning goals, practising pedagogy and assessing SWD learning progress. This questionnaire explored the diversity of beliefs, perceptions, and experiences rather than the frequency distribution usually captured by quantitative surveys (Jansen, 2010). The ordinal data of the questionnaires were tabulated and the median for each question was calculated to observe the science teachers' tendency in their activities in each case/school, then for comparing and contrasting the three cases. According to Maxwell (2010), including numbers in qualitative research has several benefits including: contributing to "internal generalizability"—"generalization within the setting or collection of individuals studied, establishing that the themes or findings identified are in fact characteristic of this setting or set of individuals as a whole" (p. 479); enabling the researcher "to identify and correctly characterize the diversity of actions, perceptions, or beliefs in the setting or group studied" (p.479); assisting the researcher "to identify patterns that are not apparent simply from the unquantitized qualitative data" (p. 480); and helping the researcher "to adequately present evidence for … interpretations and to counter claims that … [the researchers] have simply cherry-picked … [the] data for instances that support these interpretations" (p. 480). The findings from the questionnaire were then clarified through the individual interviews.

3.2.4.2 Individual and Focus Group Interviews

The researcher conducted one-on-one interviews with all participants and directed the focus group interview with the six targeted science teachers. Semi-structured questions were delivered to the participants to explore their experiences in science teaching and learning practices catering for SWD. Daymon and Holloway (2002) asserted that focused interviews can be more adaptable and can enable the researcher to better comprehend the points of view of the interviewees. Focused interviews can also refocus the inquiries, produce more data and enable the researcher to clarify the purpose of the study. The focus group was designed to clarify participants' understandings and extend their insights into the concepts (Cohen, 2000; Cohen et al., 2013).

The interview guide (Appendix 4) was used to provide a framework for the discourse and to ensure consistency in gathering information from every interviewee, as suggested by Patton (2002). Interviews with students with hearing impairments did not involve a sign language interpreter; rather a written form was used to communicate with them. Each interview lasted between 60 to 90 minutes with the average completion time being 50.12 minutes with science teachers, 42.04 minutes with support teachers, 36.26 minutes with principals, 22.12 with SWD and 65 minutes with the head of the inclusion program of School A. The interviews were transcribed and coded using NVivo software. Authorisation to record the interviews was requested and anecdotal data were recorded.

The research sites were located in the District of Bantul and the Yogyakarta Municipality in the Province of DI Yogyakarta, Indonesia. The participants spoke Bahasa Indonesia and Javanese—a home-grown language of DI Yogyakarta—therefore, the interviews were conducted in these two languages to enable a more free-flowing conversation and in recognition of the caution by Liamputtong (2009) that the language used can impede the nature of the interview. The responses were transcribed and then translated from Bahasa Indonesia and Javanese into English and then adjusted grammatically from the Indonesian to the English context. The English translation was then reviewed and checked back and forth from the primary sources to manage and control the original meaning.

During the individual and focus group interviews, field notes were written to record the behaviours, manner, activities, and other events that participants demonstrated, and initial interpretations were made. The interviews and additional notes were useful to enrich the interview data. In addition, reading the field notes before transcripts are done helps the researcher to "make sure the inquiry is unfolding in the hoped-for direction and can stimulate early insights that may be relevant to pursue in subsequent interview while still in the field" (Patton, 2015, p. 473).

3.2.4.3 Classroom Observation

Observations of the teaching and learning activities that occurred in the science classrooms were recorded in field notes (Appendix 6). These field note forms helped the researcher to capture the teaching and learning process more clearly. Observations were also conducted on the physical buildings and facilities for SWD in each school. All observation field notes were tabulated on the same day as the relevant interview.

3.2.4.4 Document Collection

Documents related to science teaching and learning practices (e.g. the existing science curricula, lesson plans, teaching materials, learning materials for SWD, sets of assessment, vision and mission of the schools) were gathered and analysed during the process of data collection.

3.2.5 Data Analysis

Data collected were categorised, indexed, and cross-referenced to capture emerging themes. Data analysis was conducted virtually simultaneously with data collection, as recommended by Merriam and Tisdell (2016) and Miles et al. (2014) because such a process enables researchers "to make quick adjustments to study design as required" (Gao, 1990, cited in Baškarada (2014, p. 14). The data collected in this study were analysed both inductively (by coding the data patterns and discovering potential relationships and themes) and deductively (by using the researcher's previously determined UDL theoretical framework to guide the analysis), followed by establishing themes and cross-case analysis (Yin, 2014) as described in Figure 3.6.

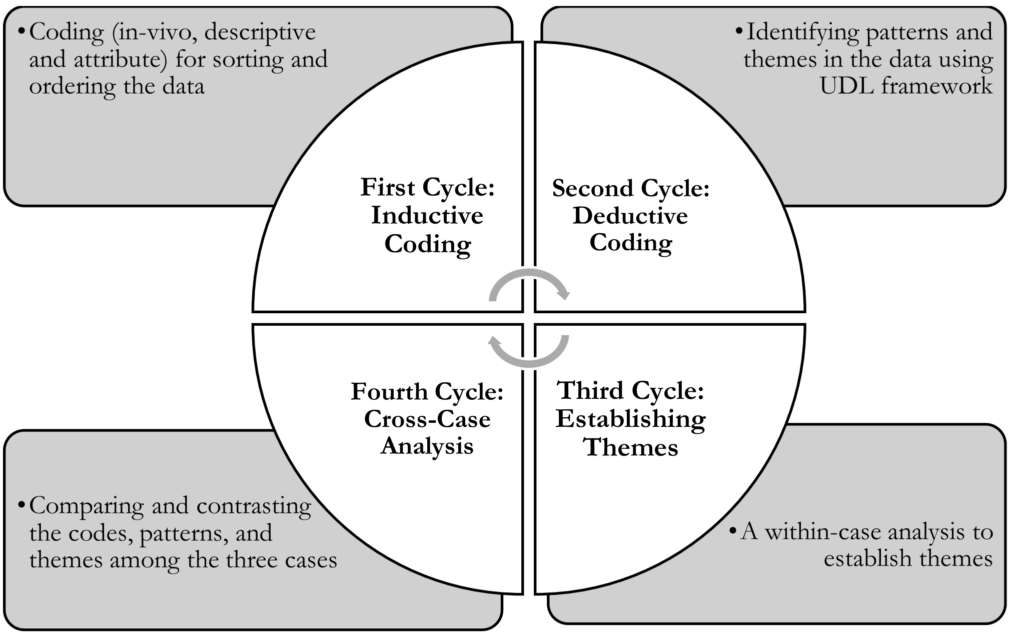


Figure 3.6 Data analysis process (adapted from Yin (2014))

Data in this research were gathered from four sources, and data were analysed in cycles for each case (Miles et al., 2014).

3.2.5.1 First Cycle: Inductive Coding

Prior to the first cycle of data analysis, all the transcripts, field notes and documents were read and reviewed, and memos were added (Creswell, 2013) using NVivo software Version 11.4.3. As suggested by Yin (2009), software may help with the coding and categorising of a large amount of text. Different types of codes were created, tagging the relevant data (Miles et al., 2014; Saldana, 2009) in order to create a pattern of emergent themes. In-vivo/literal codes using the "own language" of the participants that best described the data and descriptive codes were created to summarise the basic topics/issues in the data (Miles et al., 2014, p. 74). Data were also classified based on their type (e.g. interview, observation, documentation), time, and participants using attribute codes (Miles et al., 2014). The coding results were then grouped in relation to the relevant topic or issue. Inductive coding was conducted repeatedly using an iterative process—"going back and forth repeatedly on the data" (Kekeya, 2016, p. 86)—at different times and in various environments to get better results.

3.2.5.2 Second Cycle: Deductive Coding

The second cycle was essential to gaining a better understanding of what the participants said by identifying units that were relevant to the study using deductive coding. An existing framework, the UDL, was employed to identify patterns and themes that emerged from the data (Patton, 2015). Coding and memo-ing, using NVivo software to narrow the emerging patterns and themes within cases (Schools A, B and C), was followed by content analysis to identify patterns that emanated from the questionnaires, interviews and observations. The results of this deductive coding established which findings were relevant and which were not. The relevant coding was again checked and grouped according to particular themes, while data that were not pertinent were stored in a separate folder. The results of coding, categorising and the appearance of themes and their relationship to research questions can be found in Appendix 7.

3.2.5.3 Third Cycle: Establishing Themes

In the third cycle, pattern coding was conducted to further categorise data and to establish themes (Yin, 2014). The patterns were compared from descriptive coding that emerged from the questionnaires, interviews and observations that demonstrated teaching and learning activities for SWD. The deductive coding in the third step enabled the researcher to explore a particular theme and reflect again on whether this theme could answer the research questions posed. Once the pattern was established and the theme was determined, the researcher re-analysed the data for each case for the within-case analysis (Creswell, 2007; Creswell, 2013) according to the predetermined themes which are described in Chapters 4, 5 and 6.

3.2.5.4 Fourth Cycle: Cross-Case Analysis

The descriptive expressions and themes were ascertained in the fourth step, and "cross-case analysis or cross-case synthesis" (Creswell, 2007, p. 75; Creswell, 2013, p. 101; Yin, 2014, p. 164) was instituted. The themes and patterns that emerged from the cross-case analysis were used to review and answer each research question. According to Yin (2014), in a cross-case analysis, findings among cases are aggregated; however, differences in cases deserve to be considered and reported as well.

3.3 Evaluating the Methodology - Trustworthiness

The literature notes that the quality of qualitative case study research is often under critique in terms of its reliability, validity and generalisability (Creswell, 2009; Punch, 2005; Punch, 2014b). Merriam and Tisdell (2016) highlighted that to ensure validity and reliability, triangulation is suited to an interpretive-constructionist approach. To evaluate the trustworthiness of the research process, it is important for researchers to describe in detail how they analyse the data and to articulate what assumptions inform their analysis (Nowell et al., 2017). Providing "well-chosen examples and quotes" also offers the readers a closer relationship with the phenomenon (Halling, 2002, p. 30). To ensure the trustworthiness and answer the question the researcher needs to consider: Can the finding be trusted? Trustworthiness of this study was established by adopting four criteria proposed by Guba (cited in Forero et al. (2018); Korstjens and Moser (2018); Nowell et al. (2017); Shenton (2004)), which are: credibility, transferability, dependability and confirmability.

3.3.1 Credibility

The credibility of this study was ensured by using: a purposeful sampling technique in recruiting participants; a thick description of the phenomenon being studied (Patton, 2015); frequent debriefing with supervisors and peer researchers to shape the research toward more credible findings; and triangulation. Method triangulation (i.e. questionnaire, interview, observation and document analysis) and data source triangulation (i.e. science teachers, support teachers, principals, SWD and the head of inclusion program) were applied in this study to "test for such consistency" (Patton, 2015, p. 317) in information derived at different times and by different means (methods and sources), and "to get richer, fuller data and/or to help confirm the results of the research" (O'Cathain et al., 2010, p. 74). Peers were engaged to check the translation of interview questions and transcripts because the interviews were conducted in languages other than English.

3.3.2 Transferability

To assure the transferability, "background data" were obtained to determine contexts, and comparisons were made by detailing the phenomenon in question (Shenton 2004, p. 73). The background of every participant and the contexts being studied were provided. The background outlined the number of schools involved, any restrictions occurring, the number of participants involved, information gathering techniques utilised in this study, and the time of information gathering.

3.3.3 Dependability

The dependability of this study employed overlapping techniques (a qualitative questionnaire, interviews, observations and documents analysis—methods triangulation) to allow the study to be replicated (Shenton, 2004). Data gathering from different sources were analysed and cross-checked (triangulated) thoroughly. Moreover, the dependability of this study was also enabled through appropriate methodology. In keeping with a qualitative case study methodology as outlined by Yin (2014), the researcher ensured steps were made explicit and sequential, which would allow them to be replicated by other researchers. By doing so, the possibility of repeating the study has been enhanced.

3.3.4 Confirmability

To ensure confirmability, a detailed description of the method has been explained to help readers "to determine how far the data and constructs emerging from it may be accepted" (Shenton, 2004, p. 72). *First*, the researcher's beliefs and assumptions are acknowledged. *Second*, a fair elaboration of the shortcomings in terms of method and its potential effects are addressed. *Third*, a detailed description of the method is explained to help readers understand how the findings were constructed and formulated to enable them to accept the results.

3.4 Ethical Considerations

A high level of ethical regard was established throughout the process of this research. The researcher considered the ethical issues according to two categories. *First* were issues related to ethical and professional conduct during data collection, addressed by avoiding conflicts of interest and involving voluntary participants who consented freely to the research. Before data collection began, all participants signed the consent form and the researcher ensured that confidentiality was maintained and that only the researcher and supervisors had access to the data. Approval was sought from the Social and Behavioural Research Ethics Committee of Flinders University on 22 December 2017 (Appendix 8).

Second were any ethical issues discovered as the research developed. As Punch (2016) summarised, the main ethical issues could be "harm, consent, deception, privacy and confidentiality of data" (p. 31). Care was taken to ensure participants did not experience any harm or risks due to this research, by giving each participant detailed information about the scope and purpose of the study. Care was also taken to ensure participants' comments were not misrepresented, by providing the opportunity to check the transcript of their interviews. Interviews occurred at a location and time of the participants' preference to preserve their anonymity, confidentiality and privacy. Interviews with SWD were carried out outside of class hours to maintain the anonymity of the SWD from their peers and other teachers. Participants could terminate their involvement whenever they choose without consequence, as confirmed in the consent form. The identity of participants was and remains confidential and pseudonyms were used to ensure they cannot be identified. Because of the small number of participants, however, anonymity cannot be guaranteed. This research did not have any deceptive elements; and to demonstrate transparency, participants were offered a synopsis of the report.

3.5 Technology and Data Security

Data security was one of this study's concerns. All data—qualitative responses, interview transcripts, observation field notes and other identifying information concerning the participating subjects—were saved on the researcher's personal computer with password encryption to ensure security and safety. Audio recordings of interviews and full transcripts were stored in locked file cabinets. Backup copies of the transcript were also stored on Flinders University computer server for safety. Backed-up data were stored on a password-protected external hard disk. All physical documents and notes will be kept in a locked cabinet for three years to 2024, following the completion of this study.

3.6 Summary

This chapter has examined the research paradigm used in the study and the rationale behind the selections of a qualitative collective case study, interpretivism and constructionism. To better understand the phenomenon of inclusivity in science teaching and learning offered in three SPIE, a qualitative collective case study was employed. To achieve the aim of this study, this chapter additionally described the research methods, i.e.: case selection, participants' recruitment, and the four instruments (a qualitative questionnaire, interview guides, observation sheets, and document analysis sheets) employed in the data collection procedure and technique. The major activities used in the investigation, including accounts of how the data collected were analysed through the four cycles recommended by Yin, were also delineated. The chapter concluded with the evaluation of the methodology of the study, including the issues of trustworthiness that were embodied in the research, and a clarification of the ethical considerations and data security.

Chapter 4
Within Case Analysis of School A

Chapter Four presents the analyses and findings of the first case, School A. The findings and analyses are based on four data sources—the interviews, questionnaire data filled out by the science teachers, science classroom and physical building observations, and instructional documentation—and these are organised into four themes and sections. Before the in-depth analysis is presented, a brief explanation of School A's profile is provided to gain an understanding of its context.

4.1 Profile of School A

School A is a public School Providing Inclusive Education (SPIE). This school provides free tuition, receiving funding via the public education budget from the Department of Education and Sports (Dikpora) of Province Daerah Istimewa (DI) Yogyakarta through the School Allocated Budget (BOS) and parents contribute small amounts for certain school programs. Among 723 students enrolled in the academic year 2017/2018, 24 of them were students with disabilities (SWD), including cerebral palsy, autism, slow learner, students with hearing impairment (HI), students with vision impairment (VI) and physical disabilities.

School A has welcomed SWD since 1982. At that time, the term 'inclusive school' was not in use but rather the term 'integrated school' was used and only students with VI (total blindness and low vision) were accepted. School A was officially labelled as an SPIE in 2011 by the Dikpora and this school began by receiving five students with HI (Lilly, interview/08/02/2018). The Dikpora provided School A with a support teacher who attended twice a week, on Fridays and Saturdays[2], to assist SWD.

Commencing with the academic year of 2006/2007, School A had adopted the 2006 Curriculum for Grades 7 to 9. Then, from the academic year of 2016/2017 onward, School A gradually implemented the 2013 Curriculum for Grade 7, replacing the 2006 Curriculum.

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[2] Most public schools in Indonesia run their educational process over six days (Monday to Saturday).

When data were collected, this school had adopted two curricula, i.e. Curriculum 2006 for Grade 9 and Curriculum 2013 for Grades 7 and 8.

Despite the various types of SWD, this study focused on how science teachers (Melissa and Susan) in School A created inclusive science classrooms opening access to learning science for SWD, especially for students with HI. The perspectives and experiences of two students with HI (Alex and Angie), their support teacher (Julie), the head of inclusion program (Lilly) and the principal (Harry) were also gathered to reveal how science classrooms were made inclusive for all students.

4.2 Theme 1: Goal-setting for Students with Hearing Impairment

Findings of this study are addressed by describing the participants' perspectives and experiences in answering Research Question 1: "How do science teachers set goals for students with hearing impairment?", categorised into four sub-themes.

4.2.1 Establishing Expectations for Students with Hearing Impairment

Teachers' and principal's interviews indicated that students with HI were expected to gain social skills rather than academic ones. Lilly said: "This school only expects one thing, to prepare students to live a normal decent life in the community, live with a good standard. Within our limitations, provision is made to equip them" (interview/08/02/2018). Julie expected that SWD could learn and be role models for their junior counterparts. Julie said:

> My expectation is that hopefully, they can learn well. Their abilities can be developed, can be accomplished; can fulfil their needs and can also work with others, can be a role model for their juniors [as a SWD]. Proving that a child with disabilities does not always ask for pity. He can excel as others (interview/10/02/2018).

In another view, Susan expected that SWD could be equal to their peers, as she said: "though the child I was teaching has special needs, I hope at least she can be equal to the normal child" (interview/07/02/2018). Harry, the principal, asserted that all school members should be familiar with the inclusion concept. He expected all to accept the "inclusion and non-inclusion children[3]" and to treat SWD in the same way as others (interview/19/02/2018).

[3] School A uses specific terminology calling students with special needs 'inclusion children' and their peers without disabilities 'non-inclusion children'. This term is also found in other schools in Indonesia, as reported in a study by Andriana, E., & Evans, D. (2017). Why I am chosen as inclusion child? In V. Plows & B. Whitburn (Eds.), *Inclusive education: Making sense of everyday practice* (pp. 175-193). Sense Publishers.

Self-report written responses indicated that science teachers in School A always provided clear expectations to students with HI from the start of the course. Susan explained that she did this "to give understanding to the students in general and SWD in particular what the purpose of achievement in learning entailed" (questionnaire/02/2018). Melissa asserted (questionnaire) that she frequently defined high expectations for students with HI while Susan indicated that she sometimes did. Both teachers mentioned (in interview) that when teaching students with HI having no learning difficulties, they always set high expectations just as they would for their peers without disabilities, and sometimes even higher than average, but for students who also had lower cognitive abilities, Melissa indicated that she often held no predetermined expectation. Melissa, Susan, Julie and Lilly stated that, in general, disabilities (i.e. slow learner and hearing impairment) attached to the students made it harder for them to learn science and resulted in lower achievement than their peers without disabilities.

A finding from the interview with Susan confirmed that she realised that goal-setting for individual students at the start of the lesson was an important factor in helping students learn in the best way. Susan mentioned that science teachers should make a map of the standards (SK and KD) and learning objectives for SWD, because it would help the teacher to decide upon the appropriate teaching methods and assessments for students. On the other hand, Julie said that although science teachers might not set explicit goals, they did implement those which were expected of the students with HI. Julie said:

> Although the learning goals have not been written in the lesson plan, but in the implementation, our teacher already had a record, a note. She memorised all her students, especially student with special needs. … I realised that one of our weaknesses was to document what we have done, for example, writing the modification of learning goals in the lesson plan or we can say, writing a special lesson plan for students with special needs (interview/10/02/2018).

4.2.2 Reframing Standards as Learning Objectives

Sub-theme 2 documents science teachers in School A's experiences in reframing standards into learning objectives; they are presented in three points as follows.

4.2.2.1 Writing learning objectives

Several actions were taken by science teachers in School A when creating learning objectives for students with HI. As indicated by interview and lesson plan analysis, Melissa and Susan designed the learning objectives by considering the cognitive, psychomotor and affective learning domains as documented in Table 4.1. Science teachers mentioned that the learning objectives were not always determined by the teachers themselves, but sometimes taken from textbooks and the Science Teachers Working Group (or *Musyawarah Guru Mata Pelajaran*/MGMP), and modified as needed.

Table 4.1 The way science teachers in School A reframed standards into learning objectives

When reframing standards into learning objectives for SWD, I …				
Statement	Melissa		Susan	
consider the knowledge domain (cognitive)	frequently	Cognitive learning objective has been set by adjusting to the students with HI's level of cognitive/ability. .For example: learning objective for regular students is to "mention 5 examples of environmental issues", then for students with HI has been modified to "mention 3 examples of environmental issues".	always	Because if students could comprehend the knowledge as a target of national curriculum, then the cognitive learning objectives have been designed based on the standards (SK and KD), through several activities.
consider the skills domain (psychomotor)	frequently	Psychomotor learning objectives have been created by making adjustments for the ability level of students with HI. For example, avoiding discussion methods for students with HI because speech skills cannot be easily measured for them.	always	Psychomotor learning objectives have been designed when required for students to perform their laboratory skills, to prove in real terms. For example: learning objectives: calculate a leaf area or observe a water contamination through an experiment.
consider the attitude domain (affective)	always	Because it's expected that all students including SWD have a good attitude, the affective domain has been set as a characteristic that should be shown by them, such as discipline, respect, diligence, responsibility, carefulness, etc.	always	Attitude domain has been set through learning activities, not directly linked with the topic given. For example, students learn to respect the opinions of others when discussing, how students express their feedback when their peers are presenting their task.
Source: questionnaire/02/2018				

An example of how science teachers in School A translated the standards (i.e. KD) into learning objectives is given in Tables 4.2, which indicates that science teachers predominantly established cognitive learning objectives. Melissa used the words 'mention' and 'explain', which are associated with Levels 1 and 2 of Bloom's Taxonomy of Educational Objectives, whereas Susan also applied the words 'investigate' and 'construct', which are associated with Level 3 of Bloom's Taxonomy.

Table 4.2 The example of learning objectives made by science teachers

Teachers	Standards (KD)	Learning objectives
Melissa	Explain the relationship between processes that occur in the lithosphere and atmosphere with health and environmental problems.	1. The students will **explain** the notion of global warming. 2. The students will **explain** the impact of global warming. 3. The students will **explain** how to combat global warming.
Susan	Analyse the occurrence of environmental contamination and its impact on the ecosystem.	4. The students will **explain** the meaning of environmental contamination. 5. The students will **explain** various types of environmental contamination. 6. The students will **explain** the meaning of water contamination through investigation. 7. The students will **investigate** the influence of clear and polluted water on the condition (movement) of fish 8. The students will **construct** ideas on how to overcome and reduce water contamination.

Source: science teachers' lesson plans

Data from questionnaires showed that Melissa and Susan used two strategies (SMART and ABCD)[4] in creating learning objectives. Their statements are given in Table 4.3.

Table 4.3 Strategies used by science teachers when designing learning objectives

When setting up learning objectives and goals for SWD, I …

Statement	Melissa		Susan	
use a "SMART" (Specific, Measurable, Achievable, Relevant, and Timely) strategy	frequently	SMART strategy has been applied as a guidance for achievement. They can reach the objectives or not. Specific means I considered the type of disability of the students. Measurable means can be graded. Achievable means can be achieved by students with special needs by appropriate teaching method, for example, for the blind, using oral explanations and for hearing impaired using observations and many notes. By appropriate strategy, learning objectives can be easier to achieve.	frequently	SMART strategy has been used to set learning objectives that aligned with basic competencies that should be achieved and it's material that should be learned by students.
use an "ABCD" (Audience, Behaviour, Condition, and Degree) strategy	always	ABCD strategy has always been used when setting learning objectives and it is always stipulated in the purpose of learning. And to facilitate their achievement, learning objectives must be adjusted to the students with special needs' circumstances.	frequently	This strategy has been used to set learning objectives that lead students to have more confidence. And this strategy was suggested by the government.

Source: questionnaire/02/2018

4 Indonesian education system has two strategies, namely 1) Audience, Behaviour, Condition, and Degree (ABCD) and 2) Specific, Measurable, Achievable, Relevant, and Timely (SMART) in order to write learning objectives

Further, questionnaire analysis indicated Melissa frequently categorised learning objectives into essential and non-essential. Melissa and Susan's written statements are given in Table 4.4. In the interview, Melissa emphasised that she was more focused on the essential objectives, especially when they related to the National Examination, as SWD needed to pass the National Examination to graduate.

Table 4.4 The way science teachers in School A categorise learning objectives

When setting up learning objectives and goals for SWD, I …				
Statement	Melissa		Susan	
categorise the objectives into two groups: need-to-know (essential) and nice-to-know (important, not essential)	frequently	Learning objectives were categorised to simplify the learning process. The important objectives tried to be achieved (e.g. for National Exam), whereas the less important (additional material) might not be achieved.	sometimes	Essential means important as stated in the curriculum and it should be achieved, non-essential is as an additional material. For example: knowledge of waste management—with Reuse and Recycle, e.g. reusing plastic bag, recycling garbage from plastic wrap to produce a bag, purse, laptop bag, sandal, etc.—is essential to be learned.
Source: questionnaire/02/2018				

4.2.2.2 Aligning learning objectives with teaching method and assessment

Written responses and instructional documents showed science teachers in School A established content-based learning objectives that were measurable and achievable. Melissa asserted that she always set goals and objectives for students with HI that guided instruction and assessment, while Susan confirmed that she frequently adjusted the learning objectives, method of instruction and assessment for students with HI based on their abilities. Figures 4.1 and 4.2 show how Melissa and Susan's lesson plans were aligned with the learning objectives, the teaching method and the assessment.

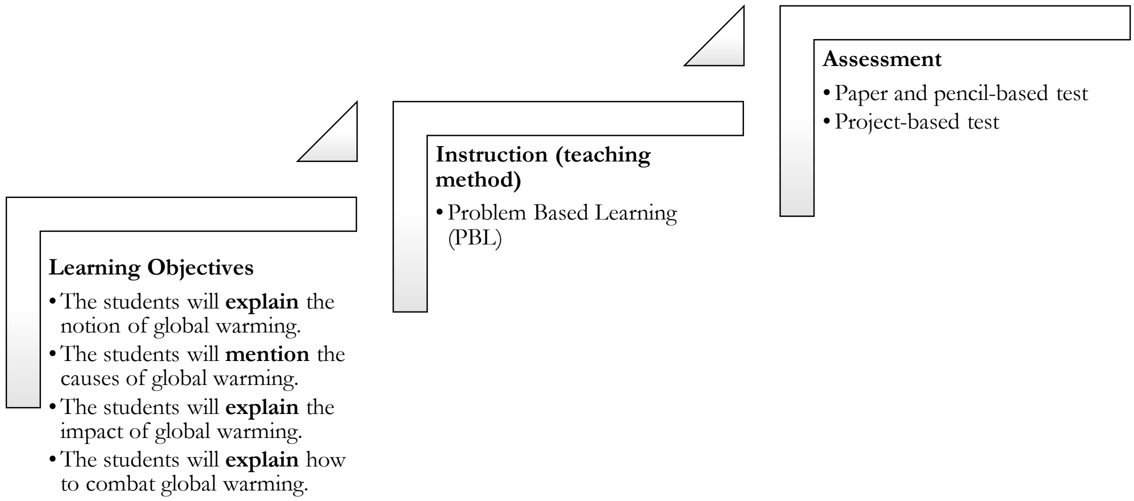

Figure 4.1 The alignment between learning objectives, instruction and assessment by Melissa

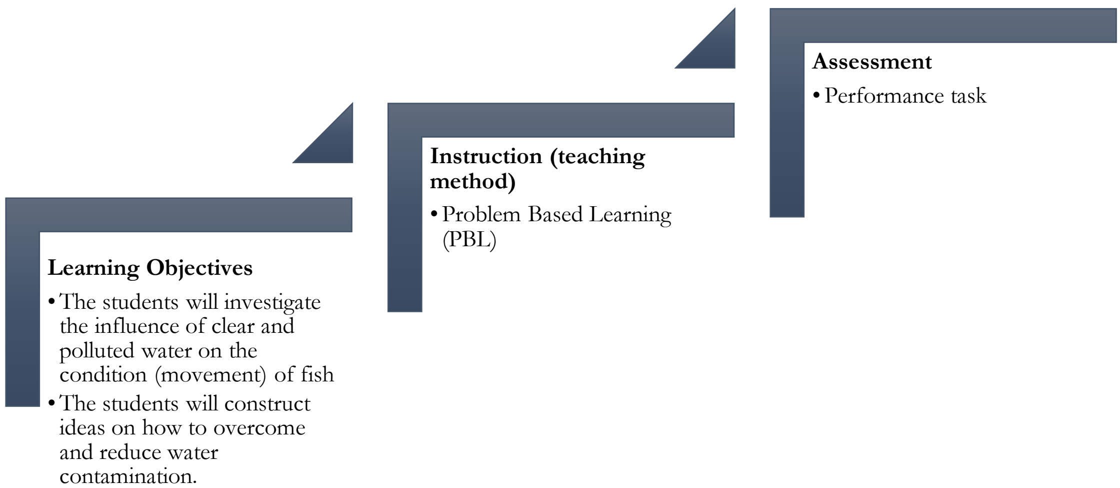

Figure 4.2 The alignment between learning objectives, instruction and assessment by Susan

4.2.2.3 Accommodating students with disabilities' needs when setting learning objectives

Evidence indicated that science teachers in School A established learning objectives that accommodated students with HI learning needs. In the questionnaires Melissa and Susan declared that they frequently implemented appropriate accommodations for students with HI by adjusting the standards (Susan) to increase students' motivation to learn science (Melissa). However, Melissa stated (questionnaire) that she rarely, while Susan said she frequently accommodated their personal interests and values. Further, Melissa and Susan both asserted (questionnaires) that they frequently invited students with HI to speak to them. Melissa wrote: "to help to overcome their difficulties, acknowledge their existence, make SWD feel cared for, and make me as a place to vent", while Susan mentioned: "I established a communication with parents, to help motivate SWD" (questionnaire/02/2018).

4.2.3 Modifying Learning Objectives for Students with Hearing Impairment

An analysis of lesson plans and syllabi indicated that no specific learning objectives were made for students with HI. As in Table 4.2, Melissa and Susan designed the learning objectives for general purposes, although Susan asserted that she made adjustments when catering for SWD in her classroom. She stated:

> Even though I made only one lesson plan for all, I have adjusted the learning objectives [for SWD] by cutting down the regular learning objectives. For example, I arranged 10 learning objectives for regular, then I only targeted six [learning objectives should be passed] for students with HI. It should be placed in the lesson plan, but sometimes I have no time. The only difference in learning objectives for regular and special needs was on how many [learning objectives] they should achieve (interview/07/02/2018).

Similarly, Melissa mentioned: "… her [students with HI] learning objectives were down-graded" (interview/10/02/2018). Melissa also highlighted this situation in the group interview (GI):

> When I created learning objectives for students with HI, I distinguished these from the regular students. The easiest way that has been implemented in this school is by cutting down the number of the learning objectives. First, I would check their ability, then if he or she has a certain ability level, I would cut down the learning outcomes for some of the points. For instance, the regular students should master more at the cognitive level [of Bloom's Taxonomy], they should achieve at a higher level than students with HI. If the regular students have six learning objectives, then the students with HI can pass only two objectives (GI/08/03/2018).

While Julie indicated:

> We [teachers], especially me, only made one lesson plan for one topic. In this lesson plan, we defined learning objectives that should be achieved by all students. I usually wrote a note under the learning objectives to distinguish those learning objectives intended for students with HI. For example, I formulated four learning objectives, number 1 to 4, and I wrote a note under the learning objectives that number 1 to 3 are for Nicky [students with HI]. And yes, for each student with special needs, the learning objectives can be different from their peers (interview/10/02/2018).

Interview analysis showed that School A conducted a diagnostic test in the admission process to assess a student's cognitive level and science teachers used this information when designing lesson plans (including determining expectations and learning objectives for SWD). However, as all students (including with disabilities) should pass the National

Examination in Grade 9, Melissa and Susan stated that individual or modified learning objectives were not set but, rather, learning objectives were linked to material that would be in the National Examination.

4.2.4 Creating Minimum Criteria for the Passing Grade for Students with Hearing Impairment

Data analysis indicated that science teachers in School A established criteria for achieving the minimum passing grade or KKM[5] for students with HI. There were two forms of KKM, one for regular students and one for SWD. Melissa, Susan, Lilly and Harry asserted (in interview) that even though teachers gave the same figure/score for KKM, this score had different meanings. Lilly explained (interview) that KKM for science is 70, which means the regular students should answer 14 out of 20 questions but that the students with HI could answer only 7 out of 10 questions. The following statement also was asserted by Melissa, who said:

> The KKM for regular and students with special needs must be distinguished. We applied, for example, the KKM for science is 75. For students with special needs, when she can only write the formula, I considered she has passed the standard, but for the normal, they must not only write the formula but also its application to pass the standard. Sometimes, it's a bit difficult, setting the same grade but I should differentiate their competencies (interview/10/02/2018).

On the same view, Harry stated:

> The instructional design is one for all students, but we apply different treatment when assessing students with special needs. It means that when we have a KKM of 75, 'normal students' are required to master 10 chapters, but for her [students with HI] only 2, 3, or 5 chapters are required. Although written in the instructional document as the same score, meaning the KKM is the same, later, the treatment in marking will be different (interview/19/02/2018).

4.3 Theme 2: Pedagogical Practices for Students with Hearing Impairment

Theme 2 presents the findings from School A regarding Research Question 2 about how science teachers in this school adapted science pedagogy and chose learning strategies that

[5] In the Indonesian context, the benchmark is known as Criteria for Minimum Passing Grade or *Kriteria Ketuntasan Minimal* (KKM), which is a standard that is usually in the form of a minimum score that should be passed by a student who has mastered the topic given.

they believed were suitable for students with HI. This theme is structured into three sub-themes as follows.

4.3.1 Supporting Recognition Learning to Build Students with Hearing Impairment's Knowledge

As analysed from information gathered, science teachers in School A applied various ways to present information to support recognition learning for students with HI.

4.3.1.1 Activating background knowledge

Science teachers in School A provided similar ways of activating students' prior knowledge when teaching science. Classroom observation of a Grade 9 class (13/02/2018) showed the science lesson being opened by greeting, praying, followed by introducing and outlining a topic, and an apperception[6]. Melissa asserted (interview) that apperception was the most widely used to introduce a new topic by attaching new ideas to prior knowledge, however she stated she sometimes did this (questionnaire). Melissa emphasised that an apperception was used "to connect between material that has been mastered with new material" (questionnaire/02/2018). Observation also revealed when Melissa conducted teaching activities, she applied a 'Question and Answer' method to remind the students about previous material and to give a link to the new material. She gathered the students into five groups, then she played a video of the process of global warming and asked students to write down the important information given in the video and asked them to make up questions (in a group) related to the video. Each group asked and answered the questions from the other groups. Students who could answer a question correctly gained a point score. Concerning the student with HI, in his group he did take a note and discussed with his peers. During the lesson, Melissa offered him the opportunity to answer a question from another group and he could answer the question correctly.

Susan mentioned that she frequently attached new ideas to students' prior knowledge (questionnaire). Observation in Susan's classroom (15/02/2018) confirmed the way she did this was similar to Melissa. Susan gave an example of how she attached a new idea to the

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[6] Apperception is a "mental perception … the process of understanding something perceived in terms of previous experience" (https://www.merriam-webster.com/dictionary/apperception#other-words). In the Indonesian context, pre-teaching activity is called an apperception. This activity is conducted to activate the students to learn, motivate them and engage their curiosity about the topic being learned.

prior knowledge when she taught an Environmental Contamination topic. She was showing a video on the bad effects of plastic waste and asked the students to think about the video shown. Then, she led the students to read the material about how to conduct the 3R (Reduce, Reuse, Recycle), for example, by using re-useable plastic bags for shopping. After that, Susan asked students to write and share their opinions about preventing soil and water from being contaminated by plastic waste.

4.3.1.2 Providing real-life examples

Data analysis showed science teachers in School A provided examples of the numerous ways in which information was presented to students with HI. As Melissa and Susan asserted (interviews) that science was packed with symbols and difficult terms, they assisted students with HI to understand the symbols and scientific terms by showing real examples as readily found in daily life. They stated (questionnaires) that they always ensured that the examples and content used in science class were relevant for students with HI. If the information given was not clear for students with HI, Melissa admitted (questionnaire) that she would ask again whether the students understood the information given or not. Melissa stated:

> For those who cannot hear at all [deaf], I have a lot of problems. Then the material must be obviously clear. For example, the term of excretion, he might not understand if I just told him excretion is the process of eliminating waste matter. But, if I gave him a more real, with the real example, like urine, he can imagine and understand what the meaning excretion is (interview/10/02/2018).

Data indicated science teachers in School A asserted they connected the material to real-life applications. Melissa admitted (questionnaire) that she frequently presented a real-life example to make learning applicable. Similarly, Susan asserted (questionnaire) that she always connected the material with a real situation that students faced in their daily life. When Susan was teaching a topic titled Environmental Contamination, she brought polluted water taken from her home as well as some fish. Students were asked to observe the fish movement in clear water and in polluted water and then requested to make a report of their observations.

4.3.1.3 Highlighting critical features and key concepts

Another way used by science teachers in School A in presenting information to support recognition learning for students with HI was by highlighting the critical features and key concepts. Melissa wrote in the questionnaire that in the lesson introduction, she frequently began each class with an outline of material to be covered to give an illustration so that students would be better prepared. Melissa indicated (interview) that an outline sometimes contained science key concepts. . She also asserted (questionnaire) that she frequently highlighted key concepts and explained how they related to course objectives in order to strengthen mastery of the material, whereas Susan stated that she always provided an outline of material to be covered. At the end of the lesson, Melissa and Susan stated (questionnaires) that they always concluded each lesson with a summary of key points, to help clarify concepts. The classroom observation (13/02/2018) also revealed that Melissa wrote a summary of the key points that students were to learn on the chalk board.

Melissa and Susan also admitted (questionnaires) that they always represented concepts graphically as well as verbally, although they did not mention in detail how this was done. Classroom observations showed Melissa and Susan giving more tone and high intonation to the key concepts. Melissa stated (questionnaire) that this made it easier for students to remember the concepts.

4.3.1.4 Providing multiple learning media and formats

Science teachers in School A varied the learning media and formats in limited ways in presenting information for students with HI (see Table 4.5). Melissa and Susan, however, admitted (interviews) that the most preferable format was the written form.

Table 4.5 The examples of science learning media and formats used by science teachers in presenting information

Type	Melissa	Susan
Text	text book, worksheet	text book (student reference), worksheet
Graphics	usually image and text media are in one. For example, the flower picture is described with text (flower parts)	Picture of cell
Audio	N/A	N/A
Video	for abstract material (not directly visible), e.g. the effect of global warming	Environmental contamination
Others	skeleton on the motion system	plants: showing meristem tissue; shows plant organs

Source: questionnaire/02/2018

Science teachers in School A provided a few flexible media and tools for individualising work for students with HI. Melissa admitted that "no special media were designed for students with HI" (interview/10/02/2018). Despite adjusting the expected learning outcomes for students with HI, Melissa asserted (interview) she applied individual approaches, teaching slowly and providing lots of written forms to help students with HI to access the content. Melissa also mentioned she provided a printed summary for students with HI to help these students learn in a concise way. On the other hand, Susan said (interview) she provided many supports, for example teaching patiently, so students with HI might better understand the teacher's explanation; and providing additional materials through WhatsApp (WA) and asking the student to read it and learn. Susan admitted that she explained some things with an example:

> I usually explain things by writing them on a piece of paper, then drawing them if possible, then I continue explaining with examples. For instance, when I explained about waves, I drew the wave curve and explained the swing vibration and gave the examples of that. I also provided them with companion textbooks, K13 textbooks, questions for practising (interview/07/02/2018).

Science teachers in School A asserted (interview) that they tried to make science information more perceptible for students with HI. Melissa mentioned the easiest way to do this was by opening her lips more widely, keeping the pace of teaching slow and by using more written forms. Similarly, Julie also stressed that the appropriate way to present science information to students with HI was by "increasing the displays, using the LCD, the teacher's lips opening wide and speaking more slowly" (interview/10/02/2018). The principal also stated a similar idea to Melissa and Julie, as Harry stated:

> For students with HI, the teacher usually applied the same teaching method for all students. The difference is, because our classroom is inclusion, which has a deaf student, teacher must convey the conversation using a really good Indonesian language because the deaf can read the lips' motions. The way they understand the material is through the lips' movement of the teacher. Therefore, I always emphasise to all teachers who have deaf students, to be painstaking, not in a hurry when delivering the materials. But sometimes, when teachers get slow in delivering those materials, the other normal students will be bored (interview/19/02/2018).

4.3.2 Supporting Strategic Learning to Build Students with Hearing Impairment's Skills

This sub-theme represents options provided by science teachers in School A to support strategic learning in building science skills for students with HI. Science teachers in School A offered various options in supporting strategic learning for students with HI.

4.3.2.1 Providing flexible models of science process skills

Melissa and Susan provided various flexible models of skilled performance and teaching strategies to build students' skill. *First*, the questionnaires specified that Melissa and Susan always began the lesson with an advanced organiser[7]. They questioned the students with essential questions as an indicator of the direction that the topic would take and that students would learn. The reasons for using an advanced organiser were "to probe students' early knowledge of a new topic that they would have" (Melissa), and "to inform students about the purpose and objectives of learning being studied" (Susan).

Second, science teachers asserted (questionnaires) that they frequently applied active and student-centred learning approaches to "rock up the class atmosphere and keep students staying awake and not sleepy" (Melissa). Melissa highlighted that the teaching strategies she used were aimed at "getting students involved and they were more active, giving students opportunities to find the concept [not being given by the teacher], increasing their independence, getting the materials inherent in their memory".

Third, science teachers provided laboratory practicals to build the skills of students with HI. When conducting a practical laboratory, Melissa and Susan emphasised (interview) that they provided a worksheet to help students do the practical work. Especially for students with HI, science teachers usually demonstrated the first sequence of activities that the students were to follow during the practical, asking the students to follow or imitate what the teacher had demonstrated. This was confirmed during observations of Susan's classroom. However, an interview with Julie indicated that SWD in School A were not fully involved in practical activities, rather that they were asked to observe their peers doing the practical activities or to undertake an assignment in the inclusion room.

Fourth, another important finding indicated in the questionnaire responses was that science teachers in School A allowed students with HI to grasp material in their preferred learning style and at their own pace. Melissa and Susan admitted respectively (questionnaires) that they frequently and sometimes allowed students with HI to grasp material in their preferred

[7] "An advance organizer is a set of beliefs or concepts given to the learner before the main learning materials are presented to him/her. This is done so that a fixed mental structure is prepared and then new learning is related to that" Aslani, G., Haghani, F., Moshtaghi, S., & Zeinali, S. (2013). A Comparison of the Effect of Presenting Advanced Organizers in Web-based Instruction. *Procedia - Social and Behavioral Sciences, 83*, 200-203. https://doi.org/10.1016/j.sbspro.2013.06.039 .

learning style. Both Melissa and Susan also said that they frequently allowed students with HI to grasp material at their own pace because, according to Melissa, it would help the student "to get better results" as well as "giving additional hours after school was finished" (questionnaire/02/2018). Melissa stated she never assisted students with HI to identify how they learned best, but Susan asserted that she sometimes did. These statements were not clarified during the interview.

4.3.2.2 Providing various methods for responding to and interacting with science materials

Science teachers in School A provided limited ways for students with HI to respond to and interact with science material. To get the attention of students with HI, Susan admitted (interview) that she usually waved or gently patted their shoulders or would ask their peers to pat them then she would explain the task at hand. Susan added that sometimes among students with HI, their peers would use sign language in discussing material with them and sometimes peers (who were skilful in sign language) would act as their interpreter when they were needing to answer questions that the teacher was asking. Observations conducted in two classrooms revealed that the science teachers did not control background noise, although students with HI were seated in the front row.

Other methods used by Susan to give students with HI ways to physically engage with the materials was by demonstrating what the student was to get from the lab activity and then allowing him or her to write his or her responses on paper. Susan mentioned:

> I usually asked her to demonstrate what I had asked before, in a practical activity. I gave an example first; for instance, in measuring the concentration of soluble solutes, I illustrated how to measure concentration. After that, I asked her to demonstrate what she thought and then asked her to write or draw the explanation (interview/07/02/2018).

Similarly, Melissa demonstrated something to be imitated by students with HI when doing lab activities.

Reading the material was the most preferred method for students with HI to interact with science material. Melissa emphasised (interview) that when she taught Grade 9, the student with HI in her classroom was very active and when he got lost, he would usually ask and remind her to re-explain what she had said. Melissa added that interaction between herself and the students with HI was done by making notes on paper "… mostly through writing for communication" (interview/10/02/2018).

4.3.2.3 Offering flexible opportunities for demonstrating skill

Questionnaires indicated that flexible opportunities for students with HI to demonstrate their skills were provided. Melissa provided alternative project formats, e.g. brief reports, oral presentations, while Susan allowed students the opportunity to make videos, draw pictures and write newspaper articles.

4.3.2.4 Providing opportunities to practise with support

Findings showed that various opportunities to practise with support were offered by the science teachers in School A. Melissa asserted (questionnaire) that she frequently gave students with HI additional time, because she said "it will give SWD a chance to achieve better", whereas Susan stated she sometimes gave them additional time, especially when students with HI needed more time "to further explore the material". Susan emphasised (interview) that she should be patient in teaching students with HI and that she allowed them to finish the task at home and collected it at the next meeting.

Science teachers also provided opportunities for students with HI to practise by giving additional after school programs and additional material. Melissa offered additional hours in the after-school program voluntarily (interview) to provide the students with extra support to help them learn better (questionnaire), while Susan asserted that every Saturday afternoon she would distribute a task that should be done by students for additional practice, mentioning:

> I have a program to improve the students' outcomes, their competencies. Every Saturday night, like this is this afternoon, I will distribute a task, a set of questions that should be answered and collected by them at the next meeting. Because science would be tested nationally, the questions set are related to that National Examination (interview/07/02/2018).

Additional material also was given to all students, not only students with HI, through the WhatsApp Group (WAG):

> I have a WA Group with students and their parents. I shared additional material. Sometimes students shared the material. A couple days ago, one of my students shared the pictures of cells that didn't exist in the textbook or in the worksheet. Therefore, the material became more comprehensive (Susan, interview/07/02/2018).

Melissa stressed (questionnaire) that she always paired students with HI with one other peer to give them opportunities to participate more, share knowledge, develop patience, socialise, and feel that they were the same as others. Susan frequently did this and she mentioned that peer-learning could make students with HI mingle more with classmates (questionnaire/02/2018) helping them to build awareness of others (interview/07/02/2018). The students without disabilities usually gave assistance to students with HI, as Melissa said: "For the student with HI, because sometimes he was slower to record [the information] …, then he usually was assisted by the other student" (interview/10/02/2018).

4.3.2.5 Providing ongoing and relevant feedback

Findings showed that the science teachers provided feedback for students with HI. Melissa stated that she frequently, but Susan asserted that she always, provided clear feedback (questionnaires). Susan emphasised that feedback was given to correct what students had not mastered and for test make up. Susan added: "feedback was followed by giving the student a remedial [for a student who has not mastered the topic] and an enrichment program [for a student who has mastered the topic]" (questionnaire/02/2018). Susan also stressed (questionnaire) that she frequently provided feedback to students with HI by questioning them directly about what their problem was in learning science. Further, feedback was given at the end of the class to check the comprehension of students with HI. Melissa admitted (questionnaire) that she frequently asked the students to answer the question at the end of class, arguing that the feedback given made the "students feel cared for", whereas Susan said she always did this.

4.3.3 Supporting Affective Learning to Build Students with Hearing Impairment's Motivation and Engagement

This sub-theme describes the views and experiences of science teachers in School A practising pedagogies to support affective learning of students with HI. Data analysis revealed the evidence that science teachers in School A applied three aspects in supporting affective learning, as follows.

4.3.3.1 Providing adjustable levels of challenge

Data showed science teachers in School A provided limited challenges for students with HI. Susan admitted that she offered a challenge to students with HI by giving each a question. As she said: "Try this number, can you do this? like that, then she tried, Angie then tried directly" (Susan, interview/07/02/2018).

4.3.3.2 Offering choices of content, tools and media for communication

Interviews elicited that Melissa offered the students with HI an individual choice for deciding science content, tools and media for communication. She mentioned: "supposing the Javanese language is *ngladeni* (serving), I tried to ask and serve what they wanted and then pushed them to keep trying" (Melissa, interview/10/02/2018). Melissa and Susan asserted (interviews) that such choices were offered to recruit SWD interest and to increase their motivation to learn science.

As a way of giving opportunities for students with HI to choose the content, science teachers in School A made available captions, transcripts and subtitles for videos. In the written response, Susan said she frequently while Melissa asserted that she sometimes provided a summary of the video shown when the video did not have subtitles, and this was also evidenced by classroom observations. However, Melissa stated (questionnaire) that electronic materials available on the internet websites had not been used much in this school and stating that they never (Melissa) or rarely (Susan) checked for ancillary electronic materials.

Although in the questionnaire science teachers mentioned they frequently adopted instructional technologies, the interviews provided contradictory information. They did provide alternative communication media to support affective learning, for instance, Melissa and Susan said (interviews) that they used pieces of paper as a medium for communication. Besides that, Melissa preferred using the oral-aural method (lip-reading) to communicate with students with HI. If such a student did not understand, Melissa would use a mobile phone to browse something and then use it to explain it to her student. She said:

> When I explained about a plant to him [students with HI], I would express first orally, occupying lip-reading and asked whether he understood or not. If not, or if he difficult to imagine, then I initiatively browsed it through mobile phone, the image of what I meant (Melissa, interview/10/02/2018).

The interview with Susan also indicated that the mobile phone was installed with chatting apps namely WhatsApp (WA) as a tool to communicate with students with HI, to give them tasks and to talk with their parents. Susan emphasised that through WA she communicated personally with students with HI to assist them to choose and do their assignments and tasks, and to learn. Susan said she could directly express what she intended to the student with HI. Melissa asserted (questionnaire) that WA made the communication easier when she needed to seek and provide information for SWD. Melissa added that through WA, she could ask personally if the students with HI faced any difficulties in learning science and she also could remind them about important information or announcements from school.

In other ways, science teachers in School A indicated (interview) that they frequently offered additional time in various forms, such as requesting individual meetings (inside and outside classrooms) and utilising WA at any time. Further, Susan in her written response admitted that besides WA, she preferred talking face to face to the students with HI, so that students were not reluctant to communicate about the lessons and, if they had difficulties, "they could ask the teacher anywhere, outside the classroom, either at home or at any place" (questionnaire/02/2018). Susan also asserted (questionnaire) that she could be contacted anytime that SWDs wished, which therefore could increase their confidence and their learning motivation.

4.3.3.3 Offering choice of learning context

Before the lesson began, the science teachers admitted by questionnaire that they always created a positive welcoming class environment. Melissa stated that this was done so SWD felt a sense of belonging, trusted others, were comfortable, and felt encouraged to tackle questions and to ask questions, whereas Susan asserted this was done to boost the eagerness of students with HI to learn science. In this case, Susan gave examples of creating a welcoming class atmosphere by greeting all students, asking what they had done through the weekend and, especially for students with HI, she always asked if they were ready to learn or not. Not only did they create a welcoming class environment, but also both science teachers in School A asserted they frequently generated some "energy". Melissa asserted in the written response that she created a comfortable and relaxed atmosphere in her classroom and it was in evidence during the class observation, where the science classroom environment was friendly to everyone, and the teacher addressed some science concepts with humour as well as suspense. In similar ways, Susan asserted in the written response that she often gave the students an interlude during the lesson to make the science classroom livelier.

In other ways, data confirmed that recruiting interest was promoted by science teachers in School A by decreasing threats and distractions. In this illustration, Melissa and Susan arranged seating by "pairing one student with special needs with one peer who was without disabilities" (interview/10/02/2018), although data from the interview with Julie (the support teacher) indicated that SWD sometimes preferred sitting alone in the back row. Melissa asserted (interview) that she never treated SWD differently and all students knew that they were treated in the same way, for instance by applying the same test for all students.

4.4 Theme 3: Assessing and Monitoring the Progress of Students with Hearing Impairment

Theme 3 reveals findings in terms of how science teachers in School A assessed students with HI and how they were accommodated in terms of the assessment process. In answering Sub-Research Question 3 (In what ways do science teachers in School A monitor and assess students with hearing impairment progress?), this theme is ordered into three sub-themes as follows.

4.4.1 Measuring Knowledge Development

Data indicated science teachers in School A offered various methods to create assessment for recognition learning development in students with HI. In creating assessment that measured recognition development, Melissa said (questionnaire) she frequently created assessments straight from the learning objectives, even before outlining course content. Melissa mentioned this was done to make sure the lesson targets were achievable and science lesson aligned with the goals. On the other hand, although Susan said (questionnaire) she sometimes created assessments straight from the learning objectives, she also said "I always prepare a quiz for SWD before the science lesson takes place" (interview/07/02/2018). The example of Melissa and Susan developing science assessment instruments can be seen in Figure 4.3.

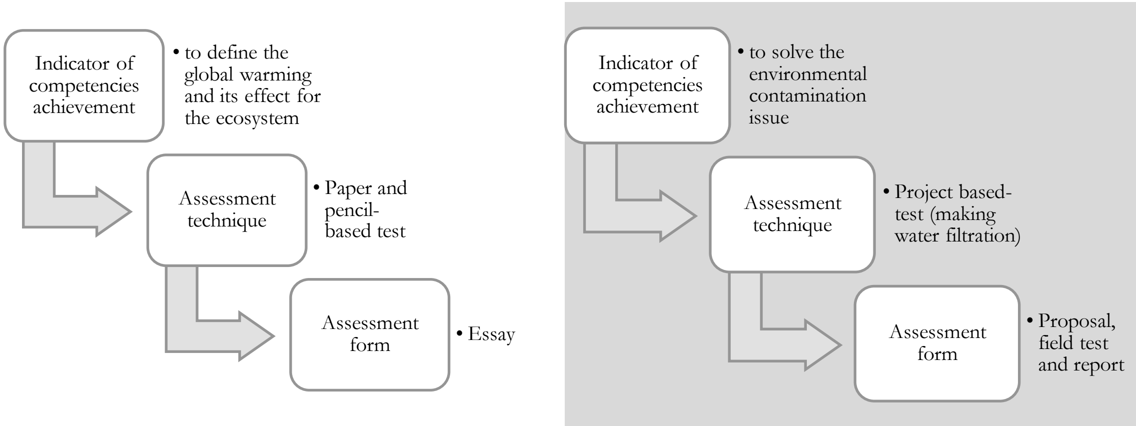

Figure 4.3 Developing science assessments by Melissa (left) and Susan (right)

Questionnaires showed that Melissa asserted frequently while Susan sometimes that they assessed recognition learning through alternative assessment. Melissa added she used alternatives to the traditional quizzes and exams to "anticipate the lack of grade from the quiz and formative test" (questionnaire/02/2018). Alternative assessments that had been applied to students with HI were oral tests and performance tests. Susan admitted that students with HI found it hard to spell, but in fact that they could follow the oral test using sign language when accompanied by peers, as interpreters. Another alternative assessment was the performance test, which was conducted as a part of science practical activities (Susan's interview).

To make clear how students with HI did their assignments, both science teachers emphasised that they always gave instruction both in writing and verbally (using lip-reading), and their reasons are given in Table 4.6.

Table 4.6 The way science teachers in School A gave instruction on the assignments

When creating assessments that accurately measure knowledge development of SWD, I …

Statement	Melissa		Susan	
give instruction on the assignments both in writing and verbally	always	I always give them an instruction before they do their assignments, to make it easier for them to work and not be confused. If they understood the directions, the expected results were more satisfying.	always	The instruction given in order for SWD to understand how to do their assignments and tasks, were given in writing and orally (using lip-reading).

Source: questionnaire/02/2018

To measure accurately the knowledge development, Susan admitted (questionnaire) that she sometimes created a grading rubric to ensure objectivity when assessing which was confirmed in her instructional document. In contrast, Melissa said she never created a grading rubric. She insisted (interview) that she had difficulty in creating rubrics, did not know how to do them and did not have enough time to do them because of her workload.

4.4.2 Measuring Skill Development

Data showed science teachers accommodated differences in strategic learning by applying a few different methods. In the questionnaire, Susan admitted sometimes offering practical assessments and assigning tasks through social media in monitoring students' skill. Susan mentioned (interview) that she sent the tasks through WA group and monitored how students followed her instructions to complete the tasks. On the other hand, Melissa stated she never assessed the students' skill development.

4.4.3 Measuring Affective Development

Data analysis indicated science teachers applied limited techniques in assessing the affective learning domain. In developing self-regulation for students with HI, Melissa provided a success story and talked personally to the students, as she mentioned:

> I usually gave him a success story, how people with disabilities cope with their deficiency and changed it into power and how they became a successful person. Sometimes I just told them like this, "sometimes God created the living thing is varied, all sorts. God creates deficiencies and advantages with a purpose. You are given the lack like this, but surely you have advantages, that maybe you have not found yet. Well, you should find out. To cover your shortcomings, now your achievement should be pursued. You can, do not lose with the others", I often said like that (interview/10/02/2018).

The interview with Susan also showed that she provided self-assessment in the form of a journal and reflection paper. In another way to monitor affective development of students with HI, Susan asserted (questionnaire) that she sometimes had those students explore the value and meaning of their science learning experiences for themselves and society, for instance, as Susan stated, by sending them to the art and culture contest.

4.5 Theme 4: Other Factors that may Contribute to or Hinder the Way in which Science Teachers Create Science Classrooms that are Inclusive for All

Theme 4 describes other factors that contribute to or hinder making science classroom inclusive for all.

4.5.1 The Understanding of Inclusive Education

4.5.1.1 Students' perspective towards science

Interviews indicated that Alex and Angie admitted enjoying learning science. Alex asserted he liked science because "it's fun" and "easy to memorise" (interview/17/02/2018). In another case, Angie asserted (interview) she preferred biology to physics because biology could be memorised, while physics required more arithmetic skills.

4.5.1.2 Students' view on inclusion

Data analysis showed Alex had better understanding about inclusion than Angie. At his first answer, Alex said he had never heard the term inclusion, but he then corrected himself and said, as far as he knew, "inclusive school is a school with special needs students" (interview/17/02/2018). On the contrary, Angie had no idea about the term inclusion or inclusive.

4.5.1.3 Teachers' view on inclusion

In this school, teachers had similar opinions about inclusion. Susan asserted she had not even read the reference on inclusive and inclusion, therefore she said: "I don't know yet the definition of inclusion. As far as I am concerned, I am teaching an inclusive class. There are inclusive students in Class A, B, and C" (interview/07/02/2018). But, when the question came to her about inclusive classrooms, she indicated:

> In my view, an inclusive classroom is a special class which has children who have … lack … needing special attention. There are children in a class … some special students in the class that need special attention, how to learn, and so on including the assessment (interview/07/02/2018).

While Melissa, in her view, said that the greatest reason for parents sending their child to a mainstreaming or inclusive school was to let their child live life naturally; as she said:

> The purpose of parents putting their children in school, which is actually general, but has a status of inclusion, actually the purpose is to let the child get used to the common behaviour of the children. Then in the future, when he went into the community, he would not be surprised. For example, there is a child who is ignorant, then he has been bullied, so he is not easily offended. I mean that. It's supposed to be a school too, but I have tried to equate the rights between the student with special needs with the general (interview/10/02/2018).

On the other hand, when Lilly, the head of Inclusion Program, was asked for the definition of inclusion, she said: "in here, … no one is busy looking for the definition of inclusion" (interview/08/02/2018). Lilly also said: "just like that, but never then, how come we are inclusive, what is inclusive, like that already, no questions like that" (interview/08/02/2018). Lilly added:

> because what is in their mind, … can make children with special needs live together with the regular …. Exclusive means student with special need's world. But this [school] is not like that, this is inclusive. Come join us, please get along, please blend, we will not discriminate against you, precisely when there has been discrimination, this discrimination benefits children with special needs, just like that. Well, it is inclusive (interview/08/02/2018).

Julie said that "inclusion …, children who learn together with normal children in a general class and they learn together, get along together, it should" (interview/10/02/2018).

All participants agreed that School A is already inclusive. Melissa asserted (interview) that the majority of teachers in School A already knew the inclusive meaning and what they should do when they welcomed SWD. Melissa asserted that her classroom was inclusive as she mentioned:

> In my opinion, I have tried to be inclusive, so it was really inclusion. My classroom is already inclusive. For the past, we were inclusive. It was because of limited personnel, limited funding, more help, what is it now, now it is said to be good, not good, very good, that's good, not very good (interview/10/02/2018).

In addition, Julie asserted that School A was inclusive using the following argument:

> I think this school is already inclusive. We have the same … learning together, practising together, …. And the teacher was good, for example if a child had difficulty, the teacher would immediately handle it. In here, the inclusion process works well, everyone supports, the principal also supports, the teachers all support, compared to other schools. It was good in here, I have a room, …, safe and comfortable. In other schools, I often hear that, …, the support teacher occupies one room with the counsellor. They didn't have their own rooms. I have one (interview/10/02/2018).

And Lilly had her opinion about inclusive school, meaning teaching with heart, as in her statement:

> The inclusive culture in this school has been formed. Praise God, most people have no problem in accepting SWD. For example, when a teacher faced difficulty in teaching

> SWD, then I just suggested he take it easy, just cut down the learning objectives. The important thing is the SWD felt to be the same as their peers. When their friend read, they participated in reading, they did what their friend did, it's inclusive. That means, the learning process was passed by the child, even though maybe the other child got 10 points he got 1 point, it's not a problem. The important thing is that he went through the learning process. We were like that. … And in many times, in the official meeting, we always reminded the teacher, if we are an inclusive school. We are inclusive, that we teach with heart. Basically, sometimes the teacher educates students, sometimes the teacher is educated by students, so sometimes educated by students (interview/08/02/2018).

Another finding indicated in the interview with Julie was that a special school was important to prepare the students to go to the inclusive school. She asserted that "the inclusive can be hard for students, unless that child has been prepared in the special school first" (interview/10/02/2018). She added:

> If they [the students with special needs] were sent directly to an inclusive school, it seems like, their understanding, their vocabulary was actually just like that, it's still limited. But if we sent it through Special School, those Special School will handle student individually. It will be more like, more prepared (interview/10/02/2018).

Specially for students with HI, Julie said they would not face difficulty with language if they were schooled first in a special school, as in her statement: "because he was already in special school that operated using lip-reading" (interview/10/02/2018), and she asserted: "by being able to lip-read, he immediately took lessons in the class and was immediately able to catch the teacher, sometimes, it was rather fast" (interview/10/02/2018). She also asserted that special schools would prepare SWD better, as in her statement:

> Children are varied, so if the one who has, usually used to go through Special School, that's all it was prepared. For example, it was one student that already able to write and read Braille, but if he suddenly sent to the inclusive school. The problem was, he learned with other normal students, in a public school, the teacher was also not a special teacher, not individual teacher. Most of the lesson didn't support with a support teacher. The support teacher was only one, not every day, for how many students, …. But if they sent to a Special School, the students were just at most two or three, every day accompanied, it would be different (interview/10/02/2018).

The support teacher mentioned that an inclusive school cannot accept students with all conditions; it can welcome a student with an average intelligence and above but not below average, as in her statement:

> For a child whose IQ was still able to participate, still on average and above, that's very good (schooled in inclusive schools). He would be able to develop, could continue to high school, could go to a higher school, can achieve what they wanted. … But if the IQ was below, it's not possible. It's better in a Special School. There were a lot of skills in Special School that can be taught. Later, it can be used for the provision of his life, like that for my student, the same as the one whose intelligence was below, was given the skills (Julie, interview/10/02/2018).

Although all participants asserted that School A was an inclusive school, Melissa and Susan said that a measurement of the inclusivity had not been conducted, as Melissa mentioned in her statement:

> To measure the inclusivity using the instrument and so on, no, I have never heard. But if it's just to know, how short was that, yeah, with attention every day. For example, the first one was Alex, the first time you didn't notice, then I know if I had a student with HI. For the past few years, we had moderate hearing-impaired students and some who were totally deaf, by the way, …, it's also automatically measuring. But scientifically using questionnaires, using the questionnaire, we have not yet done it (interview/10/02/2018).

4.5.2 Support Teacher Roles and Collaborative Work with Science Teachers

Data analysis found a support teacher in School A had limitation in the role and in collaborative action with science teachers in fulfilling students' needs. The science teacher was the person who was responsible for developing science lessons for students with HI. Melissa and Susan mentioned (interviews) that a support teacher did not always come to work with students with HI in their classrooms. Melissa said:

> Our support teacher often accompanies me, but not for all meetings, because she only comes to this school on every Friday and Saturday. We serve more than 20 students with special needs across all grade levels. Therefore, she was overloaded and her priority was working with students who really needed her assistance or helping teacher who has subject that was very difficult to learn, such as mathematics (interview/10/02/2018).

When the support teacher was working with Melissa, she asserted they would discuss the material briefly before starting the lesson. After that, the support teacher would observe what Melissa did in delivering material, and then the support teacher delivered that material to the SWD using a one-on-one method. Melissa stated:

> When she [support teacher] came in, then she would pay attention to me first, how I taught, how I delivered the material and how she was to master the material. She was sitting next to the student with special needs and she explained the material to that student after I explained it. Sometimes in the middle of teaching, she asked me when she found any concepts that she didn't understand (interview/10/02/2018).

Melissa also mentioned that the support teacher was very helpful in accommodating the needs of the students with special needs, while Melissa was teaching for the whole class. Melissa said:

> [the support teacher] attending and supporting were very beneficial for me. It made it easier for me to teach because I had not even to pay much attention to the students with special needs. Because sometimes it took a lot of time if we only showed concern to the students with special needs (interview/10/02/2018).

Data indicated that collaboration between the support teacher and the science teacher in creating an inclusive classroom was undertaken in limited ways. When designing the instructional plan, no collaboration between the support teacher and the science teacher took place. Melissa mentioned: "we have no collaboration with the support teacher in designing lesson plans, syllabi and programs" (interview/10/02/2018). Julie said a similar thing:

> No, nothing, no collaboration with the science teacher. In fact, she designed the teaching and learning plan by herself. … I only asked to discuss when teacher faced difficulty in accompanying students with special needs. In reality, for example, when the practical exam was conducted, I was told to accompany the students [with hearing impairment], to translate what the teacher required and what student should do. But for the daily lesson, it was managed by the teacher herself. I only gave notes, may be only written, maybe written for students with special needs like that, it's not as given in general (interview/10/02/2018).

The collaboration came in the way the support teacher advised in choosing appropriate teaching strategies for SWD, as Julie admitted: "I only discuss or sometimes collaborate with science teachers, having limited teaching strategies in the classroom, in identifying the best strategies for those students with special needs, not in designing the lesson plan or syllabus" (interview/10/02/2018).

Data also showed that only one instructional planning document was made, for regular students. Although science teachers only designed one regular lesson plan, in the implementation, every teacher tried to memorise if he/she taught students with special needs and then the lesson would be automatically adjusted on site, when teaching and learning were happening, as asserted by Lilly:

> Sometimes the planning and the implementation might be different. Although the specific adjustment for learning objectives had not been written in the lesson plan, but in the implementation, every teacher already had a record, maybe only in her diary, this student has ability like this. Then, teacher should adjust their requirement to those students, adjust the teaching and learning, because in here [School A], every student should be promoted to the next grade whatever their abilities. Maybe it's the weakness of our teachers to make special lesson plans for students with special needs. … And for me, personally, I often discuss [about the formulation of expected learning outcomes], but I don't know for other teachers, there should also be discussions (interview/08/02/2018).

In addition, Julie asserted that she was not only asked to accompany the science teacher in delivering the materials, but also when the exam was conducted, as she said:

> I not only accompany for regular teaching and learning, but sometimes in practical sessions or in an examination. On that day, I was asked to accompany a practical exam. Because I was not always supporting this class, science teacher then only gave me a

> brief note, what I had to do to transfer what the teacher wanted. Because it's special, then we made any adjustment that was suitable for that student [with HI] (interview/10/02/2018).

Another important finding was that collaboration was undertaken among science teachers in non-formal ways. Melissa admitted (interview) that unstructured meetings were conducted among science teachers to discuss what appropriate learning methods worked best for students with HI. The meetings also discussed how to overcome challenges and barriers in relation to the learning needs of the students with HI (Melissa, interview/10/02/2018).

4.5.3 Teacher Training and Support

Data confirmed that School A provided some training and support for teachers who catered for SWD. Although Melissa asserted she had received training for developing inclusive curriculum in science, she indicated that she still experienced difficulties in implementing the inclusive classroom. She mentioned in the group interview:

> I have had several trainings, every year this school conducts the training for teachers who cater for students with special needs. Almost all teachers in here teach students with special needs. In that training, it has been explained that there are special lesson plans and syllabi for students with special needs, indeed, it does exist. Therefore, teachers should make two different lesson plans, one for regular and the other for special needs students. But it is theoretical, as practically I haven't made one. The structure of those special lesson plans is the same as the regular ones, different only in the learning goals, outcomes and should be adjusted based on the needs (GI/08/03/2018).

4.5.4 Physical Building Access

Physical building observation (05/03/2018) revealed that School A had an adequate standard of building and facilities for SWD. School A had 18 classrooms in Level 1 and five classrooms in Level 2, a laboratory of language (consisting of 25 units of computers), a science laboratory, sport arenas, a meeting room, a hall, a teacher room, a principal room, and an administrative room. School A was also equipped with a library, a mosque and an appointed inclusion room. The building in School A could be reached by wheelchair users because it had a ramp and was equipped with guiding blocks along the way to every room, a toilet for the disabled and a parking area for the disabled.

The appointed inclusion room was a common place for teaching students with special needs. This room had been divided into two, one for the support teacher and the bigger room, equipped with roundtable and media, for teaching of students with special needs. The support teacher would pull special needs student out to the inclusion room for special assistance or additional lessons. Harry, the principal, asserted that having an inclusion room was a top priority of his policy. He asserted that this room could be used to facilitate all students with special needs, gathering all of them and educating them at one time, stating:

> The inclusion room, in the back, is too small. We need to build the bigger one. We don't have an inclusion room, which is convenient for them [students with special needs]. If they feel convenient then it will boost their motivation to learn. I as the principal should serve them best. This school is already declared an inclusive school and the inclusion room is a must. It's a mistake when we accepted them [students with special needs] as we couldn't serve, help and fulfil their needs (interview/19/02/2018).

4.5.5 Parents' Involvement

Interview analysis confirmed that parents were involved in promoting an inclusive education system in the school. Every semester, parents were invited to attend the semester meeting and discuss the issues related to their child's development. For the parents of Grade 7, the school usually conducted a socialisation meeting on inclusive education, how the system was run, who was the person that should be contacted regarding this system and what were the things that had been provided by the school to enable inclusivity for all students. But for the parents of Grades 8 and 9, the discussions were about their children's development and issues.

Related to science learning, Melissa asserted (interview) she always communicated with the students' parents, found out what the cause of their disabilities was from them and how to find the best way of dealing with students' learning problems. In a similar way, Susan also mentioned (interview) that parents of students with special needs fully supported and always gave attention to what challenged their child in the school, but sometimes these parents were over-involved in helping with their children's homework or assignments. Harry, the principal mentioned (interview) that many parents of SWD did not understand their children's conditions, their disabilities and how to deal with learning issues faced by their children.

4.5.6 Policy and Supportive Program

Since School A had welcomed students with special needs, the findings showed that this school had provided supportive policy and programs to promote an inclusive environment.

Findings revealed that this school had a policy that, whatever the prospective condition of students who applied to this school were, they should be accepted. Another policy was that every child was promoted to the next grade and graduated. All teachers, including science teachers, were asked to provide an appropriate learning approach that suited each student, especially those with special needs. The interview with Lilly indicated that all school members also had built a supportive culture to make this school more inclusive of everyone. Lilly emphasised that all teachers in this school were required to distinguish children with special needs from among their peers in their classroom and adjust their learning based on their needs. Harry said (interview) that the teacher should accept then know which one is the student with special needs and understand the type of their disability as a base to manage properly their inclusive classroom.

In managing the inclusive education system, School A had a special division named Division of Inclusive Education, which was led by the Head of Inclusion Program and five authority members, namely a secretary, a treasurer and three active members. In the school structure, this division coordinated directly with the principal. They worked to produce policies to support the inclusive education program in this school. They also collaborated with the support teacher, especially in maintaining learning for SWD and with other support programs, such as diagnostic tests for SWD, language skills for students with HI, and sport and art programs for SWD who were interested in those areas. In addition to intra-curricular activities, School A had extra-curricular activities, as media for students to build their self-development. These activities included: Computer Based Programs, Drum Band, Music Ensemble, Band, Journalism, Football and Scouts. Students with special needs were given opportunities to choose the activities which suited their interest and talent.

The head of the Inclusion Program pointed out that this school had a special program for students with special needs which involved the community. She added that, every semester the students with special needs were invited to join a community program, such as a study tour to a certain site and that they were asked to learn something that had been set by the inclusion program. In addition, the community centre sometimes had been invited to the school to give a small talk to motivate students with special needs. Besides, this school invited alumni who graduated from this school and had been a success to share a success story with their juniors.

4.5.7 Challenges and Barriers in Creating Science Inclusive Classrooms

Challenges and barriers faced by science teachers, the support teacher and principal in School A are divided into four categories, i.e.: types of SWD, language barriers, inclusive climate and government policy.

4.5.7.1 Types of SWD

Interviews provided evidence that the types of SWD affected the way science teachers in School A managed their classroom. Melissa and Susan admitted they found difficulty when teaching abstract concepts. Melissa and Susan tried to use simple language but those students could not catch the concepts and, if they understood, it would not be long retained in their memory. Julie commented about the students with HI, saying:

> We [teacher] confused and didn't know how to use a different way to make the students with HI quickly understand. It's very difficult, very difficult, very difficult to find best way for them. Even for the easiest concept, we explained it with various props, but students still didn't understand and they tended to forget quickly too (interview/10/02/2018).

Another challenge was the student's character. Susan mentioned (interview) that she had two students with HI in her classroom and they had very different characters; one was very offended and sensitive, and the other one very hard to handle because her ability was below the average. Lilly, the head of inclusion program, also emphasised a similar thing. She said students with HI tended towards not being confident. She added:

> To grow their self-confidence is a bit difficult too because there were some students who come in with an inferior feeling. They were embarrassed to be grouped as a student with special needs. Then I told her to be confident, because we fully supported their needs and told her that becoming SWD might have a lot of achievements, has an opportunity for national champions. It's so challenging … Then the second challenge raises awareness of the students with special needs that "you don't feel inferior to be a student with special needs", being motivated, in fact ... being a student with special needs the chances of achieving that were even greater (interview/08/02/2018).

The other important finding was that Melissa, Susan, Lilly, Julie and Harry asserted that teaching students with learning difficulties, such as slow learners, was harder than students with HI.

4.5.7.2 Language barriers

Interviews confirmed that teachers in School A found difficulties in communicating with students with HI. None of the teachers in this school could use sign language, Melissa said, and added:

> I found difficulty in communicating with them [students with HI], how to interpret what was said and how to communicate effectively. This is my big homework. He [student with HI] could operate lip-reading, even was a little, but it's still, missed the message. The other student who is totally deaf, is even harder to communicate with her, even for general conversation, sometimes she did not understand what I said. This language barrier affected the way of delivering the materials. It's a big obstacle, it's hard. I need extra energy and time (interview/10/02/2018).

Therefore, sign language was not as commonly used as lip-reading in School A, as Julie indicated:

> We didn't use a sign language in this school. Just some children can use it. Because our community doesn't use sign language and the deaf are required to understand what people talked to them, then we didn't teach a sign language. By lip-reading, they can catch, communicate with other people. Deaf children also cultivated to a minimum using sign language, even if for example, they had difficulties, the preferred media was more to write, more to the written language (interview/10/02/2018).

4.5.7.3 Inclusive climate

Interviews with Lilly and Harry confirmed that another challenge was creating an inclusive climate. Lilly said:

> The most challenging thing is, first, we build an atmosphere of conduciveness, how to make the regular students accept, can be friends to students with special needs. That's a challenge because at their age, as we known, sometimes they were bullied or teased. It's a challenge (interview/08/02/2018).

Harry mentioned:

> The teachers themselves, were not all familiar with inclusion children. Sometimes I feel how we can serve best the SWD if we don't understand them. Sometimes it's hard to make the perception that our school is an inclusion school (interview/19/02/2018).

4.5.7.4 Government policy on inclusive education

The interview with Harry indicated that he still found a mismatch between national regulation and regional or school policy. Harry asserted that the government stipulated the regulation for every school to accept SWD, but they did not fulfil the students' needs. He emphasised:

> Government policy seems to be half and half, good intentions, but no support and action. As I mentioned earlier, specifically for slow learners, they might not take an UN [national exam], but at a high school, they cannot register because they do not have a national register number. We can say, this regulation is not connected with other policy. Like it or not, every policy must look at the policy below it, but the reality is not, that's how it is, that is the problem (interview/19/02/2018).

4.6 Summary

Findings indicated that, in School A, high expectations for SWD were only established when they had no cognitive developmental issues. Science teachers in School A established clear and specific learning objectives that were adjusted from the science learning objectives for general students. The way of modifying learning objectives for students with HI was by cutting-down the general learning objectives. Science teachers started with describing learning objectives that were measurable and achievable, and which aligned with instruction and assessment. In establishing learning objectives, science teachers accommodated students with HI learning needs, but rarely for their personal interest. Science teachers, however asserted they tried to speak personally with students with HI to decide what they needed in learning science. School A applied different KKM for SWD, which meant a lower standard had been applied for them.

To support recognition learning for students with HI to learn science, findings revealed science teachers offered some strategies so that students could interact with instructional materials, such as showing real examples from daily life; providing captions, transcripts or subtitles for audio/video; and summaries with simpler language. Even though no special learning media were provided for students with HI, various ways were offered by science teachers to present science materials and emphasising the visual aid and lip-reading to convey the materials. Teaching approaches used by science teachers in School A to help students with HI to build their knowledge were: opening lessons with outlining the material that would be covered; using apperception and linking new material with students' prior knowledge; presenting daily examples to gain students' understanding of science, making a connection between what students learnt and its usefulness in life and concreting the abstract concept; and concluding every lesson with a summary of key points.

To facilitate students with HI in expressing their comprehension of science, teachers asked students to read the materials and demonstrated what students should do in practical activities; optimised lip-reading as a form of communication; used WhatsApp as an alternative media for communication; offered alternative project formats, such as brief reports and presentation; and provided a support teacher when it was necessary. Science teachers also offered various learning activities in building students' skills, i.e. started a lesson with an advanced organiser, provided a worksheet when students were doing practical activities, offered additional time to submit tasks and assignments, and asked students with HI to work in pairs.

Findings highlighted that options offered by science teachers to keep students motivated in learning science were: creating a comfortable and relaxed atmosphere; interspersing with humour and intermezzos; providing additional time for private consultation; utilising WhatsApp for media communication; offering individual approaches and assistances; and enforcing collaboration with parents, colleagues and the support teacher.

In terms of assessment, findings demonstrated that science teachers monitored students' knowledge development by using learning objectives as a guide to set assessments, applying alternative assessments, giving instruction on the assignment, and providing feedback and a grading rubric. Science teachers in School A also measured students' skill development by giving prompt, progressive and informative feedback to support learning and self-assessment. Science teachers asserted they monitored students' emotional development by providing private conversation to reveal what students' problems were in science learning and utilising student journals for self-reflection.

The valuable findings in regard to factors contributing to creating science classrooms inclusive for all was that students with HI have positive views towards science and they have an understanding about inclusive schooling as something that is related to students with special needs. Five teachers as respondents had different expectations towards SWD, but most of them stated SWD were equal with their peers and could live better in community. These five participants also clarified their views of inclusion and one of them did not have any idea about what inclusion was. The other four said inclusion was educating SWD alongside their peers in general settings, even though one participant asserted that inclusive learning would be better if students got preparation in a special school first.

All the participants asserted that their school was inclusive, because whatever the student condition, this school would accept the students to be educated and facilitate them with the support teacher and inclusion program. SWD in School A were taught separately from their peers in a designated inclusion room. Collaborative work between the science teacher and support teacher was limited in some points, i.e. giving advice about the best strategy to teach students with certain disabilities and assisting students with HI in examinations.

Limited training and development programs were offered for science teachers to develop their competencies in inclusive teaching. In terms of building and physical facilities, School A was accessible for SWD, especially for students who were visually impaired or wheelchair users. To promote and manage the inclusive practices and cultures, School A invited parents to attend the annual meeting and ran some programs by involving the communities.

Science teachers asserted they still faced challenges and barriers to promoting science inclusive practices for all, i.e. how to deal with students' behaviour, communicate with students with HI, create an inclusive climate, and the mismatch between government policy and its implementation.

Chapter 5
Within Case Analysis of School B

The aim of Chapter Five is to explore the perspectives and experiences of science teachers in School B in creating inclusive science teaching and learning for students with visual impairment (VI) based on four aspects, i.e.: setting goals, practising pedagogy, assessing progress of students with VI, and identifying factors contributing to and hindering the science classroom from being inclusive for all students. These aspects are used to answer four research questions and are described respectively under four themes. Before presenting these, a brief profile is given to gain a contextual understanding of School B. Participants of School B were science teachers (Shirley and Tiffany), support teacher (Irene), principal (Arthur) and students with VI (Nanda and Amy).

5.1 Profile of School B

School B was established in 1968 as a special school which catered only for students with VI. As a private Islamic school, School B is managed by a private foundation which forms the basis of the educational budget together with contributions from the students' parents. From 1984 to 2008, it was compulsory for all students to stay in the school dormitory located next to the school. Arthur explained (interview) that this policy had been applied to enable teachers to help and monitor students, while students with VI had many opportunities to grow their capabilities and develop their individual potential through participation in their after-school programs. When the school was transformed in status to a School Providing Inclusive Education (SPIE) in 2008 through Mayor Regulation No. 47/2008, School B terminated the policy of an obligatory stay for students in the school dormitory. Students are free to choose between living in the dormitory or living at home with parents as long as students can manage their mobility to school. Arthur asserted (interview) that School B is the only Islamic school which has the status of SPIE under the Ministry of Religious Affairs (MORA).

In the academic year of 2017/2018, School B had 53 SWD and they were all VI. To assist these students, School B provided eight teachers and four ancillary staff. The students were clustered into three groups based on their cognitive development for each grade between Grades 7 to 9, with an average class size of six students.

As an Islamic school, School B implemented two national curricula, one each from the Ministry of Education and Culture (MOEC) and from MORA. The national curriculum from MOEC is for general subjects such as mathematics, science, and English, whereas the national curriculum from MORA is for the Islamic studies. The principal stated (interview) that there was no differentiation between the Islamic schools and general schools in terms of the general subjects provided, such as science. The difference was only that the Islamic schools also offer Islamic subjects, which did have a consequence on the distribution of time allocated for all the subjects. Science teachers mentioned (interviews) that because School B was an SPIE, it needed to adopt the regular curriculum. When data were collected in the academic year of 2017/2018, School B had adopted Curriculum 2006 for Grade 9 and K13 for Grades 7 and 8.

5.2 Theme 1: Goal-setting for Students with Visual Impairment

The first research question sought participants' experiences and perspectives on how science teachers set expectations, goals, objectives and the nominated passing grade for students with VI. The answer to this research question is described in four sub-themes, as follows.

5.2.1 Establishing Expectations for Students with Visual Impairment

Data showed that in general, Arthur expected that students would play a role in society and the community while Irene expected that students could be independent in daily activities. Data analysis demonstrated science teachers in School B did not hold high expectation for students with VI. In interview, Shirley stated that expectations and goals for each student were adjusted to the condition of the students and based on their needs, while Tiffany stated (questionnaire) that she could not expect much of those students as only a few of them had abilities above the average. Shirley admitted that she expected students with VI to understand the basics of science and to operate arithmetic in more detail. Similarly, Tiffany mentioned: "she hoped students not only learn science concepts but also that they can take advantage of the concept for life provision" (interview/15/02/2018). Tiffany emphasised that she did not require students to learn the concepts deeply but only the basic aspects, because she believed that VI made the students face more challenges and barriers to learning, especially science that required more analytical thinking. Shirley, Tiffany and Irene said (interview) that students with VI preferred to learn a subject that required recitation, such as an Islamic studies subject or Quran recitation, and this resulted in lower achievement in science than in other subjects.

5.2.2 Reframing Standards as Learning Objectives

This sub-theme discusses the findings within case in how science teachers in School B reframed standards into learning objectives, described in three aspects, as follows.

5.2.2.1 Writing learning objectives

Findings indicated that science teachers in School B formulated learning objectives according to the standards of the national curriculum of science. Tiffany mentioned (interview) that although School B was under the MORA, the content standards for science adopted were from the MOEC. To establish learning objectives, Shirley and Tiffany followed the national regulation of the standard process of teaching and learning by breaking-down the basic competencies (either Curriculum 2006 or 2013). These standards were broken down into three domains of learning, i.e. cognitive, psychomotor, and affective goals and these were stated in the lesson plan. Tiffany mentioned: "I made lesson plans by downloading it from the internet and adjusting for student needs or from the Science Teachers Working Group (or MGMP). Besides, I can take the description of base competencies from e-books, which is now attached with a clear base competencies description" (interview/15/02/2018).

Questionnaires, document analysis and interviews with science teachers in School B confirmed that they pondered several aspects when they were setting up learning objectives. Questionnaires confirmed science teachers considered three domains of learning when setting up learning objectives for students with VI. Their statements are presented in Table 5.1.

Table 5.1 Science teachers' ways of setting up learning objectives and goals

When setting up learning objectives and goals for students with disabilities, I …				
Statement	Shirley		Tiffany	
consider the knowledge domain (cognitive)	frequently	Cognitive is the most important area in setting learning objectives, as the knowledge aspect must be included in the evaluation. Most of the learning objectives are set for cognitive domain.	always	School B refers to the general curriculum like other middle schools so that in creating learning objectives it is necessary to consider the cognitive aspect according to its level, based on the students' need and ability. We are under the MORA, where every semester completed the teaching aid is audited (inspected) by the supervisor of that ministry.
consider the skills domain (psychomotor)	sometimes	I included psychomotor domain, but in reality, to assess these skills for students with VI was very limited to certain skills. Practicals that required visual skills could not be conducted.	sometimes	This is based on their ability to capture learning materials. For example, in the topic Pressure, I skipped some skill domains due to their lack of skill in imagining the shape of the object. The goals and learning objectives I have made are still general, although my practice is tailored to their condition as disabled students. Especially on materials that require practicals, in addition due to visual limitations as well as the limitations of accessible visual aids.
consider the attitude domain (affective)	frequently	The attitude aspect is also an important part of the objectives and assessment of learning, but those who have the right to report it to determine attitudinal values are the subjects of civics and religion.	rarely	I did not fully consider the attitude domain and had only written it in the lesson plan after the cognitive and psychomotor domains had been set. Because of I know my students very well, I can describe their attitudes, so basically, I don't need to write it down. Just write it for administrative purposes.

Source: questionnaire/02/2018

Document analysis showed science teachers selected various verbs in establishing the learning objectives. Table 5.2 documents the wording considered by Shirley and Tiffany in reframing the standards into learning objectives (see the verbs in bold).

Table 5.2 indicates that science teachers in School B predominantly established cognitive learning objectives to support recognition learning. From the wording perspective in writing goals and objectives, the verbs selected by Tiffany and Shirley indicated offering flexibility and access to learning. For example, the verb 'analyse' is classified as Level 4 of

Bloom's Taxonomy, which allows students to actively participate, identify patterns or components, discuss and report findings (Gargiulo & Metcalf, 2015).

Table 5.2 The break-down of the national base competencies into learning objectives and learning domain

Teachers	Base competency	Learning objectives	Learning Domain
Shirley	Describe electric charges to understand the signs of static electricity and its relation to everyday life.	The students will **distinguish** positive electrical charges and negative electrical charges.	Cognitive
		The students will **distinguish** static electricity and dynamic electricity.	Cognitive
		The students will **explain** the process of lightning	Cognitive
Tiffany	Explain the pressure of substances and their application in everyday life, including blood pressure, osmosis, and capillarity of transport tissues in plants	The students will **explain** the concept of pressure	Cognitive
		The students will **analyse** the relationship between force and surface area on the amount of pressure	Cognitive
		The students will **explain** the law of Archimedes	Cognitive
		The students will **apply** Pascal's law to objects in everyday life	Cognitive
		The students will **link** the theory of substance pressure with the process of transporting substances to plants and blood pressure	Cognitive
		The students will **apply** the principle of gas pressure on objects in everyday life	Cognitive
		The students will **analyse** the application of Archimedes' law to floating, floating and sinking objects	Cognitive
		The students will **analyse** the pressure of liquid at a certain depth	Cognitive
		The students will **analyse** the principle of pressure on the process of capillarity in the transport of substances in plants	Cognitive
		The students will **analyse** the application of substance pressure in the manufacture of water rockets	Cognitive
		The students will **present** data on the results of liquid pressure experiments at a certain depth	Cognitive
		The students will **present** experimental data on the application of the pressure principle to the capillary process in the transport of substances in plants	Cognitive
		The students will **present** data on the results of experiments applying pressure in water rocket experiments	Cognitive

Source: excerpt translation from the science teachers' lesson plans

Questionnaires identified that in relation to strategy in developing learning objectives, Shirley frequently used ABCD rather than SMART strategy. Shirley said the way to choose between those two strategies was based on the visually impaired students' needs or learning outcomes that could be achieved by students. For example, the ABCD strategy application in the learning objective:

Given an e-book to read,	student	distinguishes positive electrical charges and negative electrical charges	clearly.
↓	↓	↓	↓
Condition (C)	Audience (A)	Behaviour (B)	Degree (D)

On the other hand, Tiffany always used both strategies in setting up learning objectives. She stated in her questionnaire (02/2018) that: "I applied the SMART strategy in accordance with the basic competencies of each material" and applied ABCD strategy when she "imitated existing lesson plans on the internet and from electronic text books".

The questionnaire showed that Shirley and Tiffany undertook different actions in grouping the objectives. Shirley wrote in the questionnaire sheet that she always categorised the objectives into "essential for easy material and non-essential for difficult material", while Tiffany said that she never did that. Tiffany on the other hand emphasised that she would "rather do the group material based on what might be quickly absorbed by students and on whether students can learn independently by making a summary of what they read" (questionnaire/02/2018).

5.2.2.2 Aligning learning objectives with teaching method and assessment

Shirley and Tiffany emphasised (interviews) they described objectives that were measurable and achievable for students with VI. The way of describing these objectives was by linking the objectives tightly to the instructions and assessments and that produced content-based objectives. Shirley and Tiffany asserted (questionnaires) that they frequently set goals and objectives for SWD that guided instruction and assessment. Shirley explained that after stating the learning objective, she then arranged the learning steps in detail that led students to achieve that objective. Tiffany, however, said that the objectives that required students with VI to do strategic works (such as practicals in laboratory) would be adjusted to cognitive learning or she would remove the learning objective altogether. The examples of the alignment of learning objectives and assessment made by Shirley and Tiffany are in Table 5.3.

Table 5.3 Alignment between learning objectives and assessment

Teachers	Learning objectives	Indicators for competencies achievement	Technique of assessment
Shirley	Differentiating series and parallel circuits	Explain the concept of series and parallel circuits	Paper and pencil-based test
		Create a series of electrical components both in series and parallel	Performance test
Tiffany	Analysing the relationship between force and surface area on the amount of pressure	Identify factors that influence the amount of pressure	Paper and pencil-based test
		Calculate the amount of pressure	
		Analyse the relationship between air pressure and altitude	

Source: excerpt from lesson plans of science teachers

5.2.2.3 Accommodating students with visual impairments' needs when setting learning objectives

Data analysis confirmed that science teachers in School B accommodated students with VI's needs when setting learning objectives. Shirley mentioned she frequently while Tiffany said she always invited students with VI to speak to them to discuss their learning issues. However, the students tended to close themselves in rather than expressing their difficulties (Shirley's questionnaire). Shirley admitted (questionnaire) that she frequently accommodated the personal interests and/or values of students with VI when writing affective objectives, but Tiffany asserted she never did so. Shirley added in her statement that where she established learning objectives, she conducted observations on students' attitudes, speech and behaviour inside and outside the classroom, before and after the lesson, using these as the baseline from which to set the objectives.

5.2.3 Modifying Learning Objectives for Students with Visual Impairment

The analysis of lesson plans and syllabi confirmed that no specific learning objective adjustments were made for students with VI, although the verbs (see Table 5.2) used by science teachers in School B were adequate for them to gain access to learning. The way science teachers in this school adjusted learning objectives for students with VI was by cutting down the regular learning objectives. Shirley said:

> I only created the learning objectives in general even though we have three classes with different levels of cognition. Let's say I made it for the regular classroom, so for all students, not specific for a certain student or a certain class. For example, learning objectives 1, 2, 3, for cognitive, then 3 4 5 for psychomotor. And for those with certain condition, like double disabilities, visually-impaired and slow learner, I just adjusted by cutting down some of the learning objectives, to what I thought she could achieve. But I don't document it. … I tend to use only the cognitive domain, … because we haven't

> been required to report the psychomotor and affective domains in the report card. I don't know if the homeroom teacher adds a grade for the affective and psychomotor domain (interview/08/02/2018).

However, LO were determined for a minimum requirement of standards and focused on objectives that would help students to pass the National Examination.

5.2.4 Creating Minimum Criteria for the Passing Grade for Students with Visual Impairment

Data revealed that science teachers in School B did not establish criteria for a minimum passing grade (KKM) for students with VI. Shirley and Tiffany admitted (interviews) the KKM was set for general students by following the instructions from the Department of Education.

5.3 Theme 2: Pedagogical Practices for Students with Visual Impairment

Theme 2 addresses the way in which science teachers created teaching plans and strategies for students with VI in an individual manner and is organised into three sub-themes as follows.

5.3.1 Supporting Recognition Learning to Build Students with Visual Impairment's Knowledge

Data analysis showed science teachers in School B designed instruction that supported recognition learning to build knowledge development for students with VI.

5.3.1.1 Activating background knowledge

Interviews, questionnaires and classroom observations revealed that when science teachers introduced the lesson, they sought to attach new ideas to preceding knowledge. In the questionnaire, science teachers in School B asserted they connected the students' prior knowledge with the new material that they would learn. Shirley and Tiffany said (questionnaires) that they frequently attached new ideas to prior knowledge when structuring material to build knowledge for students with VI. Shirley said that "prior knowledge and new knowledge is interrelated. For example, to teach the topic of Electrical Energy, students must have prior knowledge about the potential difference and electrical current", while Tiffany mentioned that "prior knowledge is related to examples of applying each material (questionnaire/02/2018). For example, in the topic on Physical and Chemical Change, I demonstrated some changes that they had never known before. For instance, a transformation of sugarcane to sugar or an application of theory to new technology" (questionnaire/02/2018).

Irene said that visual limitation caused students with VI to have minimal prior knowledge of particular science concepts. For instance, Irene mentioned students who were blind or had vision loss since birth would have difficulties in imagining colour when they learnt colours to determine pH in Acid and Base lessons.

5.3.1.2 Providing real-life examples

Data disclosed that science teachers in School B provided real examples of ways in which students with VI could interact with science materials. In the questionnaires, Shirley mentioned she frequently and Tiffany said always presented real-life examples to make learning science applicable. Shirley also stated she frequently whereas Tiffany always ensured that examples and content used in class were relevant to children with VI (questionnaires). Shirley mentioned in her questionnaire (02/2018) that "the material they have been learning became part of fact of events in everyday life", while Tiffany said:

> In giving examples and the application of theory, I usually took relevant examples, or at least they can imagine. It is easier when teaching students who still have a slight vision or are not blind from birth. If they cannot imagine, I tend to skip or replace with other examples. For instance, in the Vibration material, they can imagine pendulum but cannot imagine the spring density. Then I should describe more clearly (interview/15/02/2018).

Support teacher Irene said:

> It is important to categorise the basic material that is applicable in daily life and difficult material. For students with VI, it is more important to learn the basic and applicable materials. I tried to deliver the material that can be practised in everyday life, made it more meaningful and useful than the complicated learning material that is not necessarily meant for [SWD]. For example: learning about food preservation or conventional biotechnology such as the production of salted eggs or the production of *tempeh* or *tape* [fermented cassava]. It will be more meaningful than learning about mirrors, lenses, optics. Nevertheless, all material is still taught but more emphasised to the more meaningful or essential (interview/24/02/2018).

5.3.1.3 Highlighting critical features and key concepts

Data showed science teachers in School B highlighted critical features and key concepts by the ways in which they presented materials. The first way was in the opening lesson; Shirley admitted to sometimes outlining the material and preferring to teach directly what the sub-materials that students would learn. On the other hand, Tiffany asserted (questionnaire) that she always stated what the main topic and its chapters were, as she mentioned (interview/15/02/2018):

> Before beginning the lesson, I always explained the main topic of the material, the chapters and sub-chapters of the material, so that students understood what material was being studied.

Questionnaires confirmed Shirley (frequently) and Tiffany (sometimes) highlighted key concepts and explained how these concepts related to the learning objectives. Shirley asserted the reason for highlighting the concepts was to ensure that the students understood clearly which essential material they would learn. On the other hand, Tiffany declared that she highlighted key concepts when a new topic was given. She said: "at the beginning of the topic, I will explain what material would be learned and what learning objectives should be achieved" (questionnaire/02/2018).

Findings also revealed that Shirley and Tiffany mentioned key points in the closing lesson. Shirley said (questionnaire) that she frequently concluded every session with a summary of key points, while Tiffany mentioned that she always did, as she said: "in each of the learning sessions I convey the subjects, especially those concepts that they should at least remember" (questionnaire/02/2018).

Questionnaires indicated that Shirley (frequently) and Tiffany (always) provided the key concepts verbally and graphically. Shirley admitted that the key concepts were more often presented verbally, while Tiffany added sometimes graphically. In this case, Tiffany explained: "In the topic on the Law of Archimedes, I instructed students verbally how this law should be applied to the concept of Liquid Pressure, while I also directed my students to write down some key concepts about this law" (questionnaire/02/2018). Tiffany also wrote:

> I always associate every lesson in everyday life. I gave the examples of lifting and rigging equipment as application of the Incline Plane, then I also showed them what real example in the daily life of Straight Regular Motion and so on (questionnaire/02/2018).

5.3.1.4 Providing multiple media and formats

Findings evidenced that science teachers in School B offered media and formats in science for students with VI, as presented in Table 5.4.

Table 5.4 Science learning media and formats provided by science teachers in School B

Please give examples of ways in which you present information using the following types of media and formats.

Types	Shirley	Tiffany
Text	Summary of material in the form of text soft file.	In conveying science material in accordance with the theory that is in the teacher handbook, I gave full attention to how the physics formula should be written. For example, the formula of pressure is $p = F/A$, I explain that p is a small letter, as F and A are capital letters.
Graphics	The wave material uses an embossed image so that it can be touched by the student. It is used to describe the frequency, period, wavelength, number of waves. Drawing a picture on the back of a child so that children can imagine what I say. For example, the shape of "wave".	I lack or never use images because of their limitations as visuals.
Audio	Materials that are theoretical such as in biology use a lot of audio, in this case, students read the material through the mobile phone with talk reader installed or by recorded material provided by the government.	My audio recording is in the form of audio which contains formative tests. When test begins, I just turn on the audio, at any time can be played forward or backwards depending on the request of the students. They told me to repeat or to re-sign.
Video	The video in science teaching for blind children is very difficult to apply due to the limitations in seeing.	I played YouTube learning videos to be listened to by children. I described when children do not understand.
Model	Static electrical material for the electroscope model uses the model of the body or student concerned as the electroscope model with the head portion describing the electroscope head, while the leg portion describes the electroscope leaf. We have a 3D model of atom made from wood. I try for it to be touched by the children in accordance with the material or the relevant learning objectives.	I only describe orally what atom/molecule/compound are.
Others	Android phone that has JAWS installed or talk reader. Mnemonic: in Topic Optical, using "MICEK" → myopia with concave lens etc.	I do practicals on the material that is possible to be conducted. Example of acid-base by using litmus paper, I divide the group with each group there are low vision students (some of whom can still see a reasonable distance).

Source: questionnaire/02/2018

Irene asserted that the teacher should consider visual stuff when he/she chose learning strategies, saying:

> Because of the limitations of blind children who cannot learn through visual observation, learning strategies should allow for direct access to objects or situations. Blind students should be guided by touching, hearing, smelling, tasting and looking for low vision children. For example, touching flowers that are blooming and who have not bloomed, holding the chicken to know what it looks like, smelling the spice etc. (interview/24/02/2018).

Tiffany said:

> Because the student's ability in this school is actually the same as the general student, just because of visual limitations, I tended to limit the material that actually requires practicals (constraint in props). But for the learning and assessment, I think the same with students in general. The difference is just to replace writing the material on the chalkboard by spelling out orally and choosing a simple number (questionnaire/02/2018).

Irene also emphasised that if students with VI preferred audio style, then Irene offered the lesson by audio aids. Irene mentioned: "to make students understand the subject matter, I provided them to listen to songs, poems, and other related matters. For instance, recording material but made singing poems such as the material features of living things" (interview/24/02/2018). Irene provided opportunities for the students to find their own resources (i.e. web-based materials) and they learnt together in their group.

5.3.2 Supporting Strategic Learning to Build Students with Visual Impairment's Skills

This sub-theme draws together the findings on how science teachers in School B practised pedagogies to support strategic learning for students with VI. Science teachers in School B offered some ways to give students with VI opportunities to build their skills, as follows.

5.3.2.1 Providing flexible models of science process skill

In the questionnaires, Shirley and Tiffany asserted they frequently began the lesson with an advanced organiser, using essential questions. Shirley mentioned the way she used advanced organisers was by presenting facts that occurred in nature and questioning the students about things related to the topic. For example, students learn about the earth's magnetic pole and Shirley asked about the natural facts related to magnets. Shirley also described another example where she used questions: "Have you ever been shocked after walking on a carpet or putting on a sweater? Combing your hair? Getting out of a car with cloth seats? Can you explain what caused the shock?" (interview/08/02/2018). In addition, Tiffany explained her way of starting a lesson by seeing the students' condition and repeating the previous material, as she explained:

> Before entering the material, I always observe the condition of their facial expressions. They were ready to study or not, for instance by asking about their activities last night until that morning. Then, I repeat the last material before proceeding to the new material and asking some critical questions about the material that would be taught. I will not start new material before students understand the material that has been taught. Often, students are embarrassed to ask, then I am trying with the task of looking for questions that are relevant to the material being taught (interview/15/02/2018).

Questionnaires confirmed science teachers in School B had limitations on applying active learning approaches for students with VI and their reasons are in Table 5.5.

Table 5.5 The science teachers' reasons for implementing students' active learning approach

Which of the following options do you provide when structuring material to build knowledge for students with disabilities? I …

Statement	Shirley		Tiffany	
make learning "active"	sometimes	I've tried to make active learning, but the limitations of teachers in encouraging students to be active because these students tend to just listen.	frequently	This depends on the ability of students in each class. If in a classroom with a child who has the ability and quickly absorbs, I will give more practice questions after material given, than the class with children who have a moderate ability. I can repeat 2 or 3 times the same material in this class until they get in it.
make learning participatory	sometimes	One way to make them participate in the class is by giving them questions respectively. Unfortunately, students rarely expose their opinions, especially in answering questions.	sometimes	I rather apply this to classes that are active/fast in absorbing the material. Often, they ask to be given more questions to better understand. But I also often ask them to look for individual problems to be solved together in addition to making them understand more and increasing participation.
use student-centred learning approaches	rarely	Not applicable considering the limitations in practice tools and instructional media that leads the students to find the concept independently.	frequently	I tend to encourage students to be more active, looking for problems to solve together.

Source: questionnaire/02/2018

Interview and classroom observation revealed the way science teachers in School B delivered science material was by using several teaching methods, e.g. lecturing, discussion, observation, and simple practical work in the laboratory. Tiffany said that the lecturing method was the best way to teach students with VI who were also slow learners, and the active learning approach was only applicable for groups of students of medium to high level cognitive ability. Tiffany asserted (interview) that she tended to repeat the material delivered to the students several times to ensure that they understood, while Shirley mentioned:

> to handle students who are slow learners, we are not too demanding, so it's up to him [the student], … should not be the same as his friends, … should not have to write down the material or listen to me. … We don't have a high demand and requirement (interview/08/02/2018).

In his view, Arthur also said that lecturing was the most preferred method used by almost all teachers in School B. He pointed to his statement in the interview (13/02/2018): "we use the lecturing method a lot, although there are also other methods, but the majority are still, lecturing is dominant. … sometimes [the teachers] use games". Arthur emphasised that science teaching and learning are very dependent on the teacher's creativity. He said in the interview (13/02/2018): "it's the teacher's own creativity so that the students understand, sometimes they collaborate with a student who is collecting data as a researcher in this school".

The interview with Irene conveyed how that she organised discussions, offered to observe outside the classroom and provided simple practicals in the laboratory. Irene emphasised that she tried to vary the teaching methods to give students various learning experiences. Irene asserted that the discussion method was suitable for students with VI as they tended to be active in discussion, questioning and answering. Irene said that it was expected that students were also able to express their opinions and formulate conclusions, besides they were also expected to argue, refute and defend their opinions. Irene also asserted she accompanied students to observe their environment, such as when she was teaching the topic on the Introduction of the Ecosystem, she asked students with VI to observe the outside school environment. Irene mentioned:

> I usually assigned them outside of the classroom. They became more creative, not keep listening to us in the classroom, they were bored too. They have high confidence and excitement. They searched the material through the internet. … When taking them to field observation, I took them to somewhere, walking. I invited them to practise, to test it, made something, like fermented-cassava, salted egg or natural preservative. They were really happy (interview/24/02/2018).

Another way of providing models of Science Process Skills was by practical work. Irene said (interview) that not all topics can be practised in the laboratory, but some that do not require high visual skill can be. Irene mentioned that students were asked to do acid-base experiments in a simple way and, as this experiment requires visual perception, Irene partnered students who were totally blind with students who still had vision.

Data provided evidence that both Shirley and Tiffany admitted they had difficulty in assisting students to identify the best way to learn. Shirley said (questionnaire) that because she was an itinerant science teacher, she had limited time to accompany students, while Tiffany and Irene said (interviews) that they had tried to ask and discuss with students what they liked to do in learning science.

The last option for providing a flexible model of science process skills for students with VI was by allowing them to grasp material in their preferred learning style and at their own pace. Tiffany mentioned (questionnaire) that she always allowed students with VI to grasp material in their preferred learning style and at their own pace, whereas Shirley said sometimes and frequently as in Table 5.6.

Table 5.6 Options for allowing the students with VI to grasp the material

Which of the following options do you use when building skills for students with disabilities?

Statement	Shirley		Tiffany	
Allow them to grasp material in their preferred learning style	sometimes	Sharing electronic textbook files in the form of learning materials for students to learn independently.	always	I do more combine my teaching style with their learning style. I customise both of them. Especially in the less-absorbing class, they prefer to find the material by browsing, after I have given the link to the material to be studied and what the points are.
Allow them to grasp material at their own pace	frequently	Sharing electronic textbook files in the form of learning materials for students to learn independently in accordance with the speed of each understanding	always	As I explained earlier, I will not move to the next topic before they understand the material already taught.

Source: questionnaire/02/2018

5.3.2.2 Providing various methods for responding to and interacting with science materials

Data highlighted that science teachers in School B provided few methods for students with VI in responding to and interacting with science material to support strategic learning. Tiffany admitted (interview) that students learnt by dictation and they recorded the materials with slate and stylus. The students were also facilitated with computers, in which screen reader software such as JAWS was installed to access the materials, however all participants said this access was limited. In the questionnaire, Shirley provided another option for interaction between students with VI and science material by "asking directly to the WhatsApp Group (WAG)" (interview/08/02/2018), and Tiffany said she preferred the students to respond by submitting tasks and assignments in Braille.

5.3.2.3 Offering flexible opportunities for demonstrating skill

Findings revealed that science teachers in School B offered few opportunities for students with VI to express their skill. Shirley admitted (questionnaire) she used alternative project formats, i.e. brief reports. She said: "students were required to read the material from the website then to summarise the important information that related to the material being taught" (interview/08/02/2018). On the other hand, Tiffany stated (questionnaire) she used brief reports and oral presentation as alternative projects. Irene also mentioned that she asked the students to give oral presentations to demonstrate their skills, saying:

> I often use a presentation. Before the students presented, I instructed them a task. For example, the topic of Environmental Pollution. I divided the students into groups, coincidence there were six students, then I grouped into three, two students for each group. Group one looked for water pollution, Group two for air pollution, and another group looking for soil contamination. I said: "please search over the internet and arrange the material based on your understanding about the pollution". Then I ordered each group to present using PowerPoint (interview/24/02/2018).

Nanda said similarly. He asserted that his teacher asked the students to present their work, saying: "My teacher instructed us to discuss a particular topic and we were required to search the material on the internet. After that, my teacher asked us to present our work in front of the class" (interview/17/02/2018).

5.3.2.4 Providing opportunities to practise with support

Findings clarified that Shirley and Tiffany offered some supports to give students with VI chances to practise learning science. Shirley mentioned (interview) she used a mnemonic strategy to help VI students memorise new concepts and recall the previous lesson. Shirley also asserted that she offered additional lessons after school, saying:

> We feel that students need to add hours to learn science. Unfortunately, no students asked for the additional lesson, then it directly programmed by the school. For example, in one-week, what subject that needs to be for the additional lesson. … It depends on who arranged the schedule for the additional lesson and who feel still less in delivering the material (interview/08/02/2018).

The second way of giving support to practice was by offering students additional time. To give students chances to practise recalling and utilising information, Shirley admitted (questionnaire) she frequently and Tiffany asserted she always offered students additional time to do their tasks. Irene added that the way of offering additional time was by "giving additional time for homework, therefore students are expected to ask parents, relatives, tutors, or volunteers when in their home when they found difficulty in doing their homework" (interview/24/02/2018).

The other option that Shirley and Tiffany provided as support for building skills for students with VI was by allowing them to work in pairs as described in Table 5.7.

Table 5.7 The science teachers' way in allowing students with VI to work in pairs

Which of the following options do you use when building skills for students with disabilities?				
Statement	Shirley		Tiffany	
Allow them to work in pairs with non-disabled students e.g. in the laboratory where physical and/or sensory effort may disadvantage SWD	rarely	There are no complete facilities and infrastructure for practicals, teachers should seek their own. And for blind students, is more limited to hearing and touch sensory.	sometimes	In grade 7 I once tested the acid-base by dividing the group. Where students who are still a low vision in each group will see the colour change on litmus paper. Or about a homogeneous/heterogeneous mixture. Not all materials can be practised because of the limitations of props.
Source: questionnaire/02/2018				

Irene explained an example of how the students worked in pairs. She stated: "when I taught the students about the function of the microscope, I ordered them to work in a group of two. One had to palpate the whole microscope and the other one described its function and usefulness" (interview/24/02/2018).

Science teachers admitted (interviews) that students with VI could contact them at any time through the WhatsApp (WA) chatting application as a form of extra support for them.

5.3.2.5 Provide ongoing and relevant feedback

Data showed that science teachers in School B provided feedback to support strategic learning. Shirley and Tiffany wrote answers in the questionnaires as in Table 5.8.

The interview with Irene revealed that feedback was always given in an ongoing manner by Q & A method. She mentioned that after students demonstrated tasks or submitted assignments, she always provided comments (verbally) on what students had done. She also asked the students what parts they had not understood. If the students had not understood a particular part, Irene would repeat the lesson. Amy, the student, also asserted (interview) that her assignment was corrected and sent back to the student which let her know her strengths and weaknesses.

Table 5.8 The ways of science teachers in School B in providing feedback

When creating assessments that accurately measure knowledge development of students with disabilities I …

Statement	Shirley		Tiffany	
provide clear feedback	sometimes	Provide time for students to clarify the results of their assessment.	always	I always do this by holding a remedial on the formative test/mid-semester test/final test. And the opportunity of each student in answering or describing their thinking about the ongoing material during the learning process, so that both active and passive students get the same opportunity.
Give prompt, progressive and informative feedback to support learning and self-assessment	frequently	Through WA group of Grade 9	frequently	Every time I finish teaching, I always ask whether they understand or not. It can be known by repeating the material before. If they imitate/continue my words, it means already understand. If it is silent, then I will repeat from the beginning because it is a sign they have not understood.

Source: questionnaire/02/2018

Data analysis confirmed that Shirley (frequently) and Tiffany (always) invited students to answer the question at the end of class to check the understanding of students with VI. Shirley mentioned (questionnaire and interview) that she asked the question and the students expressed the answer orally. In addition, Tiffany said she usually asked students to write what she said, "to check the material whether the students already understand or have not asked me to write back with slate and stylus and asked to read, sometimes students cannot read their own writing" (interview/15/02/2018).

5.3.3 Supporting Affective Learning to Build Students with Visual Impairment's Motivation and Engagement

This sub-theme explores the ways science teachers in School B practised pedagogies that supported affective learning, gained student's engagement and motivated students to learn science; they are presented into four aspects, as follows.

5.3.3.1 Providing adjustable levels of challenge

Data exposed that science teachers in School B provided limited adjustable levels of challenge for students with VI. Shirley said: "in a regular school, all materials are taught, from the lowest level to the highest level can be taught there. For blind students, we have to choose the light/easy material … and only for upper-middle-level students with a high interest in science are challenged with difficult questions" (interview/08/02/2018). Similarly, Tiffany mentioned:

> Although the learning objectives remain same with regular class, the materials are simplified. … Challenges given to students depend on the level of each student, usually through questions from easy level questions for students with low cognitive abilities and difficult questions for the higher cognitive level (interview/15/02/2018).

5.3.3.2 Offering choices of content, tools and media for communication

Findings indicated science teachers in School B offered limited choices of content, tools and media for communication to support affective learning. In the questionnaires, science teachers asserted they never provided captions or subtitles for videos even though they sometimes used video for science learning. Shirley (sometimes) and Tiffany (always) said they checked for ancillary electronic materials to go with the course book. Shirley mentioned checking electronic books (BSE) and try-out questions set for Grade 9 and discussing these via WAG. On the other hand, Tiffany mentioned (questionnaire/02/2018): "I often download PowerPoint learning materials for more than three to complement my teaching process other than some electronic text books or research papers".

Data showed science teachers in School B adopted instructional technologies to express what students knew and increase communication. Shirley mentioned (questionnaire) that students presented their assignments through PowerPoint. In addition, Tiffany asserted that she and her students used a smart phone to assist them in learning and utilised WhatsApp (WA) chatting application for communication and task submission. Science teachers admitted they could be contacted anytime though WA. Tiffany also mentioned (questionnaire/02/2018): "We, the teachers here use our smart phone for learning. I personally, in addition to finding material that students can self-contained or independent [for Biology], I often asked them to search examples of arithmetic [in Physics]".

5.3.3.3 Offering a choice of rewards

The other option offered by science teachers in supporting affective learning and to recruit students' interest to learn science was by a reward. Irene stated that she usually provided rewards when students could answer a question correctly. Irene said: "If that student can answer my question correctly, then I gave a reward, lollies or something. Is not a big deal, a small attention, not that much … more correct answer more rewards" (interview/24/02/2018). Irene asserted a reward can make students happy and interested with the teacher and science. She not only rewarded her students in the teaching and learning process, but also outside the classroom, on special occasions such as Moslem Celebration day. Irene said: "A small attention means a lot for them" (interview/24/02/2018).

5.3.3.4 Offering choice of learning context

The last option provided by science teachers in School B in supporting affective learning was giving the students choice of learning context. Shirley mentioned (questionnaire) she sometimes captured students' attention "by expressing the natural phenomena associated with the material", while Tiffany asserted she frequently captured the students' attention by telling them knowledge that they might not know. Tiffany said:

> I usually associate with the knowledge that they may not know. Can be done with a story, or with a simple numerical calculation example. For instance, I told the nuclear danger by telling the Chernobyl case. Or I make calculations with simple numbers, in addition to the students better understand. They will also like the material because the numbers are not difficult (not using fractions or decimals) (interview/15/02/2018).

Similar to Tiffany, Irene asserted she captured students' attention by bringing actual samples/goods of what the students would learn, as in her statement:

> When they learned Additive Food topic, I ordered the students to bring food or drink that I might think used an additive such as artificial colour and preservative. They were excited and curious about what would they learn about. After the lesson, we ate the food together (interview/24/02/2018).

Science teachers also asserted (interviews) they made science learning relevant to life by linking the material given with everyday life, such as how electricity turns on electronic devices (Tiffany), how healthy food affects the body (Irene), how static electricity works for lightning (Shirley). Some reasons for using daily life examples included: "to provide knowledge to students about the benefits of learning science, to give examples of natural phenomena that occur for discussing the material" (Shirley's questionnaire), "to make science learning more fun and valuable" (Irene, interview/24/02/2018). In addition, Nanda also asserted that the science teacher "always linked the material with daily life" (interview/17/02/2018). Nanda mentioned:

> My teacher always linked the material to daily life and it's possible for science. When discussing bacteria, then is possible to take the example that can be linked with life every day. We learned about the bacteria's name, how to maintain cleanliness, for example, keep food free from bacteria and so on (interview/17/02/2018).

For Nanda, linking the science material into daily life was very useful as he said:

> For me, when learned science, and then the teacher linked with everyday life, then it might be a new reference for me, new knowledge. For example, the bacteria, before the teacher explained what the bacteria are and how to maintain food hygiene, I know nothing. After I understand with that explanation, then the negative effect of bacteria could be avoided (interview/17/02/2018).

Data showed science teachers in School B created several ways to increase student interest and minimise threat in learning science. By doing, both science teachers asserted frequently they created a welcoming class environment. Tiffany said (questionnaire/02/2018): “it was done to build the students’ mood”, while Shirley mentioned welcoming class was done by “calling one by one the students’ names and asking how were they before the lesson started and treating them fairly”. Similarly, Irene said: “first, it’s important to make students feel comfortable and happy by keeping their stories up. I provided a tidy and enjoying atmosphere, built effective communication with them, conducted more discussion and emphasised more on science concepts” (interview/24/02/2018). The questionnaires revealed that Shirley frequently and Tiffany always implemented appropriate accommodation for students with VI. Tiffany stated that: “in opening lessons, I always adjust to the students’ mood to set their willingness to learn. I almost never go straight into the material and I do not treat the students differently than other students in general” (interview/15/02/2018). Shirley stated that she “didn’t burden the students with difficult task” (interview/08/02/2018), while Tiffany said: “this is also related to their ability to absorb the material. I didn’t treat the same thing for all classroom” (interview/15/02/2018).

The second way was by creating humour and ice breakers during the lesson. Science teachers in School B stated they frequently did this. Shirley gave an example in creating humour, as she said: “when you buy salt in the shop stall, ask the seller to buy sodium chloride, don’t mention salt, and see what his response is” (interview/08/02/2018) and in creating an ice breaker by telling an overview of life going forward, after graduating from school etc. On the other hand, Irene asserted (interview) she provided a fun game, whereas Tiffany admitted she provided story telling as she mentioned: “often because this lesson is tedious for some students so that if their capture (attention) has dropped down in the classroom, then I shift by telling stories or joking or asking about their activities outside of the class” (questionnaire/02/2018).

The third way was by providing a morning routine. Arthur asserted: “every morning, at 7, before they start the lesson, they prayed then recited the holy Quran” (interview 13/02/2018). He added that “It’s not an extra[curricular], it’s routine scheduled, after every daily praying, then rehearsal for MC [Master of Ceremony] and speech and it’s scheduled” (interview 13/02/2018).

5.4 Theme 3: Assessing and Monitoring the Progress of Students with Visual Impairment

Theme 3 draws the data analysis of how science teachers in School B assessed the progress of students with VI in cognitive, skill and affective developments, and is organised into three sub-themes.

5.4.1 Measuring Knowledge Development

Data showed how science teachers in School B created assessment for cognitive/ knowledge development. To measure knowledge development of students with VI, Shirley asserted (questionnaire) she sometimes created assessments straight from the learning objectives even before outlining course content, while Tiffany said rarely. Shirley admitted that “the design of the assessment was prepared before the material takes place whereas the form of assessment such as the formative test was prepared when the material takes place” while Tiffany mentioned in her statement:

> I have made an assessment based on learning objectives, but also see how many learning objectives can be mastered in a single subject matter. For example, how far a student understands the concept of Motion, types formulas and answers related questions (questionnaire/02/2018).

Questionnaires also revealed that science teachers in School B provided instruction on assignments both in writing and verbally. Shirley and Tiffany admitted they frequently offered instruction to students with VI. Shirley said she offered instruction verbally to students to provide direction and to encourage them to do their tasks or assignments. Shirley asserted (questionnaire) she never instructed in writing form. Tiffany mentioned (questionnaire) she provided detailed instruction when students should write formulation/arithmetic in physics. She emphasised: “even though those students cannot write as we [sighted people], I want them work on a coherent step, even in writing a formula or a size of a unit, they should understand which one they should use, capital letter or small letter. I want them to pay attention to it well" (questionnaire/02/2018). Tiffany also asserted (interview) that before she conducted a formative test, she usually started with a question to be solved by students all together, then offered them individual tasks while she explained how their assignment would be graded and how they should do their task.

Another finding confirmed by questionnaire was that alternative assessments to the traditional quizzes and exams were offered by science teachers to assess strategic learning. The alternative assessments were created to monitor students' activity as shown in teachers' statements in Table 5.9.

Table 5.9 Alternative assessment offered by science teachers in School B

When creating assessments that accurately measure knowledge development of students with disabilities I …

Statement	Shirley		Tiffany	
use alternatives to the traditional quizzes and exams	sometimes	Assessment of student activeness	always	I not only judge from the quiz and formative test but also from the activity of the students in the class and the questions they ask me when learning activities take place.

Source: questionnaire/02/2018

In the questionnaires, Shirley said she sometimes and Tiffany asserted always created a grading rubric to ensure objectivity. Shirley added that a grading rubric was created when measuring affective and skills of students with VI.

5.4.2 Measuring Skill Development

Data confirmed science teachers in School B monitored students' skill development by allowing them to submit assignments in Braille or by paper-and-pencil based tests, whereas electronic formats were very limited options for students in task submissions.

5.4.3 Measuring Affective Development

Findings indicated science teachers in School B applied few approaches to measure affective development. Shirley asserted (questionnaire) sometimes having the students with VI explore the value and meaning of learning science for their selves and society, by explaining the application of science knowledge in daily activities and its benefits for the society. On the other hand, Tiffany asserted she always motivated the students to learn science and explained that what they learned would be useful in daily life. Related to the experiential learning, both teachers said they never did this kind of assessment to monitor the affective domain of the children. Shirley added that she used observation sheets to capture affective development.

Tiffany mentioned (questionnaire) that she considered one aspect of affective domain such as discipline to be assessed as a part of affective learning. She said:

> I divided the assessment among others: 1. the learning process (student activeness in class); 2. students' ability to answer questions in class; 3. assignments; 4. formative test; 5. mid-semester test/final test. I also consider the aspect of their discipline in entering the class (on time or late) (questionnaire/02/2018).

5.5 Theme 4: Other Factors that may Contribute to or Hinder the Way in which Science Teachers Create Science Classrooms that are Inclusive for All

Theme 4 draws together participants' view and experiences of factors contributing to and hindering making science classrooms inclusive for all, described in seven sub-themes as follows.

5.5.1 The Understanding of Inclusive Education

5.5.1.1 Students' perspectives towards science

Interviews with two students indicated that they had a positive perspective towards science. They liked science, but Nanda preferred biology to physics, and Amy preferred physics over biology, as they mentioned:

> Actually, I like it [science], but sometimes, when learning science, especially for physics, I like less, but for biology yes like it more (Nanda, interview/17/02/2018).

> Yes, I like physics, even though hard, but yeah, more fun, better physics than biology. Biology is like a lot that must be memorized (Amy, interview/24/02/2018).

5.5.1.2 Students' views on inclusion

Interviews with students elicited that they understood about inclusion as something that related to accepting people with disabilities. Nanda had a view of inclusion as acceptance of all students, as he mentioned: "an inclusion is a school which does not only accept friends whose terms are normal, but friends with disabilities can enter there" (interview/17/02/2018). Amy said she understood what inclusion was, but it was hard to explain. She had known that School B was an inclusive school as she said: "because this school accept students with special needs, meaning this school is inclusive" (interview/24/02/2018). She also added the strength of inclusive school was that the graduated student could enrol in public school:

> Students who are graduated from special school maybe cannot go to the public school, but they can from the inclusive school, they can go directly to the public school and can be mingled directly with others, this is the real inclusion (Amy, interview/24/02/2018).

Both students agreed that School B was not fully inclusive, as Amy said: "this school is inclusive, but all students are vision impaired" (interview/24/02/2018), while Nanda said:

> If we concerned to the students, I think not inclusive yet, because all students in here are visually impaired, all like that. But if this school also accept normal students, it might be possible, then we can call it inclusion. However, for this school, this is already inclusion. It used to be Special School but now it has been replaced with inclusion. … Special School is specifically for disabled friends, but for the inclusion, it would be fine if the normal friends want to enter, so for both normal and with needs (interview/17/02/2018).

Amy also added that "here, as far as I know, it has the same [curriculum], like a sighted child" (interview/24/02/2018). Amy was thinking that schooling in a special school was easier than in an inclusive school, as she asserted: "Come to think of it, it's easier to schooling in Special School, the lesson is easy, … simplified, more basic" (interview/24/02/2018). Nanda had an argument about the differences between a special school:

> I chose this school because hones our motoric, our intellectual ... more lessons taught. Compared to special school, this school is higher… the material is the same as the other inclusive schools …. For Special School, the material is limited for the intellectual development and more concern in skills (interview/17/02/2018).

Nanda added that the other reason he chose School B was he could learn how to socialise with others:

> I also can learn to be socialised with others. For we who are visually impaired, sometimes we feel embarrassed when to face the community and tend to be alone, then do not want to mingle, do not want to socialise with friends or with the surrounding community. But in here, I already used to have knowledge about how to socialise well with the surrounding community (interview/17/02/2018).

5.5.1.3 Teachers' views on inclusion

Data indicated all teacher participants had similar views about inclusion, as welcoming SWD in the general classroom. Tiffany said inclusion meant it "involves or includes students with disabilities into regular classes", whereas "inclusion class is classes with students with disabilities" (interview/15/02/2018). On the other hand, Shirley asserted (interview) that inclusive is special and different from most, typical, and normal. She mentioned an inclusive classroom is one which has something special, but that special tends to be a negative not positive thing. Arthur said (interview) inclusion is about giving opportunities for these children with disabilities to study whenever and wherever with anyone.

Findings confirmed that although Shirley, Tiffany and Arthur mentioned (interviews) that they had not measured inclusivity, they asserted School B and the science classrooms were inclusive. Shirley said:

> Maybe in general, yes we are [inclusive]. But in the implementation, our curriculum is inclusive, but for the input [students] is still less, less diverse and only dominated with students with VI. Naming [this school] with an inclusive school is not quite right because there is no other type of disabilities or maybe a normal person who might be interested to be schooled here. But not yet, even if we are welcoming all students (interview/08/02/2018).

Arthur mentioned: "… we also have no standard indicators, the school's inclusivity standard is how it does not exist" (interview, 13/02/2018). According to Arthur, School B was inclusive because it: "meets the needs of children with special needs, gives them opportunity to learn, and using general curriculum" (interview, 13/02/2018). Arthur emphasised that School B has a tradition in accepting, including and respecting all people.

In contrast, Irene asserted that School B was not ready to be called an inclusive school because it had no special education teacher who helped general teachers plan the lesson to maximise students' outcomes. Irene added: "special education teacher will make inclusion possible for SWD, but in this school, all returned to the respective teachers" (interview/24/02/2018).

Data showed that teachers had similar opinions about students with VI. Like students in general, students with VI are diverse, as Arthur mentioned: "Yes, they are diverse, some are active, some are lacking in enthusiasm too. It is indeed the teacher's job to always motivate children to learn" (interview, 13/02/2018). Similarly, Shirley mentioned that students with VI had a huge range of abilities. She said:

> Like other children, students with VI have a huge range of ability. Some of them have excellent memorisation, they are smart and just need them to imagine counting. And others somewhat are the opposite. They should be taught repeatedly, cannot just once and they are not too strong in the science lesson. For science, only students in the middle to the upper level are interested, but for the one who a slow learner, they tend to not like this subject, he even talks when I was teaching, he was preaching. And I

> think one reason they study in this school, in this Islamic school because this school offers the Islamic subject, that cannot be found in the other schools. And some of the students feel that impossible to enter the science department, and that's why they tend to memorise the Quran more, not science. But all of them are very independent, they usually walk alone using their white stick (interview/08/02/2018).

In another view, Tiffany admitted (interview) that it was easier to teach science for a low vision than a blind student because they already had an overview of the models or events in the science, for example distinguishing colour. Irene had her opinions about students with VI who had limitations in recognising (imagining something), but overall they were just like other students in general (interview/24/02/2018). Irene emphasised teachers should give them opportunities to learn better.

5.5.2 Support Teacher Roles and Collaborative Work with Science Teachers

The support teacher who assisted students with VI had a science education background. She was an itinerant teacher and not only assisted students with VI but also taught an entrepreneur subject related to science. Tiffany stated:

> All teachers are mentors; we have no special support teacher. Every teacher should be responsible with their classroom and all of them are qualified. We have support teacher, but teaching entrepreneurship and DLA[8] how to buckle shoes, use spoon and fork, pour water in cup without spill out. This support teacher also conduct training and testing for OM[9] (interview/15/02/2018).

Science teachers in School B asserted (interviews) that no collaboration took place with a support teacher or other teachers and they worked independently to provide science learning for students with VI. The only collaborative action was by discussing informally certain issues regarding students, but not specific to science learning. Science teachers worked independently in making science instructional documents, delivering science materials and assessing students' development. Science teachers also asserted that the Department of Islamic Education did not support School B with a teacher who had a special education background, therefore all teachers learned autodidact to support and teach students with VI.

From a different point of view, Arthur asserted (interview) that School B promoted collaborative action among teachers. As mentioned by Arthur, all stakeholders in this

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[8] DLA = Daily Life Activities

[9] OM = Orientation & Mobilisation

school were involved to make the inclusion process happen. He added: "although he has no special team to manage the inclusion process, but all teachers were willing to do so, and they collaborate very well" (interview, 13/02/2018). Besides collaboration among science teachers, Arthur mentioned collaboration was conducted between science teachers and undergraduate students who collected the data in this school to seek better problem solving related to science learning processes. The science teacher showed some palpable learning media produced from those students, such as Cell, Human Motoric System, Resonance System, all in 3D while she was interviewing.

5.5.3 Teacher Training and Support

Interviews indicated School B offered limited opportunities for science teachers to be involved in trainings and other development activities. As mentioned by Irene, because there was no teacher who had a special education background, the principal encouraged teachers to increase their competency by sending them off to workshops and training for inclusive education. Arthur asserted that he expected all teachers could manage classrooms that catered students with VI and he provided opportunities for teachers to develop their competency in teaching students with special needs. He stated:

> All teachers in this school are expected to handle SWD. If they are a new teacher, we are usually sending them off to workshops and trainings, such as write and read Braille, managing inclusive classroom, assessing SWD. They are happy to involve in those activities (interview, 13/02/2018).

5.5.4 Physical Building Access

School B was a two-level building, with some classrooms located on Level 2. Students felt confident and could easily walk through all rooms with or without their white stick, after they passed the OM test. The school also had facilities such as: health room, Sports Facilities, library (covering Braille books, cassettes, and regular books), dormitory with adequate facilities, study guidance and worship (congregational prayer and Al Qur'an recitation), Science Laboratory, Computer Laboratory, Hot Spot Area, Music Studio, Recording studio and Massage Room. The floors on Level 1 were equipped with guiding blocks and signs to enter each room, however, no disabled parking or toilets for disabled wheel chair users were provided.

5.5.5 Parents' Involvement

Findings confirmed that parents were involved in a very limited way to create an inclusive culture. Parents were invited to an annual meeting but as Arthur said (interview), they were rarely willing to attend and handed over their responsibilities to the school to educate their child. Tiffany asserted (interview) the way she involved parents to help their children obtain better achievements in science was by giving the parents materials and asking them to convey the materials to their child (at least reading aloud to their child). Tiffany added that material was in the form of additional lessons for reinforcement. In contrary, Shirley admitted that she never talked to the parents and if she faced difficulties or issues related to the student, she would contact the homeroom teacher, then he/she would contact the parents.

5.5.6 Policy and Supportive Program

As mentioned earlier, School B moved from being a special school for visual-impaired students to a SPIE and it is a continuing job. Since this data were collected in 2018, this school has had no applicants except visual-impaired students. Arthur said that because historically this school was especially for visual-impaired students, people did not know that this school could accept all students and therefore should be promoted as such in order to increase prospective students. As an SPIE that basically serves students with VI, this school runs special programs for them, i.e. Reading and Writing Braille, Activity of Daily Living (ADL), Orientation and Mobility (OM), Massage and Reflexology, Quran Recitation.

5.5.7 Challenges and Barriers in Creating Science Inclusive Classrooms

Challenges and barriers faced by science teachers, the support teacher and principal in School B were divided into two categories: student ability and media constraints.

5.5.7.1 Student ability

Interviews with teachers and the principal confirmed that student ability affected the way this school created inclusivity. Shirley said (interview) that the range of student ability was a problem in providing the best teaching method for them, while Arthur mentioned:
"Dealing with blind children is different from the usual sighted children. It turns out that

special skills are needed, extraordinary patience, guide them slowly. We as a teacher should be able to adapt to them" (interview, 13/02/2018). Shirley emphasised some students had difficulties in recording materials and less ability to retain the science concepts in their memory. Amy, the student, admitted she found difficulties in learning science. Other students with VI also had learning difficulties. Shirley said (interview) the students had multiple disabilities. Shirley and Tiffany admitted it was even harder to tackle students with multiple disabilities, while Irene commented (interview) about students with multiple disabilities:

> Sometimes we faced students with multiple disabilities, and they are sometimes moody. Sometimes he didn't want to study, didn't want to write, he didn't want to be forced, didn't want anything. If this happened, I just accompany him, directing him, until his good mood back (interview/24/02/2018).

5.5.7.2 Media constraints

Another challenge and barrier found from the data analysis were media constraints. Amy said:

> Learning science became hard because teachers did not provide us with media. We just imagine what the teacher said. Another problem when we should do the practical in a laboratory, like chemistry. I never conducted the acid base experimentation. And it's so difficult. It required vision [to distinguish] pH level by colour (interview/24/02/2018).

A similar statement was provided by Nanda:

> The biggest obstacle is probably, at this time, science is provided with lots of pictures, pictures of rocks, planetary structures that we cannot see. As a blind, we are weak and if there is no tool, no visualiser, then it will be a problem. Another example is bacteria, I just know their names, but we can't do practical. Maybe it's the toughest challenge. For physics, the biggest challenge when we meet with difficult arithmetic and for biology the most issue is related to visualisation like pictures (interview/17/02/2018).

Arthur mentioned that he realised media were important to help students with VI to learn science:

> It's difficult for them to just imagine, like the space dimension. Hence, there must be a model, so they know what the dimensions of space are like. They also can't distinguish colours, what black is like, so it must be there, it used to be like black, it smells like that, but it's not standard, it's just innovation to introduce it like that. But in exact science, we don't know either (interview, 13/02/2018).

Shirley and Irene commented (interviews) that delivering material was difficult without media, because some of the material was abstract. Shirley added that the material itself was sometimes too difficult for students with VI and Irene said not many modifications were made either in learning strategies or media to help students with VI learn science.

5.6 Summary

The most relevant finding was that each science teacher in School B held low expectations for students with VI. For students with VI to access science curriculum, science teachers reframed standards as learning objectives, in which support recognition (cognitive) learning dominated. However, no modifications in learning objectives or the passing grades were made to accommodate the needs of students with VI.

Findings indicated science teachers in School B provided options in the ways students with VI could respond to and interact with materials. Science content and examples used in class were relevant for students with VI, as long as they could imagine. Because of the visual limitations of students with VI, science teaching and learning were designed to maximise the use of other senses such as touching, hearing, smelling and tasting. Science teachers in School B implemented many learning approaches to optimise learning processes and build students' knowledge. Before presenting materials, they outlined the materials to be covered and what learning objectives should be achieved, introduced the lesson by attaching new ideas to preceding knowledge, highlighted key concepts and made science relevant to life, and summarised at the end of the lesson. Science teachers in School B offered learning media for students with VI in limited quantities, such as Braille text books, Braille graphics, audio, science kits, and electronic books that could be read on students' mobile phones.

To support strategic learning, the findings showed science teachers in School B offered few ways to give students with VI opportunities to build their skills, by asking students to speak to them privately to decide the best teaching and learning strategies that would work for them and using these to write lesson plans. Teachers also challenged students with difficult questions, to make students think deeply. Teaching methods used by teachers were lecturing, observation, discussion, and presentation, whereas practical activities in the laboratory were rarely conducted. Science teachers provided few options for students with VI to express what they knew. The technology used most to increase communication was an Android mobile phone. They also offered some methods to build students' skills, by beginning class with advanced organisers, offering additional time for task completion, allowing students to grasp material in their preferred learning style and at their own pace and allowing them to work in pairs.

To support affective learning, findings demonstrated that science teachers in School B created positive welcoming classes, used easy numbers for arithmetic purposes, grouped students based on their cognitive level, offered rewards, provided various supports and collaborated with other school members including parents.

Science teachers in School B used six strategies to measure knowledge development: checking students' understanding, creating assessment straight from the learning objectives, offering alternative assessments, giving instruction on the assignment, creating grading rubrics and providing clear feedback and expectations. To monitor this skill development, science teachers in School B allowed students to submit assignments electronically but mostly required them to be in Braille. To measure affective development, science teachers in School B asserted they explored values of learning science for students with VI and their society. They also utilised little experiential learning activities and observed what students did in the classroom.

Students with VI in School B had a positive understanding towards inclusive education while, on the other hand, teachers viewed inclusive education in a limited direction, in which inclusive education was basically including SWD in a regular classroom. No official support teacher was assigned to this school, but a teacher who had a science education background assisted students with VI in an entrepreneur subject. Limited training and support for science teachers were offered. In term of the physical building, School B was categorised as not fully accessible for white cane users because no lift was provided to access the second floor, only stairs. A limited involvement with parents was applied in achieving the IE.

Chapter 6
Within Case Analysis of School C

In line with Chapters Four and Five, this chapter further addresses the four key research questions of this study and is organised into four themes. Following this introduction is a brief profile of School C as the third case in this study, then themes one to four. Main findings are described based on the thoughts, views and experiences of science teaching and learning by six participants, i.e. Sarah and Ann (science teachers), Donna (support teacher), Linda (principal), Ben and Felix (students with learning difficulties/LD). Other findings from questionnaires, classroom observations and instructional documents analyses were also considered to cross check with other findings.

6.1 Profile of School C

School C was a private school that was supported by an educational budget sourced from a private foundation and from the students' parents. Linda, the principal, asserted (interview/22/02/2018) that School C recognised that "every child is unique" by purporting to implement the principle of Education for All (EFA) and by it being labelled an inclusive and multicultural school. The school respected differences and aimed to ensure that students grew in a religious environment that recognised economic, cultural and special needs (Oktaviana & Kurniasari, 2017). Programmes in School C (Appendix 10) were developed based on an inclusive and multicultural education approach.

School C enrolled 110 students in Grades 7, 8 and 9 in the academic year of 2017/2018 and 38 of them were students with disabilities (SWD). The average class size in each grade was 20 students and each class catered for SWD. To help cater for SWD, School C provided 21 teachers and ten ancillary staff as well as one support teacher who had a special education background.

School C implemented the National Curriculum for middle school levels by enriching the content of learning materials tailored to the needs of children and the context of the school, families, local and global communities. In 2018, School C adopted K13 for Grades 7 and 8 and Curriculum 2006 for Grade 9. School C also adopted international curricula, i.e. International Middle Years Curriculum (IMYC) which covers Information Communication and Technology (ICT), Mathematics, English, History, Geography and

Science; and the Cambridge Secondary 1 Curriculum to address English and Mathematics. The IMYC is specifically designed to support students' needs and is directed to a lifelong process of cultural development and student empowerment.

6.2 Theme 1: Goal-setting for Students with Learning Difficulties

The first theme was generated from findings in answering Research Question 1: "How do science teachers in School C set goals for students with learning difficulties?" and it is described in four sub-themes, as follows.

6.2.1 Establishing Expectations for Students with Learning Difficulties

Data indicated that every teacher held similar expectations toward students with LD. Linda, the principal had a set of expectations for students with LD, as well as more generally for all students. She said:

> Simply, they can develop according to their own needs. This school wants to encourage children, to get them off to a good start, to be able to survive outside, so that they can spread the inclusive virus and can live independently. This is what we expect. Whether special [children] or regular [children], they also must be independent and can make a social contribution in the community as well. We have certain programs that enforce students to learn to live in the community, such as the community service program (interview/22/02/2018).

Ann and Sarah, the science teachers, commented (interviews) that they hoped all students knew the basic concepts of science. Ann added:

> I emphasised by mastery the basic concepts, they can use these concepts to learn science in Grade 9 [which will be useful for national examination too]. At the very least, they can do basic arithmetic [for those who are in the lower to middle level]. As now they are in Grade 7, the difficulty with basic counting is a barrier to learning science (interview/20/02/2018).

Sarah highlighted that if students with LD wanted to learn more, e.g. the application of a science concept, it would be a "bonus", but only few of them did (interview/19/02/2018). The typical students with LD in this school were less motivated and sometimes moody and these conditions according to Sarah made them struggle in the teaching and learning process and led to it being hard for them to achieve high scores in science.

As revealed in the questionnaires, science teachers held individual expectations for students with LD. Sarah asserted she always held high expectations and said (interview) that her expectations for students with LD were set by discussing with the support teacher what was best and most suitable for students with LD. Sarah also indicated that discussions with the support teacher were essential to identify a learning approach that suited each student with a disability because the support teacher was the source of information and the key person who understood the student's learning problem. Similarly, Ann reported (questionnaire) that she defined the expectations for each student in different ways because "every child has a different capability and cognitive level". Findings indicated that the science teachers described expectations for each student (not limited to students who had special needs) before the semester began. This activity occurred twice every academic year before semesters one and two began.

6.2.2 Reframing Standards as Learning Objectives

This sub-theme describes the way science teachers in School C translated national standards of science into learning objectives in three areas, as follows.

6.2.2.1 Writing learning objectives

Science teachers reported that they considered three domains of learning: cognitive, psychomotor and affective, when setting up learning objectives and goals for students with LD. Sarah stated in her written response (02/2018) that she considered the knowledge (cognitive) domain by "arranging cognitive learning objectives based on the level of students' intelligence[10]"; the skill domain by "including practical and project planning"; and the affective domain by "observing the students' behaviour when engaged in projects and practical work, then describing the result in the report card". Additionally, Ann gave examples of how she addressed the cognitive domain when designing learning objectives by "creating a different worksheet per student's needs or abilities". For the psychomotor domain, Ann pointed out that she created simple practical tasks such as measuring the temperature of objects using a thermometer and asking students to read the scales. In addition, she also considered the affective domain by assessing the students' behaviour.

Besides considering domains of learning, science teachers in School C followed the national curriculum by breaking down the standards (SK/KI and KD)[11] into learning

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[10] Intelligence in this statement refers to cognitive abilities

[11] SK (or *Standar Kompetensi* = Standard Competency) and KI (or *Kompetensi Inti* = Core Competency) are the types of the content standards in Indonesian curriculum

objectives. As an example, Ann and Sarah expanded the standard into topic, learning objectives and learning domains (see Table 6.1). As seen in Table 6.1, science teachers picked various verbs when determining learning objectives. The words 'explain' and 'determine' are the verbs associated with Level 2 of Bloom's Taxonomy of Educational Objectives; the word 'calculate' is for Level 3; the word 'investigate' is for Level 4; and the word 'compile' is for Level 6.

Table 6.1 The translation of the standards into learning objectives

Teachers	Basic competencies	Topics	Learning objectives	Learning domains
Ann	Analysing the concepts of temperature, expansion, heat, heat transfer, and its application in daily life, including mechanisms to maintain body temperature stability in humans and animals.	Temperature	The students will **explain** the definition of temperature.	Cognitive
			The students will **investigate** various types of thermometers.	Psychomotor
			The students will **determine** the scale of temperature by taking temperature measurements using a thermometer.	Cognitive
Sarah	(3.11) Analysing the concepts of vibration, waves, and sounds, in everyday life including the human hearing system and sonar systems in animals (4.11) Presenting the results of experiments about vibrations, waves, and sounds	Waves	The students will **explain** the meaning of vibration	Cognitive
			The students will **investigate** pendulum vibration occurrence	Psychomotor
			The students will **calculate** the frequency and period of vibration swing	Cognitive
			The students will **explain** the meaning of waves	Cognitive
			The students will **investigate** wave occurrence	Psychomotor
			The students will **explain** the meaning of vibration	Cognitive
			The students will **compile** search results about radar systems in the form of posters/papers	Cognitive

Source: excerpt translation from science teachers' lesson plans

Data confirmed that the science teachers considered two strategies (SMART and ABCD)[12] when defining learning objectives. Sarah approached both strategies, as she reported in the written questionnaire: "I always use a "SMART" strategy, for instance: by "tailoring the

[12] SMART stands for Specific, Measurable, Achievable, Relevant and Timely and ABCD stands for Audience, Behaviour, Condition and Degree.

material to suit the child's needs, using worksheets or exercises" as well as always using an "ABCD" strategy because "each goal has been tailored to the student's cognitive condition" (interview/19/02/2018). Ann's approach differed from that of Sarah. Ann tended to use the SMART strategy rather than the ABCD strategy when setting up learning objectives. She asserted that the SMART strategy was used to "create learning objectives that lead to learning activities that all children can access" (interview/20/02/2018).

Considering the way in which science teachers reframed standards into learning objectives, Ann reported (questionnaire) that she rarely categorised learning objectives into essential (need to know) and non-essential (nice to know) because she asserted that all learning objectives were important. By contrast, Sarah tended to split the learning objectives into those two categories and asserted that she focused on teaching the essential subject matter: "the essential subject matter was given a stronger emphasis" (questionnaire/02/2018).

6.2.2.2 Aligning learning objectives with teaching method and assessment

Science teachers indicated ways to create learning objectives that were measurable and achievable. In doing so, first, science teachers reported (questionnaires) that they always set content-based goals and objectives for students with LD that guided instruction and assessment. Ann commented (questionnaire) that she notified the students verbally about what they would have after learning the topic. In the interviews, Ann and Sarah asserted that they used learning objectives as the basis for choosing the teaching style and assessment.

6.2.2.3 Accommodating students with learning difficulties' needs when setting learning objectives

Science teachers admitted (questionnaires) that they established learning objectives that accommodated the students' needs. Science teachers tended to use the personal approach to identify what the students' problems and needs were when creating learning objectives designed to engage, interest and motivate students with LD. After they had identified the students' problems and needs, they then discussed with the support teacher what the best approach for those students should be, embedding the discussion outcomes into the instructional planning (or sometimes by just making a note in the lesson plan). In addition, the personal approach mentioned by Ann and Sarah meant that students with LD were invited to speak about what they needed in learning science. However, as stated in the questionnaires, Ann rarely accommodated the students' personal interests when constructing science learning objectives while Sarah did so frequently. Ann asserted that values were being taught through Religion and Civics (PPKN) subjects. By contrast, Sarah asserted that values could be taught in all subjects, including science, for example when discussing about the application of science in daily life, she emphasised what values could be learned by students.

6.2.3 Modifying Learning Objectives for Students with Learning Difficulties

Table 6.1 indicates that science teachers had no specific learning objectives for students with LD, but rather these were designed for all students in general. Nevertheless, Sarah asserted she prepared individual learning objectives for each SWD:

> I formulated her learning objectives, for example, learning objectives number 1, 2, and 3 [for slow learners], then learning objectives number one to six are for 'normal students'. It can be different for each student. I prepared it and then documented, at least I have notes for this (interview/19/02/2018).

Ann, by comparison, admitted establishing the learning objectives for all students, with no specific objectives for each SWD, although she differentiated the individual worksheets based on the students' needs. She asserted that for students with LD who could not reach the regular learning objectives, for example students who could not read and write, she would focus on improving their reading, writing and basic arithmetic skills first. In addition, Ann asserted that she did not really focus on the document's 'stuff'; rather, she was concerned with how she handled a science classroom which welcomed students with LD. She mentioned in the group interview that:

> We tend to be more practical, with what we face in the classroom, with what the student needs, directly. Sometimes the planning and its realisation do not match. We always surprise every day, different things can happen (GI/08/03/2018).

The interview demonstrated that School C conducted a diagnostic test in the admission process to determine a student's ability. This test result was used as a baseline to create appropriate accommodation for SWD, to set learning objectives and expectations for them.

6.2.4 Creating Minimum Criteria for the Passing Grades for Students with Learning Difficulties

Data indicated that science teachers created criteria for the minimum passing grade (namely KKM) in two forms based on the students' levels of cognitive ability. Ann stated that she varied the KKM for students with LD from their typical peers. She said: "this is clearly that the KKM [for slow learner] is different from the regular. For example, I set KKM for slow learner at 60 and 70 for the regular learner". She added:

> [Students] only know that I set the same passing grade for all of them. Basically, I only have 2 KKMs, 70 and 60. 70 for regular, from medium to high range. Although I provided different worksheets for them [the medium to high range students], but their KKM was the same. But for Ben, Michele and others, who still struggle with reading and writing, I just set 60 for their KKM (interview/20/02/2018).

The same view also was expressed in the interview with Linda who acknowledged that although all students were sometimes given the same material during the science teaching and learning process, their KKM were differentiated and the grading lowered.

6.3 Theme 2: Pedagogical Practices for Students with Learning Difficulties

Theme 2 expresses the way science teachers in School C created individual instruction for students with LD. This instruction was designed to support knowledge development (recognition learning), skill development (strategic learning) and affective learning development.

6.3.1 Supporting Recognition Learning to Build Students with Learning Difficulties' Knowledge

Data confirmed that in designing individual instruction to support knowledge development, science teachers in School C applied some different ways, as follows.

6.3.1.1 Activating background knowledge

Science teachers indicated they activated or supplied background knowledge in the introductory session through an apperception. Some options used by Ann were linking her instruction to the real-world context and activating relevant prior knowledge by a Question & Answer strategy, asking about the previous material given. Ann stated:

> I repeat the material that has been taught before, reminding them of some important concepts. I asked several questions about the concepts before I open a new topic and display the PowerPoint I have prepared for the material I am going to teach. I tell the kids, that I repeat [the key concepts] continuously (interview/20/02/2018).

In comparison, Sarah preferred to use a simulation as the pre-teaching critical prerequisite concept:

> I prefer to use a simulation, because students will pay attention to what I simulate. I want to focus the children on me first. Then, … I'm easier at directing the class. … not just for children with certain conditions, but to all my students (interview/19/02/2018).

Sarah usually presented a simple simulation to imitate the science process or situation, as she mentioned: "I brought things from home then made a simple simulation in the classroom. Or if not, through a computer, I used a computer simulation" (interview/19/02/2018). Her statement was confirmed by the classroom observation (03/03/2018); she used a computer simulation from the website (https://phet.colorado.edu/sims/html/wave-on-a-string/) to show how the amplitude and the frequency affected the wave (see Figure 6.1). She asserted in the written response that "a simulation is the easiest way to get them (students) to pay attention". However, Sarah said this strategy could not be used every day:

> Unfortunately, although a simulation is very effective to gain students' interest to learn science, but it cannot be done for all topics. I used this only for the opening session, to start the topic, and to catch the students' interest (interview/19/02/2018).

Image removed due to copyright restriction

Figure 6.1 The computer simulation used by Sarah in the introduction session of science lesson

Ann stated (questionnaire) that she sometimes delivered questions to identify the students' prior knowledge, while Sarah frequently did this for all children, saying:

> I will usually ask about prior knowledge of students. For example, if they learned about electricity, then the introduction was a discussion of objects that need electricity or where electricity comes from (questionnaire/02/2018).

6.3.1.2 Providing real-life examples

Ann and Sarah asserted (questionnaires) that science materials were delivered using real-life examples to make learning applicable. For example, Ann mentioned that she "provided learning videos about freezing samples and melting ice cubes", while Sarah asserted that real-life examples were frequently used because "students will be very helpful, if faced with the real condition first" and she also stated that: "as much as possible I discuss about the applications that students found in everyday life" (questionnaire/02/2018).

Science teachers always ensured that examples and content used in the science class were pertinent to students with LD. As science requires students to learn special terms and symbols, Sarah said she always gave the best examples students could ever see or know. For Ann, she asserted (interview/20/02/2018) that she always "gave an example in the beginning then continued with the concept of what they would learn" to clarify unfamiliar science syntax, because for students with LD, language was limited. Ann emphasised:

> students with LD are different with hearing impaired students. Students with LD have a language that seems imperfect. When they make a sentence, like a standard sentence, a rigid sentence, but their vocabularies are not as limited as the hearing-impaired students (interview/20/02/2018).

Ann then asserted that when teachers used appropriate science content and examples to match with the type of student's disability, he or she could participate more in learning. Subsequently, Donna asserted that: "students with LD need a simpler language, then we deliver [the material] with the language that they can understand. Sometimes they missed some difficult or specific terms, as science has many special terms. We will explain those terms by simplifying them" (interview/19/02/2018).

6.3.1.3 Highlighting critical features and key concepts

Another thing to support recognition learning was how Ann and Sarah facilitated students with LD distinguishing between the important and less important information. Ann asserted (questionnaire) that she always highlighted the key concepts and explained how they related to course objectives by "mentioning the points to be learned and the learning objectives". She also stated: "the key concepts should be repeated, again and again" (interview/20/02/2018). In the same way, Sarah admitted (questionnaire/02/2018) that she "usually described important concepts repeatedly with emphasis on explaining them thoroughly" and "explain ahead of time" before the class began. Other ways that key concepts were highlighted by Ann and Sarah are described in Table 6.2.

Table 6.2 Ann's and Sarah's ways of highlighting key concepts

Statement	Ann		Sarah	
Begin each class with an outline of material to be covered	always	Mention the material given orally or in writing.	frequently	I usually convey the subject that the student will learn at the beginning of the meeting and give an overview about it.
Represent key concepts graphically as well as verbally	always	Re-emphasise to the child about important concepts.	always	For emphasis on important concepts, I explain repeatedly, I also write/describe them on the board. For example, the principles/laws in physics.

Source: questionnaire/02/2018

Key concepts were written on the chalkboard to keep students informed and to increase students' retention of science concepts covered during lesson. Classroom observations confirmed that after Sarah and Ann explained the topic, they wrote down the key concepts of the topic on the chalkboard and pointed to the concepts with high volume and pitch, and special gesture and expression. Sarah admitted (interview) doing this to remind students of the key concepts that should be understood. Felix, a student participant, reported a similar occurrence stating: "the key concepts were written on the chalkboard and Sarah asked us to revisit those concepts" (interview/22/02/2018).

Science teachers stated (questionnaires) that they always concluded every session with a summary of key points. Ann added that she provided feedback to students 10 minutes before the class finished, while Sarah said: "it's used to confirm student understanding and highlight the important concepts, I usually finished my lesson with a conclusion" (interview/19/02/2018).

6.3.1.4 Providing multiple instructional media and formats

As indicated by interviews and learning observations, science teachers provided SWD with various types of learning media and formats to present science information (see Table 6.3).

Table 6.3 Types of science learning media and formats

Types	Ann's statements	Sarah's statements
Text	In the temperature material, students with disabilities will be given the material present in everyday life	Material or worksheet delivered in the form of text. Usually used vocabulary that will be tailored to the needs of children. For example, students with slow learner and deaf need to use a simpler language selection
Graphics	Given the relevant example of a thermometer image	For students with Down Syndrome and Mental Retardation, I often (more often) use the image media to explain. For example, explaining the anatomy of reproductive organs
Audio	Be equated with others because in the class there are no children with hearing impairment	A lot of different forms of audio
Video	Be equated with others because in the class there are no children with hearing impairment	I use a lot of videos to open a lesson. Usually, I try to show videos with text, so that children with deaf needs can access
Others	Directly shown form from thermometer	As much as possible I build a child abstraction through a real example; if there is no physical model that can be held, I use a computer simulation. For example, for atom and molecular model, I use computer simulation

Source: questionnaire/02/2018

Interviews revealed Ann, Sarah and Donna agreed that students' needs are the best guide for deciding their choice of learning activities, making their individual work, and including learning media that suited student's interest. Donna, the support teacher said:

> Learning media were adjusted to the needs of children. … Therefore, it becomes a challenge for teachers to create fun learning that build students' motivation and attention. If the instructional planning did not fit the student's needs, I would change the learning method or media. Because unpredictable event could happen in the classroom and we should be ready and flexible to change what we have prepared (interview/19/02/2018).

In addition, Donna asserted that: "[science learning] is designed in such a way for a variety of methods, including learning media" (interview/19/02/2018). She added that "this school is very open, not limited to its iPad devices only, or Apple products, but open Android or whatever, but we've been heading there [use learning-based technology]" (interview/19/02/2018). In the group discussion, Sarah asserted: "almost all children love visual aids, especially those who are slow learners, they prefer visual, video, simulation, games, they prefer those aids" (GI/08/03/2018). Ann added that because School C had no students with visual impairment, she tended to use visual modalities. Ann stated:

> Visual aids are more interesting for children to learn. Sometimes I also use the apps, on the internet there are games, for making games, so that is enough to make children interested, including those with disabilities. The apps name is KAHOOT, that's interactive games. I filled in, making my own quizzes. The content is the material that I have taught, then I designed the quiz in a more interactive form, and the children with disabilities are also quite enthusiastic. When we applied games, they felt, really to gain

their score. They felt they must be obtaining a higher score, so they worked in a group, I really made grouping indirectly compete so. I spread all students with disabilities to all groups so that they can access that game (interview/20/02/2018).

Another way reported was by using audio-visual material to make science learning more meaningful, as stated by Donna:

> At that moment, I was accompanying in science lessons and we were learning about electricity. While some children did a counting, some children did not. Then we used iPad, we used applications on it. Learning was more meaningful, they knew the electrical appliance, how to use it, how to avoid such dangers. Sometimes the audio-visual is more accessible for them (interview/19/02/2018).

Many SWD have limitations with their working memory, therefore science teachers tried to enable students with LD to gain access to learning and to manage information at their own pace and capacity. For examples, they provided a summary in each worksheet, rather than asking them to learn science from the textbook. In this school, textbooks were not necessary, as Ann and Linda asserted in the interviews. Teachers were obliged to create their own worksheets for their students (Ann, interview/20/02/2018).

6.3.2 Supporting Strategic Learning to Build Students with Learning Difficulties' Skills

This sub-theme reports on science teachers' experiences in creating individual instruction to provide students with LD with opportunities to develop their science skills. The teachers' approaches are explained as follows.

6.3.2.1 Providing flexible models of science process skills

Data indicated that science teachers offered guidance on science process skills for students with LD. Science teachers affirmed they always began class with an advanced organiser[13] in the form of essential and sequential questions about what they would address all through the class. For instance, Ann stated (questionnaire) she gave the students questions on what they knew about temperature and Sarah mentioned, "I usually begin by discussing everyday events" (interview/19/02/2018).

Another way to help students process the information was by giving the students explicit prompts for each step in a sequential process, as Ann stated: "I gave an example in the

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13 Organisational cues, tools that help connect the known to the unknown, or frameworks for helping students understand what it is they will be learning.

beginning, the concept, if they have done it, I will say let's have a look" (interview/20/02/2018). For example, when using Instagram as the medium to process the information, Ann said: "I ordered students to open their Instagram and showed them it has a temperature set-up on our location. Then I asked them to find another location and to have a look what the temperature was" (interview/20/02/2018). Sarah commented that she preferred to apply a one-on-one approach, Sarah said:

> I prefer to accompany students with LD one by one. After I introduced the topic and explained the materials to all, I continued to offer personal assistance for students who need help. I help them one by one, especially when the support teacher didn't come (interview/19/02/2018).

As with Ann, she also had a personal approach to helping students with LD in her science classroom.

At the time of observation, Sarah went around looking at the work of students and helped students who were having difficulty individually. Sarah also stated that some students with LD wanted her to accompany them personally when learning difficult content; she said: "Whereas science for middle school is increasingly complex, more and more analysis, especially for physics, whether you want it or not, they (students with special needs) want me to accompany them one on one" (interview/19/02/2018).

To organise teaching and learning in a more relevant way, when Ann faced students with various disabilities or needs, she tended to give them different worksheets, stating that: "When I was explaining, the portion was the same, because it's impossible to teach one on one, but when they got a worksheet, they could learn individually using their worksheet, students with a disability would have a different worksheet" (interview/20/02/2018). Similarly, Sarah also modified the worksheets for her students: "because the classroom has a huge range of students, then every student has his or her own needs, well, I differ, such as the worksheet, the quiz, but for teaching style, teaching method is totally same" (interview/19/02/2018).

Ann preferred to use individual worksheets, interactive videos, games or simple experiments to help students with LD learn science and make them actively participate. She explained:

> Yes, I gave them a worksheet. Sometimes, they had nothing after I explained the material. When it happened, then I gave multiple formats, maybe an interactive video, then games and sometimes I had a simple experiment or then games to find (something). We rarely do practical activities in laboratory (interview/20/02/2018).

Similarly, students with LD (Felix and Ben) admitted (interviews) that their teachers offered them options in guiding information processes, by detailed explanation, discussion, practicals, doing tasks in their individual worksheets, watching videos and playing games.

The questionnaire also outlined how science teachers offered an active, a participatory and a student-centred learning approach to science process skills, as in Table 6.4.

Table 6.4 Ann's and Sarah's other options to build knowledge for students with LD

Statement	Ann		Sarah	
make learning "active"	always	Students practise directly to make a simple thermometer	frequently	Through experiments, simulations, literature study
make learning participatory	always	Each child brings materials and simple experiments	frequently	Through class discussions
use student-centred learning approaches	frequently	After the children have practical, the children make their conclusions independently	always	The learning and worksheet approach are tailored to the students' abilities and needs

Source: questionnaire/02/2018

Science teachers indicated that they allowed students with LD to learn science in their preferred learning style. Ann reported (questionnaire) she gave students with LD the choice to present their assignments in ways that best suited them; she explained for example: "giving students choices to do their assignments, such as presenting the concept of Conduction, Convection and Radiation in a poster" (interview/20/02/2018). Sarah mentioned (questionnaire) that each student was given the opportunity to choose the preferred style of learning as long as they did not disturb their peers. For example, "I have students who are comfortable sitting and having discussions on the floor and then it is also allowed" (Sarah, interview/19/02/2018). Further, Ann and Sarah were always allowing students with LD to grasp material at their own pace. Sarah mentioned: "because every student has a different pace in learning science, then I tailored the material to the students' need. Each student does not always get the exact same material, but according to their abilities and needs and their demand" (questionnaire/02/2018).

Ann and Sarah admitted (interviews) they differentiated worksheets for students with certain conditions to offer them the opportunity to learn at their own pace and style. Ann conducted a student mapping to decide what kind of worksheet was appropriate for each student, saying:

> Before I created the worksheet, I usually did a student mapping, and every teacher has their own way to map the students out. The way I used to map the students was by equated all learning components, such as materials, worksheets and problems in simple forms would see how it worked. When I faced a student, who cannot understand simple facts or cannot do simple tasks written in the worksheet, then I would make adjustment to the worksheet, I would simplify for that student (interview/20/02/2018)

Ann also asserted that beside using a modified worksheet and individual tasks, she used any activities that were suitable for their level of capability, such as reading, writing and basic arithmetic.

6.3.2.2 Providing various methods for responding to and interacting with science materials

Data indicated Ann and Sarah applied few methods for students with LD to respond to and interact with science materials. Ann and Sarah admitted an individual worksheet was the most preferable medium for the way students responded to and interacted with science materials. Another example was demonstrated during classroom observation in Grade 7A on 26 February 2018, showing that Ann used the game (through the KAHOOT application that was connected to the student's mobile phone) on the Temperature topic. This game was intended to activate the class and students were asked to group. They moved and gathered with their respective groups and shared roles. Ann then broadcast the game through the KAHOOT application using its tablet and displayed through the LCD projector, where each display contained a case to be solved. Ann gave one to five minutes for each group to think about the answer and asked them to answer the case through the mobile phone used. After completing the game, Ann examined one by one the given case and asked one of the students as a group representative to come to the front of the class and answer the case. At the end of the session, all group answers had been displayed on the screen, showing which group answered the most correctly and vice versa. The group that answered the most was stated as the winner. Another example was inviting students to present their task in front of the class, as stated by Ann in the interview.

6.3.2.3 Offering flexible opportunities for demonstrating skill

Data analysis indicated science teachers offered students with LD various media by which to express what they had learned to give them opportunities for demonstrating skill. Ann asserted (questionnaire) that she provided alternative project formats for all students, including brief reports, oral presentations, wall magazines or posters, while Sarah offered short reports, short videos, oral presentations, newspaper articles, making posters, practicals, creating things.

6.3.2.4 Providing opportunities to practise with supports

Data confirmed science teachers provided opportunities for students with LD to practise what they had learned with some supports. Science teacher participants noted that additional time to finish tasks was offered to students as per their statements in Table 6.5.

Table 6.5 Option to give students with LD additional time to do the task

Statement	Ann		Sarah	
Give them additional time to do their tasks, so that SWD can practice recalling and utilizing information	always	Always provide additional time for task submission	frequently	Due date collection tasks are made equal, but additional time is frequently given for students who encounter obstacles

Source: questionnaire/02/2018

Science teachers admitted (questionnaires) they always allowed students with LD to work in pairs, and Ann gave an example of the group formation: “Angela, Ben (student with LD) and Fergie”; while Sarah gave a reason for the grouping, as she mentioned: “small groups are organised so that each student in the group can support each other” (interview/19/02/2018). Both science teachers utilised a peer tutor approach to encourage and support opportunities for peer interactions and support, as Sarah said in the interview (19/02/2018): “Some students who were at a high level, I asked them to be a peer tutor”, while Ann said: “peer tutor runs well, at least if there was a child who was so high, he can teach the middle level peers and the really low was not left behind” (interview/20/02/2018). Donna also asserted that School C tried to offer activities where students could teach each other:

> Every class is welcome with students with various conditions. We designed activities where children can learn how they support their environment, support their friends, how they adjust learning with children with different conditions. We provided a space for them to learn and do activities, in one place. We have no programs that has been specialised for SWD, all be treated by same methods, in which children must learn (interview/19/02/2018).

To promote cooperative learning, Ann made up small groups containing 3 – 4 students heterogeneously. She mentioned: “She mentioned: “In creating small groups learning, I chose students from a range of performances, containing low, mid and high levels of cognitive ability. In any group, there should be someone who was at a high level, then s/he could help others" (interview/20/02/2018). In addition, the support teacher was involved in seeking solutions when students with LD met with difficulties in the science classroom.

6.3.2.5 Providing ongoing and relevant feedback

In the questionnaires, Ann indicated (sometimes) while Sarah (always) that they provided clear feedback in supporting strategic learning. Ann added that feedback was provided on discussion questions that could not be solved by students. Ann also asserted that she frequently asked students for their help in marking, "then [the exams] were corrected by others" (interview/20/02/2018). Feedback not only occurred through formal activities, according to Ann, it was sometimes provided by conversation with students. Donna also commented about feedback:

> Sometimes it's just simple, we invited them to have a conversation. We did a chat, I asked what they want, then I can see what they really want. They can not only be told but must be invited to talk from heart to heart. Sometimes they just said that they could not do something that we asked, then we have applied a range of approaches and explained to them what they should do, they must be responsible for what they have done. (interview/19/02/2018).

Questionnaires also showed that science teachers frequently offered feedback to support learning and self-assessment. Feedback was given to ensure students learnt the curriculum as requested and gradually showed their learning progress. They needed a clear picture of what they had learned and what they had to learn more. As explained by Sarah, feedback was given to students with LD by returning their worksheets and writing comments on them, and by providing descriptive feedback in the mid-term and final-term reports. Additionally, Ann always assessed the originality of students' assignments. Feedback also was formulated when a Students-Led Conference (SLC) had been conducted. As mentioned by Linda:

> SLC is like an acceptance of report card. Student will present what they have done in one semester. Teacher, parents and student would then discuss what was presented. It's more like a feedback, what this school has given to the children and what support of their parents (interview/22/02/2018).

The last option provided by science teachers in offering ongoing feedback for students with LD was inviting those students to answer questions to check whether they had understood the task at the end of class. Ann stated (questionnaire) she gave questions after completing the material explanation, while Sarah did this option through discussion and observing how the students did their task when completing their individual worksheets.

6.3.3 Supporting Affective Learning to Build Students with Learning Difficulties' Motivation and Engagement

This sub-theme draws the perspectives and experiences of science teachers in practising pedagogies to support affective learning of students with LD, and is described in three aspects, as follows.

6.3.3.1 Providing adjustable levels of challenge

Data indicated science teachers provided varying demands and resources to optimise challenges for students with LD and to keep students motivated to learn. As Ann and Sarah repeatedly mentioned, they used various worksheets for each student, taught them individually and provided different assignments, tasks and exams. They also gave challenges by giving an exam at the same level of difficulty:

> I gave a challenge to those kids [slow learners], personally, each student can be given a different challenge. I've tried it, so I was not merely giving them a different worksheet. But sometimes, I gave them a same task, I wanna see their difference capacity. Evidently, this child already be able, it means I didn't need to distinguish with other again (Ann/interview/20/02/2018).

> When I gave them a worksheet, they will do answer the questions in the worksheet differently depend on what their understanding. From here, then I can distinguish their level, which kind of worksheet that appropriate for those students. When they were accordance with Competency Standards, I will then give a higher level. I have differentiated the grading at the beginning. But for students who still need assistance, I will lower the standard level. So, as long as he has started to explain it or has keyword in his answer, I've given a good score for them (Sarah/interview/19/02/2018).

Challenges were also given by offering the students with LD difficult problems. Ann reported: "to challenge them, I gave a more difficult task, particularly when they were studying physics, I gave more complicated problems of arithmetic" (interview/20/02/2018), while Sarah said:

> in science, especially in physics, the problems can be set in various ways. Some problems suitable for all children, they can solve easily, but other problems can be more difficult for students with LD. I challenged them to solve the difficult problems (interview/19/02/2018).

6.3.3.2 Offering choices of content, tools and media for communication

Data indicated science teachers offered multiple choices of content and tools to gain students' motivation and engagement to learn science. Sarah tended to use individual worksheets, projects and presentations to increase individual choice and autonomy: "I used individual worksheets and sometimes I ordered children to do a project. When it's finished, they submitted their project and presented it one-on-one to me" (interview/19/02/2018). In the questionnaires, science teachers said they used a lot of forms of video in science lessons. When Ann and Sarah showed a video, they asserted they provided captioning or subtitles and if the subtitle was not available, they would explain what the video was about. The other alternative Ann and Sarah reported was to provide an interface to the science material by checking for ancillary electronic materials to accompany the textbook. Ann indicated that she (always) "looked for some references other than books" but Sarah specified (sometimes) documenting that "web content was used for literature studies under teacher supervision" (questionnaire/02/2018). During classroom observations Ann and Sarah showed the content being studied through websites.

Interviews clarified that science teachers offered various tools to help students with LD construct and compose their understanding in science. For instance, science teachers allowed students who still faced problems in arithmetic to use calculators; daily sample goods for simulation; computers for simulation; Science Practicals Kits; and iPad, Android or other digital devices. Linda added that other tools to facilitate students' learning were films, videos and science modules made by teachers in addition to textbooks (which were not highly recommended). Donna asserted School C provided facilities to support learning activities. She said:

> [electronic devices] are usually used when learning. We started to integrate distance learning in all actual learning. This school definitely provides facilities. We also have a cooperation with Apple, facilitate students with iPad, but we also open to other platforms like Android. We encouraged students who have to bring to the school (interview/19/02/2018).

Ann added in the group interview that she used the tablet to facilitate learning and make it easier for students with LD to interface with science materials and choose science content. Ann commented:

> I tried it last year, I had a simulation and this school provided tablet. They played that tablet, it made them easier to interact with material, because not every single time they accompanied by support teacher. I didn't have many hands and lots mouths, and this was quite helpful. Later I used the child's own mobile phone, although the school provided an iPad. It's actually an application from the internet, I only used existing applications, then I practised it in class (GI/08/03/2018).

Ann also indicated (questionnaire) that she adopted instructional technologies such as Instagram for student assignments, while Sarah applied applications in video, computer and tablet in the way she adopted instructional technologies. Science teachers reported that they also provided alternative media for communication, such as chatting applications

WhatsApp (WA) and BlackBerry Messenger (BBM). WA and BBM were used as an alternative to communicate with each other, while face-to-face interaction also existed, as Donna mentioned: "We can go through all sorts of things, face-to-face, if now it's easier with the WA group, or what, personally we are, via WA, BBM, or whatever, usually so, updated information can be posted through WA" (interview/19/02/2018). Ann also indicated (questionnaire) that she used WA to remind students about their task or its collection. Likewise, Sarah was even more open to using all communication media. She said (questionnaire) students can ask the teacher personally using their preferred choice or if they required counselling outside of school hours. When students with LD faced problems in science learning, the support teacher was involved in identifying what solutions were best for these students.

6.3.3.3 Offering choice of learning context

Data analysis revealed science teachers offered a choice of learning contexts as a way to increase students with LD's motivation and engagement to learn science. *First*, the interviews confirmed that to engage all learners, Ann and Sarah varied activities and sources of information so that it could be personalised and contextualised to learners' lives. For instance, Felix, the student said (interview) that he was involved in practical activities, drawing a picture of a digestive system onto a piece of fabric and making it into an apron. Additionally, Donna, the support teacher stated that all learning activities "are adapted, … according to what students need" (interview/19/02/2018). She asserted School C had a special activity (that may not be found in other schools) that was socially and culturally relevant, namely the 'outing' (excursion) usually conducted once a month. This was also mentioned by Linda:

> For the outing, actually we have rules, for one semester, usually per class, cannot be many times. But because our needs for children too, sometimes exceeds, sometimes a month that one class can be two times outing, because we want they have an apt learning (interview/22/02/2018).

Through this activity, students were invited to experience learning directly and obtain primary information that would enrich their learning experience, as Linda said: "the outing will let the students learn in a real situation as they found in daily life" (interview/22/02/2018). The outing contained several subjects including science, and students usually did an observation and interview. Felix said:

> We usually have been provided by a (guidance) booklet, then we asked to do an interview with people who were visited, did some observations, took notes what was

> happening in that place. Then we had to do the task, that already stated in that booklet. Every student has been given one booklet. … it's not only for science, but it's mixed with other subjects…. Student felt very excited because doing outing give him an opportunity to escape for a while from daily science learning routine (interview/22/02/2018).

Second, to attract the students with LD's interest in the topic given, Ann and Sarah asserted (questionnaires) they always captured students' attention. Ann mentioned one example of this was by providing an applicative example in everyday life that students often used. Another example was by showing a relevant video, simple experiment, simple simulation and computer simulation (Sarah's questionnaire).

Third, the questionnaires revealed that Ann and Sarah always created a welcoming class environment. Sarah explained in the group interview: "I always seek a conducive situation during the teaching and learning process. If a problem came out during the lesson, I will mediate the students to solve the problem, then continue the lesson process" (GI/08/03/2018). Sarah added (interview) she also created positive energy by showing a video or conducting a simulation to attract the students' attention. Ann mentioned (questionnaire) she tried to involve all children in the learning process in other ways. In addition to providing a welcoming class environment, to increase attention and recall, Ann asserted (interview) she always reviewed the previous lesson through a KAHOOT.it quiz.

Fourth, data analysis found science teachers provided ways to minimise threats and distractions to engage students with LD's interest in learning science. The science classroom observation (26/02/2018) showed Ann opened the meeting by asking students to take their mobile phone to the teacher's room, then prayed, and that was followed by Question & Answer of the previous meeting. Ann allowed students to take a break in the middle of the session and asked them to read their book (except comics) for 15 minutes as a part of Literacy Skill Development. Ann said in the interview (19/02/2018): "students enjoy their break session". Ann also varied her pace of work during the session, for instance when she moved from explaining the material to a game session, students were given a short time for preparation. The classroom layout was set up in a U shape and Ann could easily move from one student to another to check what they were doing. In this observation, some students had a discussion by sitting on the floor and Ann observed them. The classroom featured: a schedule for daily subjects and followed an agenda or events, time-table for taking note of who was absent for the session, students' handwork and shoes rack. School C also provided a steel locker cabinet for each student in their classroom for keeping their belongings.

Threats and distractions were not only reduced in the science classroom but also were reduced outside the classroom. Donna explained how School C developed an inclusive atmosphere:

> The inclusion climate has been planted from the beginning before students welcome to this school. It was starting by the interview for prospective students and their parents. We also applied a trial class, that it was actually we already started, incorporated the values of inclusion. For children who were graduated from Primary School C, they were certainly familiar with the concept of inclusion, but the children from other schools were usually, had no idea about this term. Then I opened with a discussion, I asked "Did you know inclusion? You are going to meet your friend who like this who like that". Then, to seek their commitment, they were ready or not, including their parents, we also equated the vision and mission. Introduce them to the students and parents. I did not deny, in this journey, it should be continued to be voicing the spirit of inclusion, for every day to every child (interview/19/02/2018).

During school hours, electronic devices such as mobile phones were prohibited, except for learning, because this school encouraged students to be social, making friends in addition to minimising distractions, as the support teacher mentioned:

> We have a rule that mobile phones or something like that, can only be used for learning needs, even for break session, we do not allow students to operate it. Because we cannot control, what content they open even if we have a security system. We should break it to encourage them to socialise (interview/19/02/2018).

Another important finding revealed the way science teachers in School C built students' motivation and engagement by offering outing/excursion—as previously mentioned—and integrated learning, which was a part of the Interdisciplinary unit programs (IDU). Linda asserted the outing was a program that provided students with the opportunity to learn contextually and students felt happy to go on the outing, while IDU was aimed at building communities of learners engaged in their common interests or activities. Donna asserted (interview) that other activities were built to increase an inclusive culture and values, such as opening discussions with students about what inclusion was about and how to make a friend with someone who has disabilities, and banning the use of mobile phones while in school except for teaching and learning purposes to provide the opportunity for students to socialise with each other and to minimise distractions.

6.4 Theme 3: Assessing and Monitoring the Progress of Students with Learning Difficulties

Based on the interviews, science teachers admitted they monitored their students with LD's learning progress by using a personal approach. Ann reported: "I only use personal approach, to seek their progress, one-on-one, but sometimes, I think it's less efficient" (interview/20/02/2018). The specific ways of creating assessment for knowledge, skill and affective learning are presented in the following descriptions.

6.4.1 Measuring Knowledge Development

This sub-theme clarifies how science teachers made test modifications for students with LD to measure their knowledge development. The interviews with science teachers showed knowledge development was one of the learning domains that dominated assessment by science teachers in School C. They reported that they developed an assessment form designed to measure students' cognitive development in science that was based on learning objectives for each SWD. The following explanation reveals how science teachers in School C developed assessment forms to measure the cognitive domain. Ann said (questionnaire/02/2018) she always created assessments straight from the learning objectives "as listed in syllabus", even before outlining course content, while Sarah said frequently, as "assessment is created based on learning objectives". For reaching the learning objectives, Ann explained she applied project-based assessment for the mid-test and made differentiated tasks and exams for the final-test. She clarified:

> In other schools, paper based is for the mid-test, in here, we have project and from those I haven't made a differentiation. I made a differentiation at the final-test. In the final-test, I made several worksheets, several questions, in one class, can be 7, 4 or 5, because their abilities are varied (interview/20/02/2018).

Other different forms called alternative assessments were used by science teachers. Sarah mentioned in the questionnaire she applied practical, project, presentation and oral tests, while Ann preferred providing additional tasks at home and giving the quiz before the assessment as the alternative form to measure the child's ability/understanding of the given material. Both Ann and Sarah always gave instruction on the assignments both in writing and verbally. Table 6.6 displays the method used by science teachers to facilitate the accurate measurement of knowledge development of students with LD.

Table 6.6 Method used by science teachers to facilitate the accurate measurement of knowledge development of students with LD

Statement	Ann		Sarah	
give instruction on the assignments both in writing and verbally	always	before doing the assignment, each child is given an oral briefing	always	students are always given explanation related task before doing the task

Source: questionnaire/02/2018

Other ways to capture students with LD's progress according to Ann were by using various types of assessments, such as projects for mid-test and two types of final-tests. Ann reported in the interview (20/02/2018): "I at least made two types of assessments, for low and regular". In addition, Felix stated in the interview: "teacher usually used paper-based, sometimes oral test and presentation for exam. Teacher often gave comments in the presentation, like this [work] needs improvement, there is something missing". Felix also noted that he was given a different assignment to that given to his peers. He recounted: "because I was still weak in counting, the teacher gave me different questions, different tasks. And that doesn't matter for me" (interview/22/02/2018). Similarly, Ben also mentioned having the same opinion, asserting: "Sarah sometimes give me a different task, but sometimes same with my friends" (interview/23/02/2018).

To ensure objectivity, Ann and Sarah asserted they always employed a scoring assessment checklist to track the progress of SWD and students' records. Sarah added:

> I keep using scoring, but it is different for regular and for students with certain conditions. For example, because the worksheet is different, so there is no problem in scoring. … Unless, I ever give the same worksheet to them, then I differ when marking. For students with certain condition, as long as they write the keyword, I usually give them a high score. I also made notes in the checklist form, for all children who making some progress (interview/19/02/2018).

6.4.2 Measuring Skill Development

Beside the cognitive assessment, science teachers pondered the skill development and measured this skill in some way. Findings demonstrated science teachers applied several methods to capture students' skill development in learning science. Although Ann asserted that she rarely asked students to submit their task electronically, she usually requested students submit their assignment in a .ppt form and collected it using a USB drive. On the other hand, Sarah was more flexible by giving her students choices of the submission method.

6.4.3 Measuring Affective Development

Science teachers reported they measured students with LD affective development, including their interest and motivation to learn science. *First*, Ann mentioned (questionnaire) she had these students explore the value and meaning of their learning experience for themselves and society by presenting and reflecting on their learning and assessing themselves. *Second*, science teachers provided tasks related to their surrounding environment, for instance Ann (questionnaire) said she asked the students to observe the environmental issues in the school area and to think deeply and reflect on what caused the issue, and what action should be taken to fix and to prevent the issue. *Third*, Sarah (questionnaire) asserted she asked the students to do a media project for the final term task and during outing activities and asked the students to seek what values were relevant for them. In addition, Ann and Sarah stated (questionnaires) they always utilised experiential learning activities to explore improvement in the affective domain, for example by writing a reflection in their Student Organiser (SO) after class session (Ann) and having a project-based assessment for final test (Sarah).

Another method to improve affective development was by assisting all students to use coping skills. Related to these skills, Ann said she tended to use a personal approach and talk personally to the student, and demonstrated an example:

> "You have to understand your friend", I said so, "Friends are different. You, sometimes cannot do these, look your friend, she can do that". Therefore, I only talked to him, like that. Give the situation back to him, what if it happened to him (interview/20/02/2018).

Besides as a place to gather feedback from students, teachers and parents, SLC was also used as a place for self-assessment and reflection, as mentioned by Ann in the interview. The support teacher and the principal explained that SLC was a place to celebrate the students' achievements and reflect on what they had done through that semester. Donna commented:

> In the SLC, they have reflections, both academically and other aspects. Usually it will look what kind of child's performance so far, from their grade will also be seen. What the problems that have been facing by them. Children were invited to reflect, to see what the problem they have (interview/19/02/2018).

The student's development itself was usually reported by report card (*rapor*), as Sarah stated:

> Student development, especially in science learning, usually has been communicated through homeroom teacher as for the information to be written in each student's report card, because of homeroom teacher responsible in making a report card for each student. Then, every child has their own description for their science learning. Especially for the affective domain, although it should be documented in the instructional planning, I just tend to remember what the child has done, then describe in the report card, how their development (interview/19/02/2018).

6.5 Theme 4: Other Factors that may Contribute to or Hinder the Way in which Science Teachers Create Science Classrooms that are Inclusive for All

Teachers aimed to make the science classrooms inclusive for all students based on the participants' views and experiences as described in this theme, which is organised into seven sub-themes, as follows.

6.5.1 The Understanding of Inclusive Education

6.5.1.1 Students' perspective towards science

The evidence from interviews with two students with LD demonstrated that these students had different perspectives toward science. Felix responded negatively to science, but Ben indicated a positive response. Ben asserted he liked science because "it's a bit easy" (interview/23/02/2018). In contrast, Felix asserted, "don't know, because all subjects tend to be boring"; he didn't like science because "science has much mathematical (counting) stuffs" (interview/22/02/2018).

6.5.1.2 Students' view on inclusion

Both students with LD expressed their view on inclusion in a similar way. They knew what inclusion was but found it hard to explain. Felix stated that his science classroom was "more diverse, more fun" (interview/22/02/2018). He asserted that he knew School C was an inclusive school, but did not know its exact meaning: "I know this school is inclusive, but I don't know what the meaning of inclusive is" (Felix, interview/22/02/2018). On the other hand, Ben asserted (interview) to have heard the term inclusion but forgot what it meant.

6.5.1.3 Teachers' view on inclusion

All teachers as participants agreed that the science classroom and School C were inclusive, even though they had not measured its inclusivity. For Ann, inclusion meant "diverse, varied and survive" (interview/20/02/2018). She emphasised the inclusive classroom required surviving, as per her argument:

> Inclusive classroom means, it looks like, if we become an inclusive class without surviving, it means we are struggling and learning. If we don't want to fight and learn, you won't be able to hold and handle a class, even for just to be listened to by students (interview/20/02/2018).

Ann asserted that she had tried to promote and create an inclusive climate since she has taught SWD. As she said, "I have tried to be inclusive all this time, ... making various worksheets, I hope that I can reach and embrace all my students" (interview/20/02/2018). She stated she never measured the inclusivity and did not know how to measure it (interview/20/02/2018).

In another view, Sarah asserted that inclusive meant "diversity, ... not only a diversity about physical and cognitive conditions, but might be more comprehensive, whereas an inclusive classroom is a classroom that accepts the diversity" (interview/19/02/2018). She believed that her classroom was inclusive but some students still did not act inclusively. She said:

> From the point of view of the science material, my class is inclusive. Only a few children sometimes still behave non-inclusively … I think it has been [inclusive]. Just a few students with that note before, what, isn't it full, what is the inclusion like. They think that my friend is different. … Yes. It's just how they treat friends, they still don't have, what, isn't it in accordance with the concept of inclusion, it's possible (interview/19/02/2018).

Similar to Sarah, Linda also understood that inclusive is diversity. She mentioned:

> In fact, the inclusion is diverse, actually, it's not only this particular child, but I'm more diverse in religion, tribe etc., which actually means inclusion. Inclusive teaching is what can I accommodate, invite children to learn more, what's more, more enthusiasm, more fun (interview/22/02/2018).

Although Linda had not measured the inclusivity of this school, she was sure that School C was inclusive, as she stated: "I have never (measured its inclusivity), but if I pay more attention to my children and teachers, it's already been inclusion, like appreciating religious differences, whether it is, I think the children respect each other" (interview/22/02/2018). In contrast, Donna was a little different in how she understood the inclusion; for her, "inclusion is negotiation" and "the inclusive class is a home to every student" (interview/19/02/2018). She said that inclusive did not mean only students with special needs or disabilities, but all students. She mentioned:

> Inclusion is not merely for students with disabilities, but for all, as the original meaning. But, as we know, in our [Indonesian] regulation and for lots documentations, is still used the term for students with special needs. We will shift it and back to the original meaning of inclusion, although here, no significant difference regarding that name (interview/19/02/2018).

School C had tried to eliminate the label of students with special needs, as Donna mentioned:

> Inclusion is for all, not only for students with special needs. We are starting, eliminating the label of students with special needs. … We have started to eliminate it, to leave it because support is needed by everyone and every child is different (interview/19/02/2018).

Formally, Donna admitted that School C had not yet measured its inclusivity, but informally this school was indicated as achieving the inclusion principles.

6.5.2 Support Teacher Roles and Collaborative Work with Science Teachers

All participants asserted that the support teacher was the backbone of the inclusive practices. Ann stated (interview) that the support teacher was employed to help science teachers teach material to SWD, using a one-on-one strategy. Sarah said: "…without being asked for help by us [science teacher], our support teacher always stands by in the classroom. She directly handles the students who need helps or who are less able to catch the lesson" (interview/19/02/2018). The support teacher also was asserted to be someone who knew what the students needed and wanted, as Ann mentioned in the interview. She said: "I used to be a support teacher past years ago. I stayed in the classroom and I knew that this student wanted like this, the other student needed that way" (interview/20/02/2018). Recently, the support teacher only worked with SWD as per request. Donna said:

> Previously, the support teacher was attached to the class. … It's been two years we have started moving [from one classroom to another], …. We have two teachers in each classroom, one is subject or homeroom teacher and the other one is the support teacher. They will work together in that classroom (interview/19/02/2018).

Related to the support teacher roles and duties, Donna explained it as in Table 6.7.

Table 6.7 Role and duty of support teacher in School C

Role and duty	Interview statement of Donna
Encourage science teacher in transferring science knowledge	Support teacher helps subject teachers in the classroom, accompanies the children in transferring knowledge from teachers to children, especially those who need, not all students. Some [students] didn't need help in classroom, but we monitored and supervised them. We should make sure all children get what they deserve or get their 'food'. We help teacher to make students ready to learn, approach students to gain their attention in learning. Support teacher should monitor the way of science teacher in delivering material to the SWD, make sure that students understand teacher explanation.
Coordinate with science teacher about student's need in the classroom	Before the semester begins, support teacher has been placed in certain classrooms [class which has SWD]. We are always coordinating. For example, just before teacher go to the classroom, we had a little discussion about what teacher will give and what support teacher will do during the lesson. We are essentially mutually active, communicate with each other, to give best for student.
Coordinate with science teacher in designing instructional documents	One role of support teacher is to support subject teacher when they were designing instructional documents and at the time of its application in the class.

During the process of developing instructional documents (programs, syllabi, lesson plans), discussion and collaboration among science teachers, the coordinator of curriculum, the coordinator of students and the support teacher were conducted. Donna mentioned:

> We have a coordinator of curriculum, who supervises the instructional documents, such as lesson plan and syllabi for all lessons. The supervision is a must and during this, we have a lot of discussion. Me as a coordinator of students, our support teachers and other components were always invited into that discussion or meeting (interview/19/02/2018).

In addition, Donna also mentioned that one duty of the coordinators of students was to develop programs not only for SWD, but for all students, all classes. She stated:

> The Inclusion Coordinator manages the support teachers, it was called Special Teacher Assistant, but the name has been changed to Support Teacher. To be sure, to coordinate, with them in relation to their authority duties then supervise in relation to the duties of the accompanying teachers in the class, then also develop programs, programs for the classes (interview/19/02/2018).

Science teachers admitted that they had no special instructional documents for students with LD, and the instructional documents were only arranged for regular students. Teachers called the instructional documents (such as lesson plans and worksheets) for

SWD the "down-grade curriculum". These instructional documents were not documented because, as Ann stated:

> The instructional documents are made for regular classrooms, only one document. We don't have any specific instructional document for students with special needs. … Yes, only one document, one batch, let's say it's for regular. Everything is same. … but for the down-grade worksheet and lesson plan, usually wouldn't be included in the official instructional planning document (interview/20/02/2018).

Although Donna asserted the modification of lesson plans was made to answer all students' needs, School C had no requirement for teachers to design inclusive lesson plans. None of them made inclusive lesson plans, as declared by Sarah in the group interview: "there is no demand for inclusive lesson plans, so there is no teacher who made an inclusive lesson plan" (GI/08/03/2018). Sarah added (interview) that workshops for inclusive education in general were conducted in the past, but workshops conducted especially for modifying lesson plans and adapting material had never been held and teachers had learned by themselves. To come up with appropriate teaching for SWD, Sarah said (interview) that she was self-taught and learned directly from the support teachers. The same view was also given by Ann. She said in the group interview:

> I was even less able to fulfil the demands to make an inclusive lesson plan and syllabus, because I had never learned about it. First, I only learned to make a regular lesson plan, and after working in this school, then I learned how to make the instructional documents by my-self, without guidance (GI/08/03/2018).

Sarah admitted that as this school did not require instructional planning documents for SWD, she had flexibility to make alterations in her teaching plan before she brought the plan to the classroom. Even so, Sarah asserted that sometimes she changed the plan in the middle of the teaching process because, as she said:

> sometimes suddenly I've got ideas about something to teach them [SWD], … I wanted to add more and more … and I used this to finalise my instructional planning, write it down in the lesson plan. Yeah, sometimes it happened couple hours before I go to the classroom (interview/19/02/2018).

As previously declared, the support teacher has a role in designing science instructional planning for SWD. In the past, School C had an Inclusive Education Plan (IEP) for each student with special needs, a document that was developed and designed by a support teacher for all subjects, including science, as commented on by Sarah in the interview and Ann in group discussion. Donna confirmed and said: "Previously, when we have an IEP, I designed it, Inclusion Committee and all my support teachers. Then we knew exactly what to do for the kid every single day" (interview/19/02/2018).

Since the academic year of 2016/2017, the IEP had not been applied and science teachers only focused on adapting programs, syllabi, lesson plans and worksheets when they welcomed SWD. To develop these documents, discussion among science teachers and support teachers was conducted formally (in every Friday meeting) and informally, as stated by Ann: "I always coordinate with the support teacher or was named as the students' coordinator. I asked for lesson plans or worksheets I have made matches for my students or not" (interview/20/02/2018) and Sarah's interview statement was: "When I compile a worksheet or arrange exams, I usually consult with the support teacher first, Is this suitable or not for him/her [students with LD]?" (interview/19/02/2018).

Informally, science teachers and the support teacher had a discussion before the semester began, as mentioned by Sarah: "The lesson plan is for all students, then for a student with a 'note', I usually discuss it with the coordinator of students or the support teacher before the semester begins" (interview/19/02/2018). Similarly, Donna asserted: "When they [science teachers] started designing lesson plans, syllabi, that we will definitely have discussions. They usually asked whether their plan would suit SWD or not" (interview/19/02/2018).

6.5.3 Teacher Training and Support

Interviews indicated School C provided trainings and workshops for teachers who catered for SWD. Ann mentioned (interview) this school offered trainings on the UDL and digital learning, but training on how to modify learning objectives, activities or assessments had not been conducted. Ann added science teachers learned how to modify learning objectives, activities and assessments from the support teacher. Sarah stated (interview) that the workshops or training provided were not adequate and that she hoped that the school would provide them with the training to handle SWD, not just the support teacher.

In providing teacher career development, School C had a Centre for Studies on Inclusive Education (CSIE). CSIE engaged in research, publications and training in the field of inclusive and multicultural education. As mentioned by Donna, the training division was a part of CSIE which had responsibility for the children's needs, as in her statement:

> … CSIE has various divisions, …. The most involved for the needs of this child support is the division of training. We have a counsellor and a school psychologist. When teacher identifies problems and need for every child, then it will be followed-up by a discussion with a homeroom teacher. When we need support, usually we throw up

> to the counsellor. If counsellor cannot solve the problem, formally it's also planned how it is, it will run to me, I'll go to CSIE. Well they will certainly start from the identification of problems, mentoring, when it should involve the role of parents, they will enter the realm of parents. That happens for such support, for all children (interview/19/02/2018).

Linda also gave a similar statement about CSIE, as follows:

> What students need, the guidance, it will come from the homeroom, then counsellor, then CSIE. For example, how to assess and diagnose student talent or get to know deeper about emotional behaviour of the children, CSIE will assist with it. Including our teacher, for example, for their career development or else, supervision will also be there. Including facilitate our teacher to upgrade their competencies related to how to manage the inclusive classroom (interview/22/02/2018).

6.5.4 Physical Building Access

Observation of School C's building demonstrated that this school was accessible for people with disabilities. School C had a fairly large building which was equipped with various learning facilities such as libraries, a science laboratory, a language laboratory, a sports arena, a meeting room, a hall, a teachers' room, a principal's room, *Growth Area* Program rooms, and classrooms equipped with AC, LCD projector, chalkboard, cabinet and shoe rack. Student chairs and tables were arranged in a U-shape.

Pedestrian paths in School C were equipped with ramps that were flat and not slippery and had no bumps, had bright lighting and no dark areas, had closed drainage holes which were far from the ramp edge, though they were not yet equipped with guiding blocks. School C was also equipped with a large parking space that was always guarded by a security guard, although there was no special parking space provided for wheelchair users with no parking areas set aside as indicated by disability parking symbols. The available toilets were quite large and spacious, which allowed wheelchair users to move freely, equipped with toilet seats and some were equipped with handrails that had a position and height adjusted to wheelchair users.

6.5.5 Parents' Involvement

Findings indicated that parents had a significant role in promoting and supporting the inclusive culture in School C. In addition to SLC held twice every semester for parents to see children's performance and reflect on what their children had learned, parents were also invited to regular meetings. Parents' meetings were held at least twice a year at the beginning of each semester. Aside from being a means for socialising programs and school activities for one school year or one semester in the future, this meeting was also used as a gathering place for parents and schools, and for fellow parents. Schools considered it important that parents and schools, as co-workers in educating and guiding children, needed to always communicate positively and build synergy so that every effort made for children, both at home and at school, could take place in an optimal and integrated manner.

As well as by official meeting, communication between school and parents was conducted informally through the support teacher and homeroom teacher. As Donna said:

> Precisely, many communications with the parent happened with support teacher, or it is usually through homeroom teacher. Just because in everyday, support teachers accompany their children in class. So in this lesson, it knows how the child's dynamic performance is happening to the child. So indeed, we [support teachers] are the bank of information related to the child. Therefore, the communication between parent and support teacher is intensive (interview/19/02/2018).

The support teacher stated that information related to a child's performance in the school, what the child was experiencing during school hours and what the student felt when interacting with others, was communicated to parents. The support teacher also noticed that communication with parents who had a SWD was more intensive than with other parents. Donna mentioned: "It's just that, parents of some kids with a particular condition I have noticed are a lot more active in the school, because of the fact that maybe their child has a need that requires great support" (interview/19/02/2018).

The student with LD indicated that concerning his difficulty and problems faced during science lessons, that the homeroom teacher would contact his parents: "As far as I know, there has never been any communication between my parents and the science teacher. It is normally through the homeroom teacher; she will notify my parents. If you do not do homework, then the homeroom teacher tells the parents, not the science teacher" (Felix, interview/22/02/2018).

Linda asserted (interview) that School C promoted integrated learning as a place for students to practise their lesson. She stated science teachers used to integrate science material with other subjects, therefore it required collaborative action among teachers and students. The integrated learning was part of the Interdisciplinary Unit Program (IDU), designed to construct communities of learners engaged in their common interests or activities and developed to create cooperative learning groups (including how to integrate and use what students learnt in science lesson into community activities) with clear goals, roles, and responsibilities, as Donna mentioned:

> We have IDU that contains various program required a collaboration from each other. The IDU usually has been set at the beginning of the school year. We usually have a theme, what we want through the following year, what teaching agendas, what material in the lesson plans, let's roughly which one can collaboration. In the IDU, our collaboration is not only one class but all classes, all grades. We divided it into groups that were cross-class, cross-age also, well where children learn, even in one group there was a child with one condition, there were children regular and have special conditions become one (interview/19/02/2018).

6.5.6 Policy and Supportive Program

The interview with Donna indicated that, to foster an inclusive and multicultural culture, School C had been voicing this inclusion climate in all learning activities, both for individual and group activities. "School C realises and celebrates diversity in life by accepting themselves as they are and other individuals with whatever uniqueness each person bring into his/her life" (Oktaviana & Kurniasari, 2017, p. 6). School C had several supporting programs to embrace inclusion (Appendix 10).

6.5.7 Challenges and Barriers in Creating Science Inclusive Classrooms

Interviews indicated science teachers still faced challenges and barriers in promoting and implementing inclusive ways in science teaching and learning. Challenges and barriers faced by science teachers, the support teacher and the principal in School C are divided into four categories, as follows.

6.5.7.1 Students' individual differences

Data indicated that science teachers in School C admitted that teaching students with differences (e.g. physical characteristics, cognitive ability and behaviours related to disability) challenged the teachers. Ann, Sarah and Donna asserted students with LD tended to have less motivation, be moody and display tantrums. Sarah said: "It's difficult to deal with children who are having a tantrum" (GI/08/03/2018). Sarah also mentioned: "If there was a student who was moody, the mood was bad, it really affected the class. He didn't want to sit in the classroom or was screaming like that. It disturbed the atmosphere" (interview/19/02/2018), whereas Ann said: "... in my school, there are many who are suddenly emotional. He has a hot temper and it's sometimes difficult to deal with.

Inevitably we need to calm the child, because when in a rage he will damage what he can" (GI/08/03/2018).

Besides individual differences, another challenge was students' range of ability, as the following statements show:

> The slow learners themselves have different levels, and it gives me a challenge. Besides the diversity [wide ability range], it becomes a common obstacle in this school is the type of disabilities. Their disabilities vary in one class, very complex. Those complexities produce challenges and barriers (Sarah, GI/08/03/2018).
>
> The ability's range in my class is huge. I have child who cannot read and write as in her age. Well, that is a very big obstacle for me, even the write, read and count is still, she can't do it. It's really a big obstacle. Then, I should lower the learning process for her to the really basic one. For example, when she learned a thermometer, she cannot read the thermometer, not the digital one, that's the manual version, let's say that. Yes, is one of the obstacles. That is very disturbing, disturb us when teaching and disturb other children to learn, then they lack understanding (Ann, GI/08/03/2018).
>
> … sometimes I confused about what kind of slow learner that my students have. To what extend I should lower the learning, then can understand. We have slow learners, that some of them like kindy level, their cognitive level like that, level of kindy. Even though the material is quite complicated for him to understand, I only give the concepts he encounters in life (Sarah, interview/19/02/2018).

6.5.7.2 Parents' understanding of their children

Data indicated that parent's understanding of their children was the second barrier and challenge to creating inclusive classrooms. Ann commented (group interview) that parents did not know their children's needs and how these related to their performance, and also mentioned: "The problem is that sometimes the parents always had unrealistically high expectations of their children" (interview/20/02/2018). Ann added:

> for the parents who are nice to the child, he will adjust his cognitive condition, the problem is, … some parents who have the denial, there are those who reject the existence of the child, the condition of the child, so he works on the problem, say it's useless. Yes, and the fact is, … sifted from primary school to middle school, which middle school has many subjects, many assignments, and surprisingly, his assignments were done by his parents. Some of the children, if they have homework, especially those who are very low, their parents were done their assignment, indeed, it was really written by them [parents] (interview/20/02/2018).

Donna in similar vein asserted (interview) that the most challenging experience was to meet difficult parents, who imposed their will, not prioritising their children's needs:

> They have not fully accepted the condition of their children, not only those with special needs, but whatever it is. They have not really accepted the condition of their child, do not understand the real condition of their child, so their expectations for this child are usually what ultimately prevents children and schools from developing to facilitate the child. That's what if I'm personal the biggest challenge. Maybe even her

> child is fine, her child is academically okay, but her parents, you don't understand the interest of her child where, her talent, forcing small things, it affects how, in effect, when this child is learning. Parents did not know that need finally came to know. Oh, it turns out my kids need to be supported by the school. ...
>
> Now there are a lot of problems, even if "I look like this, my parents want this" ... Well, usually starting from there we will open a further discussion or even usually if there are parents who like that, actually already visible in the process. "You don't like this, complaint or something, this is my child, how come I have never been given this task". Parents want their children to perform like this, while their children have other needs. ... Well, in this case, we will certainly ask for discussion, either, yes, it can be found directly via WA or phone, with parents in particular, not children. For me, we follow the needs of children. But that parent who is for me is an extraordinary challenge, various parents. So those who have special needs are not only children, but parents too. That's serious (Donna, interview/19/02/2018)

6.5.7.3 Support constraints

The third barrier was the support limitation, as shown in the following comments about limited numbers of support teachers, and challenges with teaching methods, assessment varieties and modifications:

> A limit to the number of support teachers is one of the obstacles. Sometimes support teacher accompanied the student who needs support, but another time she/he couldn't, though there were many students who need assistance. Therefore, in fact, sometimes the students with LD like Felix wasn't handled because of that factor. … because we have limited support teachers, it's impossible to offer reading service in every lesson. I think the biggest obstacle is insufficient resources available in the class (Ann, interview/20/02/2018).
>
> Sometimes one trick or one method applied in this class and the other classes can sometimes be different. So, every day it is challenging to continue learning because it will meet different things too. … The challenge for teachers to create a form of learning that is fun, which is fun. … Science learning process should be fun to foster students' motivation. Well, this is a challenge, any lesson, not just science, this is an extraordinary challenge (Donna, interview/19/02/2018).
>
> Making a variety of tests sometimes is a challenge, especially if accompanied by a variety of administrative requests. If we make tests for students that are in accordance with the government, we are provided by many standardised tests, but when we have to make a test that really suits the students' needs, it's a challenge (Sarah, interview/19/02/2018).
>
> For me, another challenge is the assessment modification, because the assessment instrument must be really adapted to the condition of the child. For example, I got a class with various conditions, I usually divided the conditions, up to 4 to 5 kinds categories. It's for one class, I have many classed and especially when the exam season began, I have to make variety of tests. It's challenging. Particularly if we have no bank test, no standardised test, so I have to make it by myself (Sarah, GI/08/03/2018).

6.5.7.4 National Examination (*Ujian Nasional*/UN)

The last challenge to creating an inclusive classroom found from the data analysis was the national examination policy. Sarah explained:

> Related to the UN, is also a challenge, because the UN is not flexible enough, mainly with the universal learning principle. Additionally, the parents' requirement, their parents want their children to take the UN. It means that they don't want their children to learn a regular examination, though their abilities are not sufficient. Well, sometimes, I teach them, like, really, desperately too. And the process of parents to realise the real condition is sometimes not sometimes, it's often too late, when children almost finished their grade.
>
> Aligning the school's demands, the official curriculum for achieving the UN, and parents' target to their children, are also difficult to comply. For example, this school demand is universal learning, universal learning means that all children get the same topic, which will be adjusted to their respective children, though one class is very high complexity, with only one teacher, it becomes a challenge too. Our problem is indeed in the UN and USBN, because it is applied to all children in all schools.
>
> In 2015, the UN was also a graduation requirement, well, we have a discussion with parents, they were given options to choose, their children to conduct the UN or not based on their child's condition. Fortunately, since 2016, the UN did not determine graduation. Then it became an advantage for us because although their condition was like that, they could still take the UN, but parents had to be willing to accept the results, so it didn't give demands more to the child (GI/08/03/2018).

Ann commented:

> Maybe because of a different management between the public school under the government and private school, like the UN and so on. The government itself has opened every school to be inclusive, but the facilities or equipment are not appropriate if the demands are still in the form of UN (GI/08/03/2018).

6.6 Summary

The most significant finding of the School C case was, *first*, high expectations for students with LD were held by one science teacher through discussion with the support teacher; while another science teacher did not hold high expectations of students with LD, as long as these students could understand basic reading and arithmetic. The ways in which the science teachers reframed standards into learning objectives for students with LD was by using the Revised Bloom's Taxonomy to create learning objectives that were used to guide the creation of assessment, and to accommodate students with LD's needs. All science teachers in School C down-graded the learning objectives from the regular ones by modifying them for students with LD. Two different passing grades were applied for regular students and those with disabilities.

The *second* finding relates to the way in which science teachers in School C designed instruction for students with LD, which indicated that they varied their strategies to design learning that supported recognition (to build knowledge), strategic (to build skill) and affective learning. To support recognition (cognitive) learning, science teachers in School C supplied background knowledge to scaffold learning; offered material using multiple modalities, especially by providing individual worksheets to cater for the individual needs of each student; presented multiple examples and connected science concept with daily events; and highlighted critical features and emphasised science key concepts. Science teachers in this school ensured that the materials, content and examples given to students with LD were adjusted based on their cognitive level. To support strategic learning of students with LD, science teachers in School C provided a flexible model for using science process skills through a personal approach; offered various methods for responding to and navigating material, such as KAHOOT (a game application for fun learning); provided flexible opportunities for demonstrating skill; provided opportunities to practise with support, such as additional time to do tasks and assignments, cooperative learning and work with peers; and offering relevant feedback during the teaching and learning process. To support affective learning, science teachers in School C provided challenges that were adjusted based on the student's need; offered choices of content, tools and media for communication; and offered choice of learning contexts, i.e. varying activities and sources of information that closely linked to the students' lives, capturing students' attention, creating a positive welcoming class, and minimising threats and distractions.

The *third* finding demonstrated that science teachers in School C assessed and monitored students with LD progress in three domains: cognitive, skill and affective. Monitoring the progress of cognitive learning by students with LD was done by using a personal approach, seeking what difficulties students had and providing assistance to overcome the difficulties. To capture students' achievement, science teachers in School C applied a variety of alternative assessment methods: practical, project, presentation, oral test, additional tasks at home, and quizzes. To monitor skill development progress, one science teacher offered flexibility and freedom to choose the form of task submission (paper-based or electronic). Affective learning was monitored and assessed in several ways: by exploring the value and meaning of their learning experience through reflective activities, experiential learning, and requiring students and parents to attend Student Led Conferences (SLC) as a being place to celebrate the student's achievement and to reflect on what he or she had done through that semester.

The *fourth* finding relates to the factors contributing to and hindering the creation of science classrooms that were inclusive for all. All school members had a positive understanding of SWD and a positive culture had been built to promote an inclusive education system. Collaborative work between the science teacher and the support teacher was established to support students' needs. Although inclusive practices training for science teachers was not well established, they kept themselves updated on inclusive education issues. School C had CSIE as a place for teachers to learn to teach in inclusive settings. In terms of the buildings and physical environment, School C was accessible for people with disabilities, particularly for wheelchair users. It also offered various programs and activities to promote and apply an inclusive education agenda. Parents and the wider community were involved in creating a more inclusive society, although some parents did not accept or fully understand their children's disabilities.

Chapter 7
Cross-Case Analysis

Chapters 4, 5 and 6 have presented the findings from each case: School A (public school), School B (Islamic private school) and School C (private school). Chapter 7 draws a cross-case analysis to compare and contrast the similarities and differences across the three cases. This chapter begins with a comparison of the three schools' profiles and then discusses the findings related to the four major research questions of the study.

7.1 School Profile Comparison

School A was a three-year public middle school enrolling 723 students across Grades 7-9 in the academic year of 2017/2018. Schools B and C were private schools, having a smaller student population size of 53 and 110 students respectively. When data were collected, all students in School B were visually impaired, while in School A only 24 out of 723 students had a disability or disabilities, and in School C 38 out of 110 students had disabilities. The profile summaries of the Schools A, B and C are presented in Table 7.1.

Table 7.1 Schools' profile comparison in the academic year 2017/2018

School	A	B	C
Orientation	Public	Islamic private	Private
Source of funding	Government Parents	Private sources Parents	Private foundation Parents
Location	Rural	Urban	Rural
Grade	7, 8, 9	7, 8, 9	7, 8, 9
Average class size	20	6	20
SWD population	24	53	38
Student population	723	53	110
Percent of SWD	3.32%	100%	34.54%
Types of SWD involved in this study	students with HI slow learner	students with VI Multiple disabilities (VI and LD)	students with LD
Academic staff	42	8	21
Ancillary staff	14	4	10
Support teachers & their background	1, special education	1, science education, no special education	1, special education
Curriculum Note: MOEC = Ministry of Education and Culture MORA = Ministry of Religious Affairs	National curriculum (MOEC)	National curriculum (MOEC) Islamic curriculum (MORA)	National curriculum (MOEC) International Middle Year Curriculum (IMYC)
National curriculum 2006 for Grade 9 across Schools A, B and C National curriculum 2013 for Grades 7 and 8 in across Schools A, B and C			

To help science teachers accommodate the needs of SWD, each school provided one support teacher. School A's support teacher was appointed by the Department of Education and Sport (Dikpora) and provided assistance every Friday and Saturday. In School B, no teacher was officially appointed to be a support teacher but an itinerant science teacher acting in the role assisted SWD. In School C, one qualified special education support teacher worked with science teachers in assisting SWD.

Schools A, B and C had adopted the MOEC national curriculum. As the academic year of 2018/2019 was a transition period for implementing the latest curriculum (K13), all schools adopted K13 for Grades 7 and 8, while Grade 9 still applied Curriculum 2006. Besides K13, School B also enacted the MORA Islamic Curriculum, which affected the number of Islamic studies subjects that should be learned by the students. School C implemented K13 and the International Middle Year Curriculum (IMYC).

7.2 Theme 1: Goal-setting for Students with Disabilities Across Cases

The first research question sought participants' experiences and views on how science teachers set goals for SWD. This research question was divided into four sub-questions that aimed to find out how science teachers held expectations, reframed standards as learning objectives, established individual learning objectives and created criteria for obtaining the minimum passing grade for SWD. Participants' responses to each of these sub-research questions across the three cases are compared and contrasted in the following sub-sections.

7.2.1 Establishing Expectations for Students with Disabilities Across Cases

Findings from the interviews revealed that teachers held similar expectations for SWD. In general, teachers and principals in Schools A, B and C expected SWD to have a fulfilling life in society, be role models for their junior peers, be equal to their peers, and play a role in society in spreading inclusive ideas. More specific to science, science teachers from Schools B and C expected SWD could utilise basic arithmetic to solve science problems as well as utilise basic knowledge of science in their daily lives.

Science teachers in School A held high expectations for students with HI who had no learning difficulties but, for those who did, lower expectations were held. Questionnaires from science teachers in School B indicated that high expectations were usually held for students with VI and these were clearly defined, but the interview data contradicted this perspective, indicating that science teachers set expectations that were medium to low. Questionnaires indicated that only Sarah (science teacher in School C) held high expectations for SWD. She explained in interviews that high expectations for students with LD were developed based on discussion with the support teacher, and she admitted that high expectations for SWD were important for them to become successful in science. Ann, by contrast, mentioned that high expectations for students with LD were difficult to apply because they were limited to basic science. Ann added that the more important thing for students with LD was to ascertain their ability in basic arithmetic so they could be successful in science lessons, as this also mentioned by other science teacher participants. Low expectations were held by the majority of teacher participants because they believed that disability was one factor that impeded SWD from learning science, with the result that their achievements were generally lower than their peers without disabilities.

7.2.2 Reframing Standards as Learning Objectives for Students with Disabilities Across Cases

In all schools, the formulation of learning objectives was based on standards (SK/KI and KD)[14] of the national science curriculum. Findings indicated that Schools A, B and C had similar techniques in formulating science learning objectives for SWD.

7.2.2.1 Writing learning objectives

The analyses of science teacher participants' lesson plans (see Appendix 9) indicated that learning objectives were clear and specific, using appropriate action words from the Revised Bloom's Taxonomy (RBT) that could determine the true purpose of the standards. Interviews, however revealed some teachers admitting that they did not always determine the objectives by themselves, rather they adopted them from textbooks, government e-book (BSE), websites and the Science Teachers Working Group (MGMP). The lesson plans clearly showed science teachers mostly established learning objectives for cognitive and psychomotor goals, which are associated with recognition and strategic learning. The

[14] SK (or *Standar Kompetensi* = Standard Competency), KI (or *Kompetensi Inti* = Core Competency) and KD (or *Kompetensi Dasar* = Basic Competency) are the types of the content standards in Indonesian curriculum

objectives were clear and the wording chosen offered the greatest amount of flexibility to achieve the objectives.

Data compiled from questionnaires and presented in Table 7.2 show the median scores of the three schools, and indicate the tendency of teachers in each school to develop learning objectives for SWD ranging from the least to the greatest. These are School B, School A and School C. This tendency is in line with the interview data concerning the experiences that science teachers in each school had regarding the ways in which they formulated their learning objectives.

Table 7.2 The frequency of participants' responses with respect to developing learning objectives for SWD

When setting up learning objectives and goals for SWD, I …	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. consider the knowledge domain (cognitive)	5	4	4.5	5	4	4.5	5	5	5
2. consider the skills domain (psychomotor)	5	4	4.5	3	3	3	5	5	5
3. consider the attitude domain (affective)	5	1	3	2	4	3	5	5	5
4. categorize the objectives into two groups: need-to-know (essential) and nice to-know (important, not essential)	3	4	3.5	1	5	3	2	5	3.5
5. use a "SMART" (Specific, Measurable, Achievable, Relevant, and Timely) strategy	4	4	4	5	3	4	4	5	4.5
6. use an "ABCD" (Audience, Behaviour, Condition, and Degree) strategy	4	5	4.5	5	4	4.5	1	5	3
Overall central tendency (Median)	**4.25**			**3.50**			**4.75**		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

Data from written questionnaires showed science teachers in Schools A, B and C considered learning objectives for the cognitive and psychomotor domains to be more important than those for the affective domain. In their interviews, all science teacher participants asserted that the student's ability was the most important factor when setting up the three domains of learning objectives and making adjustments. The interviews indicated that the affective domain was the most difficult to be formulated for science lessons; Melissa (School A) and Tiffany (School B) stated that they never or rarely considered this domain (see Table 7.2 Question 3). Further, all teachers categorised the objectives into essential and non-essential, except for Tiffany (School B) who asserted she never did this (see Table 7.2 Question 4). As Tiffany believed that all objectives were important, she did not classify the objectives into essential and non-essential but rather categorised the content based on the difficulty level. She said (interview) that she would pick easier content for students with VI, so they could learn independently. Table 7.2 shows science teachers in all schools used both ABCD and SMART strategies to define learning objectives, except Ann who asserted that she had never used the ABCD strategy.

7.2.2.2 Aligning learning objectives with teaching method and assessment

To set learning objectives that are measurable and achievable, all science teacher participants asserted (questionnaires) that they aligned the objectives with instruction and assessment, except for Tiffany who said she rarely did this. In the interview, each science teacher asserted that they used learning objectives as the basis for choosing their teaching style or instructional approach and assessment, however, lesson plan analyses indicated that the science teachers identified content-based rather than goal-based learning objectives.

7.2.2.3 Accommodating students with disabilities' needs when setting learning objectives

Interview analysis found that each science teacher in each of the three schools asserted they formulated objectives that accommodated students' needs by means of different strategies, as given in Table 7.3. The median scores for Schools B and C are higher than School A, which indicates Schools B and C tended to have a more accommodative way of establishing objectives than School A.

Table 7.3 The ways that science teachers establish objectives that accommodate SWD's needs

In what ways do you establish objectives that accommodate SWD's needs?	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. Invite SWD (in their own way) to speak to me on the off chance that they have learning challenges	4	4	4	5	5	5	5	5	5
2. Accommodate the personal interests and/or values of SWD when writing objectives	4	2	3	1	4	2.5	2	4	3
3. Implement "appropriate accommodation" for SWD in my class	4	4	4	5	5	5	5	5	5
Overall central tendency (Median)	4			5			5		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

In establishing objectives, science teachers in Schools A (frequently), B (always) and C (always) tried to speak personally to SWD (Table 7.3 Question 1). In School A, besides establishing personal conversations with SWD, science teachers indicated (questionnaires) that they also established communication with parents to gather information about students' needs and purposes for learning science. In Schools B and C, the main purpose for personal communication with SWD was to identify the learning approaches that best suited them, although Shirley asserted in her interview that students with VI did not open up and tended to hide their difficulties in learning science. In terms of personal interest, Table 7.3 shows that Schools A, B and C had a similar tendency (see the median score) in accommodating students' personal interests and values. In School C, science teachers clearly explained that values were emphasised when discussing the application of science in real-life (Sarah).

As science teachers in School A catered for students with HI, Susan and Melissa asserted they accommodated those students by providing a lot of visual forms of information and offering additional after school lessons (interviews). In School B, the way science teachers accommodated students with VI was by providing easier tasks and treating each student differently. In School C, accommodation for students with LD was offered by personal mentoring suited to each student's needs and using individual worksheets. Science teachers and the support teacher in School C asserted by interview that students' needs were the best guide for deciding their choice of learning activities, including knowing the learning media that suited students' interests, and knowing what students needed and their preferred personal approaches identified through discussions among the science teachers, the support teacher, the student and parents. Applying flexible learning approaches based on the students' needs meant teachers were able to change their approach to their instructional planning.

7.2.3 Modifying Learning Objectives for Students with Disabilities Across Cases

Data from the interviews revealed that each science teacher adjusted and modified the learning objectives for SWD in similar ways. *First*, adjustments and modifications of the learning objectives for SWD were made by down-grading and lowering the standard. In School A, science teacher participants provided notes in their lesson plans which identified specific learning objectives for SWD. In School B, the learning objectives for students with VI were formulated at the very basic level. In School C, science teachers did not have a record in their lesson plans about which learning objectives were specifically designed for SWD. Science teachers in School C stated that the adjusted learning objectives for SWD could be identified when those students were provided with their individual worksheets.

Second, the science teachers in the three schools studied explained in the interviews that they focused on how to adjust the learning objectives to meet the students' abilities. For instance, the science teachers in School C asserted that they respected students' diversity and their uniqueness. Interview analysis also showed that to determine a student's ability, Schools A and C conducted a diagnostic test in the admission process to assess the student's ability, focusing on the learning aspects and using the test result as a foundation for making appropriate accommodation for SWD, including identifying what the best learning objectives and expectations for each SWD should be. Although all schools administered a diagnostic test and adjusted the learning objectives, lesson plan documentation showed that no learning objectives for SWD were recorded in these documents. Ann even said that it was more important to focus on the learning processes that were suited to SWD rather than on the documentation such as the lesson plans.

Another important finding indicated that when SWD in Grade 9 were required to pass the National Examination (UN) to graduate, science teachers would focus on the teaching materials that would be assessed in the UN. Therefore, it may be concluded that formal modifications to the learning objectives and/or individual goals for SWD were not usually made.

7.2.4 Creating Minimum Criteria for the Passing Grades for Students with Disabilities Across Cases

Finding related to goal setting is the ways by which science teachers in Schools A, B and C established the Criteria for a Minimum Passing Grade (or *Kriteria Ketuntasan Minimal*/ KKM), a standard that is usually in the form of a minimum score that should be obtained by students. There was no significant difference between the findings from Schools A and C in creating a KKM. In School A, the KKM was set at the same score (e.g. 70) but there were different criteria for SWD and 'regular' students. In School C, the KKM was different for students with LD (e.g. 60) and students in general (e.g. 70). In School B, no adjusted KKM was designed for students with VI although each student had a different level of cognitive ability (Shirley's interview).

7.3 Theme 2: Pedagogical Practices for Students with Disabilities Across Cases

Theme 2 is aimed at clarifying the similarities and differences between the three cases in the ways science teachers modified pedagogies and structured science materials so SWD were able to gain understanding, comprehension, skill, engagement and motivation in learning science. Three sub-themes were organised to explicate the views, ideas, and experiences of science teachers related to Research Question 2: "How do science teachers practise pedagogy (approach to teaching) for SWD?".

7.3.1 Supporting Recognition Learning to Build Students with Disabilities' Knowledge Across Cases

Data from questionnaires in Table 7.4 show the options science teachers used to build new knowledge to support recognition learning for SWD. The median scores in Table 7.4 indicate that each school had similar tendencies (4 = frequently) in offering strategies and options to build students' new knowledge, although each science teacher did this in different ways, as follows.

Table 7.4 Options science teachers offered to build new knowledge

Which of the following options do you provide when structuring material to build knowledge for SWD? I …	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. attach new ideas to prior knowledge	3	4	3.5	4	4	4	3	4	3.5
2. present the real-life example related to the material to make learning applicable	5	4	4.5	5	4	4.5	5	4	4.5
3. Ensure that examples and content used in class are pertinent to people with disabilities	5	4	4.5	5	4	4.5	5	5	5
4. highlight key concepts and explain how they relate to course objectives	5	4	4.5	3	4	3.5	5	5	5
5. begin each class with an outline of material to be covered	5	4	4.5	5	3	4	5	4	4.5
6. represent key concepts graphically as well as verbally	5	5	5	5	4	4.5	5	5	5
7. conclude every session with a summary of key points	5	5	5	5	4	4.5	5	4	4.5
Overall central tendency (Median)	4.5			4.5			4.5		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

7.3.1.1 Activating background knowledge

The way science teachers in the three SPIE activated background knowledge was by attaching new ideas to prior knowledge (see Table 7.4 Question 1), through an apperception. Classroom observations in School A revealed that to activate background knowledge, science teachers showed a video on Global Warming (Melissa) and Environmental Pollution (Susan) then asked students a series of initial questions related to the topic that students would be learning. These questions were then used to guide a whole class discussion until the learning was complete. Shirley and Tiffany in School B stated in their questionnaires that they showed examples that were already known to students and linked these to the given topic, as their way of activating students' background knowledge. Similarly, the interview with Ann in School C showed that she did a similar thing. She added that, after showing some examples, she continued with a 'Question and Answer' strategy to discover what students knew about the topic. Sarah preferred using a simulation as the pre-teach critical prerequisite concept for science (observation), although simulations could not be found for all topics (interview). Another important finding was demonstrated by Irene in School B who stated that students with VI tended to have minimal prior knowledge regarding particular science concepts because of their limitations in visual areas.

7.3.1.2 Providing real-life examples

Findings revealed that science teachers in Schools A, B and C provided real examples for SWD to enable them to interact with science materials. Questionnaires (Table 7.4 Question 2) showed that science teachers in each school either always or frequently presented the real-life examples to make learning applicable. In School A, interviews elicited that because science was packed with symbols, abstract and difficult terms, these difficulties were managed for students with HI by showing them real examples that were easily found in daily life. Similarly, Irene (support teacher, School B) said that palpable examples given to students with VI aided them in understanding the material. Irene also invited students with VI to learn outside the classroom in particular topics, by conducting observations and discussing what they had observed. Similarly in School C, Sarah determined that, in making it easier for students to understand the lesson, she always provided students with examples they were likely to know or had seen (interview). However, Ann and Donna stated that using material with simpler language was better for students with LD because some of them had language difficulties. Ann also mentioned that teaching with real examples would gain the students participation.

Another finding from the questionnaires (see Table 7.4 Question 3) indicated that each teacher studied in the three schools, either (always) or (frequently) ensured that the examples and content used in class were pertinent for their SWD. In School A, Melissa admitted in interview that she would ask SWD again, whether the information was clear or not. In School B, to ensure that the material used was relevant for students with VI, Shirley endeavoured to use daily life examples. In School C, Ann and Sarah indicated by questionnaire that they ensured unfamiliar science syntaxes and terms were clearly defined, with more detail and by using language that students with LD could understand.

7.3.1.3 Highlighting critical features and key concepts

Questionnaires (see Table 7.4 Questions 4, 5, 6) showed that each teacher in the three SPIE had similar ways of highlighting critical features and key concepts in a topic; which interview confirmed was by repeating the key concepts. In the interviews, Sarah (School C) added that she usually wrote the key concept on the chalkboard, while Shirley (School B) asserted that repeating the key concept was essential to making clear what was the most important concept to be mastered by students with VI. In the closing session, each science teacher concluded their lesson with a summary and Ann (School C) particularly used the last 10 minutes of the session to give students feedback.

Verbally, the science teachers highlighted critical features when they spoke—using pitch, volume, pauses, intonation, pointing, gesturing, and facial expressions (verified by classroom observations of Melissa, Susan, Ann and Sarah). Observation in Melissa's classroom showed that she highlighted the key concepts graphically and provided a summary of the important concepts in the topic by a handout given to students with HI. In this way, she could draw their attention to the most important parts of the topic. Susan, Ann and Sarah highlighted the key concepts by jotting them down on the white board, providing direction to students to stay focused on those particular concepts. However, in School B, Shirley and Tiffany did not use visual means to highlight the important science concepts for students with VI.

7.3.1.4 Providing multiple media and formats

Findings confirmed Schools A, B and C provided limited media and formats in the way science teachers provided for SWD individually. Science teachers in School A asserted they tried to make science information recognisable for students with HI by optimising visual learning media (i.e. in written formats). However, they also mentioned that no special media were designed/offered for students with HI. In School B, Irene said (interview) science teachers should consider visual material when designing instruction for students with VI. Science teachers in School B mentioned (interviews) that they optimised the use of electronic version materials, touchable media and audio forms. Shirley provided more various media than Tiffany and she limited content that required practicals because School B had limitations in science props. Irene emphasised that, as students with VI preferred audio style, she offered the lesson by audio aids, such as listening to songs, poems, and other related matters. Irene also provided the students the opportunity to find their own resources and they learned together in their group learning. In School C, the main science learning modality was the worksheet. In the interviews, Ann and Sarah asserted they developed different worksheets for different students to cover their needs. Other media used were videos, real daily examples, web-based games and computer simulations.

7.3.2 Supporting Strategic Learning to Build Students with Disabilities' Skills Across Cases

This sub-theme draws upon science teachers' experiences in selecting various learning approaches to create individual instruction for supporting strategic learning.

7.3.2.1 Providing flexible models of science process skills

Data indicated six science teachers offered various learning activities in building students' skills, as described in Table 7.5. The tendency in varying options to build students' skills was the same for Schools A and B and higher for School C (see the overall median scores).

Data from Table 7.5 Question 1 show that all teachers (always and frequently) began class with an advanced organiser by questioning students and showing real examples. In School A, Melissa said beginning class with questions was a must to probe students' prior knowledge of a new topic, while Susan mentioned that, through questioning, students knew the purpose and objectives of learning, together with the purposes of the material being studied. Similarly, science teachers in School C asserted (interviews) that advanced organisers provided connections between the known and unknown knowledge of students.

Table 7.5 Various learning activities in building students' skills

Which of the following options do you use when building skills for SWD?	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. Begin class with an advanced organiser (using an essential question) that I will address all through the class	5	5	5	4	4	4	5	5	5
2. make learning "active"	4	4	4	4	3	3.5	4	5	4.5
3. make learning participatory	3	4	3.5	3	3	3	4	5	4.5
4. use student-centred learning approaches	3	4	3.5	4	2	3	4	4	4
5. Allow them to grasp material in their preferred learning style	3	4	3.5	5	3	4	4	5	4.5
6. Allow them to grasp material at their own pace	4	4	4	5	4	4.5	5	5	5
7. Assist them to identify how they learn best	3	1	2	3	3	3	5	4	4.5
Overall central tendency (Median)	3.5			3.5			4.5		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

The other option provided by science teachers in the body session of a lesson in the three schools was making learning active, participatory and student-centred (Table 7.5 Question 2, 3 and 4). In School A, science teachers stated in questionnaires that active learning approaches made the students eager to learn science. School A science teachers applied discussion, presentation and practical methods to get students active and engaged. In School B, Tiffany mentioned in questionnaire and interview that student active learning was only applicable for classrooms which had students with middle to high level cognitive ability. Similarly, Shirley asserted in interview that active learning could not be adopted in her classroom because students with VI tended to be passive learners. To make them participate, Shirley and Tiffany said (interviews), that the best approach was by the 'Question and Answer' strategy and by lecturing. Conversely, Irene commented that active learning approaches (i.e. outside-classroom observation and simple practical work) was possible for students with VI and she did these. In School C, various active learning approaches were applied to build students' skills: practical and experimentation, simulation, presentation, observation, literature study and discussion. Another way to help students to process the information was by giving them explicit prompts for each step in a sequential process, while Sarah preferred to accompany students with LD one-by-one. Data indicate SWD in each school were rarely involved in practical activities in a laboratory.

Findings confirmed that science teachers in each school allowed SWD to grasp material in their preferred learning style and at their own pace (see Table 7.5 Questions 5 and 6). Although science teachers in School A did not clearly indicate in the questionnaire what options were offered to students with HI to grasp material, Melissa and Susan mentioned that the options offered to students with HI gave them a chance to obtain their best achievement. Data analysis from the interviews and questionnaires from School B showed that Shirley offered students with VI e-book files for them to learn independently based on their pace and learning style, while Tiffany always ensured her students understood what the topic was about before they could move to the next topic. Irene highlighted she tried to vary the teaching approaches to give students various learning experiences. According to Irene, discussion was the best approach for activating students with VI in class. Irene said that it was expected that students were also able to express their opinions and formulate conclusions; besides this they were also expected to argue, refute and defend their opinions. In School C, the interviews and questionnaires showed that Ann offered students with LD the choice to present their assignments in ways that best suited them, while Sarah mentioned that each student was given the opportunity to choose the preferred style of learning and she allowed it so long as they did not disturb their peers.

Data evidenced in Table 7.5 Question 7 (see the median scores) shows that science teachers in Schools A and B had difficulties in assisting students to identify what the best way to learn involved, even although they tried to communicate personally with the students by asking what they needed. As previously mentioned, in School C, the science teachers stated that they (always) discussed with the support teacher the best ways for students with LD to learn.

7.3.2.2 Providing various methods for responding to and interacting with science materials

Findings confirmed that science teachers in School A provided more varied methods of responding to and navigating science materials for SWD than did School B or C. To optimise access for students with HI in materials, science teachers in School A offered printed materials with pre-taught specific language, demonstrated laboratory activities then asked the students with HI to conduct the experiments as demonstrated allowing them to discuss materials with their peers using sign language. School A did not operate sign language, instead the teachers used lip-reading to communicate with students with HI. Some peers could use sign language so this helped the transfer of information from the teacher or other peers to the students with HI. In instances where sign language did not operate (including science teachers), the communication and interactions between the students with HI and others were aided by the use of pencil and paper. Melissa, Susan and Julie (the support teacher) also asserted in interview that the easiest way was to open their lips wider, keep the pace of teaching slower and use more materials in written form. Classroom observations, however indicated that the noise background in School A was not controlled. In Schools B and C, the interviews and classroom observations verified that not many physical interactions occurred in ways that enabled SWD to express their knowledge. In School B, students with VI preferred to access the science materials though their smart phones, slate-stylus and screen reader software for reading materials and writing notes. In School C, individual worksheets were the preferred media option in responding to and interacting with science materials, besides using smart phones and iPads installed with KAHOOT.it and other educational apps.

7.3.2.3 Offering flexible opportunities for demonstrating skill

Data indicated that science teachers in School C offered flexible opportunities to express what students knew by offering more varied formats than in School A or B. The questionnaires revealed that each science teacher in these schools required SWD to make brief reports and oral presentations to demonstrate their understanding. Other options offered in School A were videos, posters, and newspaper articles; in School B, web publications; and in School C, wall magazines or posters, newspaper articles and object creation.

7.3.2.4 Providing opportunities to practise with support

Questionnaire analysis (Table 7.6) indicates the tendency of science teachers' to provide support for SWD in positive ways ranging from the least to the greatest, when moving from School B to School A and then to School C.

Table 7.6 Options for SWD to practise with support

Which of the following supports do you provide for SWD to practise? I …	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. Give them additional time to do their tasks, so that SWD can practise recalling and utilizing information	3	4	3.5	5	4	4.5	5	4	4.5
2. Allow them to work in pairs with non-disabled students e.g. in the laboratory where physical and/or sensory effort may disadvantage SWD	4	5	4.5	3	2	2.5	5	5	5
Overall central tendency (Median)	4			3.5			4.75		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

One option that science teachers in each school had used was to give the SWD additional time to submit their tasks (see Table 7.6 Question 1). In School A, additional time was provided to SWD to give them the opportunity for better achievement and to further explore the material. Susan allowed students with HI to finish the task at home and collected it the next day. School B gave additional time to students with VI to do their assignments and homework and they could ask their parents, relatives, tutors or volunteers if they had any difficulties in doing the task. Shirley used a mnemonic strategy to help students with VI to memorise and recall concepts. In School C, the due date for collecting tasks was the same for everyone, but additional time was frequently given to students who encountered obstacles, Sarah wrote in her questionnaire.

The next option teachers provided in building SWD skills was in allowing them to work with peers without disabilities (see Table 7.6 Question 2). In School A, students with HI were paired with their peers without disabilities to give them opportunities to share knowledge, learn to be more patient, participative, and make students with HI feel that they were the same as others. In School B, as the facilities and infrastructure for practicals were limited, Shirley and Tiffany rarely involved students with VI in working in the laboratory, however Irene explained in the interview the way students with VI worked in pairs in conducting simple experiments. In School C, as previously said, Ann and Sarah asserted peer tutoring and group learning were always conducted by pairing the students with LD with their peers without disabilities to encouraging peer interaction and support learning activities for the tutee. In addition, one science teacher in School B supported students with VI with mnemonic strategies for memorising and recalling concepts.

7.3.2.5 Providing ongoing and relevant feedback

Written responses demonstrated science teachers in Schools A, B and C provided feedback for SWD in ways to support strategic learning. Science teachers admitted (interviews) that feedback was offered during the lesson to identify the difficulties faced by the students, by commenting on what students had done. In Schools A and B, feedback was given to monitor the student's progress, where students who had mastered the topic were given an enrichment program and students who had not mastered the topic were offered a make-up test. In School C, feedback was given to students with LD by returning their worksheets with written comments, providing a descriptive review in the mid-term and final-term report and checking the originality of the students' assignments. Another important finding from School C was that this school offered a Student-Led Conference (SLC), a program that provided students the opportunity to present their final work for the semester in front of the homeroom teacher and parents, and collect their comments. In the SLC, students, parents and teachers were provided a space in which to reflect on what had worked leading to good results during the semester.

7.3.3 Supporting Affective Learning to Build Students with Disabilities' Motivation and Engagement Across Cases

This sub-theme describes the experience of participants in Schools A, B and C in how science teachers practised pedagogies to engage and motivate SWD to learn science. Participants' responses in each aspect retrieved from questionnaires and interviews across the three cases are presented and compared in the following sub-sections. Data from observation and document analysis are also presented to elaborate and cross-check the findings.

7.3.3.1 Providing adjustable levels of challenge

Findings showed that science teachers in Schools A, B and C provided challenges that could be adjusted for SWD in similar ways, by offering SWD more or less difficult questions and problems.

7.3.3.2 Offering choices of content, tools and media for communication

The questionnaire analysis results presented in Table 7.7 confirm that science teachers in Schools A, B and C had positive ways (in different frequencies, see the medians) for providing alternative content, tools and media for communication with SWD.

Table 7.7 The alternative ways for SWD to choose content, tools and media for communication

What alternatives do you provide for students to choose content, tools and media for communication?	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. Provide captioning or transcripts for videos	4	3	3.5	1	1	1	5	5	5
2. Check for ancillary electronic materials (CD-ROM and web content) to go with the course book	2	1	1.5	5	3	4	5	3	4
3. Adopt instructional technologies to increase communication and allow for alternate ways of expression	4	4	4	5	3	4	5	5	5
4. Utilize innovation to expand class correspondence, e.g.: WhatsApp Group, FB Group, or mailing list	3	4	3.5	3	4	3.5	5	3	4
Overall central tendency (Median)	3.5			3.75			4.5		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

As visual media are limited for students with VI, Tiffany and Shirley in School B stated that they never showed videos to their students. Four other teachers in Schools A and C asserted they provided captioning or transcripts with videos (Table 7.7 Question 1). Melissa also indicated (questionnaire) that if the video had no subtitle, she provided a summary that was given to students with HI.

Another option for SWD to choose science content was in electronic formats (Table 7.7 Question 2). Science teachers in School A had not used electronic formats (Susan indicated never) to go with the course book, while in School B the 'government e-books' (called BSE) were used as the main course books for students with VI, and additional materials were provided on websites. Similarly, science teachers in School C also reported (interviews) that they provided electronic materials (mostly on websites) as additional sources of material in science lessons. During a classroom observation (13/02/2018), while teaching the topic Temperature, Ann showed this content through a website.

Concerning the tools that helped motivate students to engage in science, data from the questionnaires and interviews indicated that Schools A and B offered few tools for SWD, while School C provided some, e.g. calculators; computers and everyday materials for simulation; Science Practical Kits; iPads, Android or other digital devices containing apps for science learning.

Findings confirmed science teachers in Schools A, B and C adopted instructional technologies to increase communication and allow alternative ways of expression. School A provided no instructional technology, other than paper as a medium for communicating with students with HI. In School B, students with VI could access the computer laboratory that was equipped with a screen reader, such as JAWS, and a smart phone that was installed with a screen reader and dictation. School C equipped SWD with high-tech based aids, such as iPads with suitable applications installed for learning; computers for simulation use; Video on YouTube channel, KAHOOT quiz application which was installed on smart phones; communication platforms such as WA, BBM and Instagram for assignments; and Science Practicals Kits.

The questionnaire responses in Table 7.7 Question 4 indicated that science teachers in Schools A, B and C utilised social media applications, i.e. WA, to expand class interactions.

Melissa asserted in interview that WA made the correspondence with students with HI easier and faster. Melissa added WA provided her with an alternative to personal chatting with students with HI to figure out their problems in learning science. Susan, Shirley and Tiffany used WhatsApp Group (WAG) as media to discuss content and problems while outside the classroom. Susan demonstrated how the WAG worked in conveying information from her to all members in that group and how the students responded to her information through chatting. Ann used WA to remind students about their task or its submission. Sarah not only depended on WA but was more open to all communication media. She asserted in her questionnaire and interview that students could use their preferred media for communicating with her including requesting an after-school counselling session.

Available time for extra support for SWD was also provided by each science teacher. As previously mentioned in Theme 1, in School A, Melissa offered students with HI after school lessons, while Susan preferred to set up an appointment with those students to talk individually with them about their problem in learning science. Susan also mentioned she could be contacted anytime that SWD wished, thereby increasing their confidence and their learning motivation. No time for extra support was made available for students with VI in School B, except by discussion through WA. In School C, when students with LD faced problems in science learning, the support teacher was included in identifying which solutions were best for them.

7.3.3.3 Offering choice of rewards

Data indicated that rewards were offered only in School B, where Irene stated that their use was to boost the students' motivation to learn science.

7.3.3.4 Offering choice of learning context

Findings revealed that science teachers in Schools A, B and C applied assorted learning approaches to gain the attention of SWD, and to motivate and engage them in learning science. Data from interview analysis indicated that each science teacher presented real-life examples to make learning applicable and to gain students' interest. For instance, Tiffany showed how electricity turns on electronic devices, Shirley presented how static electricity works for lightning and Irene demonstrated how healthy food affects the body. The interviews indicated that some reasons for using daily life examples in lessons were "to provide knowledge to students about the benefits of learning science and to give examples of natural phenomena that occur in discussing the material" (Shirley), "to make science learning more fun and valuable" (Irene) and "to help students apply science concepts in a real context" (Sarah). The way science teachers offered examples was discussed in Section 7.3.1.2 *Providing real-life examples*.

Findings from the questionnaires displayed in Table 7.8, detail the methods science teachers in Schools A, B and C used to build SWD motivation and engagement.

Table 7.8 Science teachers' ways to build SWD motivation and engagement

In what ways, do you build SWD' motivation and engagement?	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. Create a welcoming class environment	5	5	5	4	4	4	5	5	5
2. Create some "energy" (e.g., humour, anticipation, suspense, ice breaker) during teaching and learning to increase attention and recall.	4	4	4	4	4	4	5	3	4
Overall central tendency (Median)	4.5			4			4.5		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

Data in Table 7.8 Question 1 show four teachers in Schools A and C always created a welcoming class environment to begin science lessons and two teachers in School B did so frequently. The interview with Melissa indicated that in School A, a welcoming class environment could build students' sense of belonging and make students feel comfortable and encouraged to tackle and ask questions, whereas the interview with Susan revealed that a welcoming class boosted the eagerness with which students with HI could learn science. In School B, Tiffany asserted (interview) that a welcoming class environment was important to the students' mood; while Shirley mentioned that she welcomed the class was done by "calling the students' names one by one and asking how they were before starting the lesson and treating them fairly". Irene, the support teacher in School B, asserted in interview that a welcoming class was important to make students feel comfortable and happy so that an effective learning process could be realised. Similarly, Sarah, in School C, explained she always created an encouraging environment during the teaching and learning process. Ann mentioned (interview) that a welcoming class environment meant involving all children in the learning process.

Findings in Table 7.8 Question 2 demonstrate that science teachers in all three schools created some 'energy' during teaching and learning to increase attention and recall. Classroom observations in School A provided evidence that Melissa addressed some science concepts with humour as well as suspense to increase students' attention. To liven up the classroom atmosphere, Susan asserted (interview) that she often gave students breaks related to the topic. In School B, when students had lost concentration in learning science, Shirley and Tiffany usually created ice breakers by giving an overview of life going forward or after graduating from school. Irene, on the other hand, asserted (interview) that she offered a fun game in the middle of teaching. Similar to Irene, classroom observations indicated that, in School C, Ann provided a fun application-based game namely KAHOOT to attract students' interest, while observation in Sarah's classroom indicated that she preferred to use simulation, and she asserted (interview) that simulations could be used for recall and to increase students' attention. Other tactics provided by science teachers in Schools A, B and C in motivating and engaging students are described in Table 7.9.

Another important finding revealed how the science teacher in School C built students' motivation and engagement. School C offered outside classroom activities such as outings/excursions at least once a month. An outing was designed in thematic learning and involved many subjects, including science. The Principal asserted the outing was a program that provided students with the opportunity to learn contextually and students felt happy to go on the outing. School C promoted integrated learning, which is a part of the Interdisciplinary unit programs (IDU), to construct communities of learners engaged in their common interests or activities. These programs were developed to create cooperative learning groups (including how to integrate and use what students had learnt in science lesson into community activities) with clear goals, roles, and responsibilities.

Table 7.9 Other approaches provided by science teachers in Schools A, B and C to build students' motivation and engagement

Approaches	School A (for students with HI)	School B (for students with VI)	School C (for students with LD)
To engage students' interest	• Showing videos. • Conducting simple experiments.	• Bringing real samples/goods of what the students would learn. • Giving a reward, such as point when student can answer a question correctly. Better reinforcement	• Giving a real-life application for a given science concept. • Providing everyday life examples that relate to the topic. • Showing a relevant video, simple experiment, simple simulation and computer simulation.
To increase their individual choice and autonomy	• Working with the area of student interest. • Pushing students to keep trying their best.	• Teaching students to read and write in a Braille format in special lesson. • Simplifying/streamline materials.	• Modifying worksheet and individual task based on students' capability. • Providing individual worksheets, projects and presentations.
To enhance relevance, value and authenticity	Varying activities and sources of information so that they could be personalised and contextualised to learners' lives		
To minimize threats and distractions	• Pairing student with hearing impairment with non-hearing-impaired student • Treating students with HI the same way. • Giving the same test to all students, although the teacher only marked based on the students with HI learning objectives.	• Providing a morning routine, such as Quran recitation. • Applying • A same question for summative test.	• Allowing students to take a break in the middle of session and asking them to read their book (except comic) for 15 minutes as a part of Literacy Skill Development. • Choosing easy questions for exercise. • Varying learning pace, giving students a short break when change for each session.

7.4 Theme 3: Assessing and Monitoring the Progress of Students with Disabilities Across Cases

Theme 3 reveals the findings on how science teachers in Schools A, B and C assessed SWD progress in knowledge, skill and affective development.

7.4.1 Measuring Knowledge Development Across Cases

Findings illustrated that all schools focused more on assessing the development of knowledge rather than skill and affective development. Table 7.10 demonstrates that School C had more effective ways of creating assessment to measure knowledge development than Schools A and B (see the median scores) and this was also confirmed by interviews.

Table 7.10 The ways of science teachers in creating assessment to measure knowledge development

When creating assessments that accurately measure knowledge development of SWD I …	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. create assessments straight from the learning objectives, even before outlining course content	3	4	3.5	2	3	2.5	5	4	4.5
2. use alternatives to the traditional quizzes and exams	3	4	3.5	5	3	4	4	4	4
3. give instruction on the assignments both in writing and verbally	5	5	5	4	4	4	5	5	5
4. create a grading rubric to ensure the objectivity when assessing	3	1	2	5	3	4	5	5	5
Overall central tendency (Median)	3.5			4			4.75		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

In School A, Melissa said she frequently created assessments straight from the learning objectives to make sure the lesson targets were achievable and that science lessons aligned with the goals (Table 7.10 Question 1). Susan said she always prepared a quiz for SWD before the science lesson took place. In School B, Shirley admitted that she planned the assessment form (paper and pencil-based tests or performance tests) for each section of material before the semester began but, for formative tests, she developed it incidentally when she was teaching. Tiffany asserted that she not only made the assessments based on the learning objectives, but also on how many learning objectives could be mastered in a single topic. In School C, based on the interview and questionnaire, Ann explained that she applied project-based assessment for the mid-test and differentiated the task, and she used an exam for the final-test.

Data confirmed that science teachers in School C used more variety in alternative assessments. In School A, Melissa (frequently) and Susan (sometimes) used alternatives to the traditional quizzes and exams (Table 7.10 Question 2), i.e. presentation and project-based assessment. Melissa stated (interview) that these assessments were used as an alternative when students with HI could not complete the quizzes and formative tests in written formats. In School B, although Tiffany stated she (always) and Shirley mentioned she (sometimes) provided alternative assessment, the interviews indicated that limited alternative assessments were offered, such as observing students' activities during the learning process. In School C, interviews revealed that Sarah applied practical, project, presentation and oral tests, while Ann preferred providing additional tasks at home and giving "surprise quizzes" before the assessment to measure the child's ability/understanding of the given material as an alternative form. Ann also utilised technology-based assessment, such as KAHOOT.it. and applied project-based assessment for the mid-test and made two different tests (for students with LD and regular students) in the final test.

Findings indicated that six science teachers across the three schools under investigation provided clear instruction when giving assignments, either in writing or orally (Table 7.10 Question 3). For students with HI, Melissa in School A asserted (interview) that instruction should be as clear as possible using lip-reading or in writing. For students with VI in School B, verbal instruction was the best way to give the instruction, teachers said. And for students with LD in School C, all teachers asserted (interviews) that they would repeat the instruction to ensure that those students with LD understood what they should do with their assignment.

Data revealed that not all science teacher participants provided a grading rubric to ensure objectivity when assessing SWD (Table 7.10 Questions 4). Another important finding based on the interview with science teachers in School A indicated that the same form of assessment was applied to all students, although teachers graded SWD differently based on their modified learning objectives. Science teachers in School C employed a scoring assessment checklist to track the progress of SWD.

7.4.2 Measuring Skill Development Across Cases

The second sub-theme describes science teachers' experience in assessing students' skill development. The techniques for capturing and monitoring SWD skills were by allowing SWD to submit assignments electronically, e.g. through social media in School A. In School B, Shirley and Tiffany preferred students with VI to submit their assignments in a Braille format rather than electronically. In School C Sarah mentioned that she offered students the freedom to choose the format in which tasks were submitted.

7.4.3 Measuring Affective Development Across Cases

Data indicated that science teachers in Schools A, B and C utilised various techniques to assess and monitor students' affective development in different ways and at levels of frequency. Schools A and B tended to have less intention to assess and monitor students' affective learning than School C (see the overall medians in Table 7.11).

Table 7.11 Various techniques offered by science teachers to assess and monitor students' affective development

What assessments do you use to monitor SWD's affective development?	Teachers Responses								
	School A			School B			School C		
	Susan	Melissa	Median	Tiffany	Shirley	Median	Ann	Sarah	Median
1. Have SWD explore the value and meaning of their learning experience for them selves	3	1	2	5	3	4	5	4	4.5
2. Have SWD explore the value and meaning of their learning experience for society	3	1	2	3	3	3	3	4	3.5
3. Utilise experiential learning activities (for example, a reflection paper) to explore improvement in the affective domain	3	1	2	1	1	1	5	4	4.5
Overall central tendency (Median)	2			3			4.5		
Note: Responses are assessed according to a Likert Scale 5-1 (5 = always, 4 = frequently, 3 = sometimes, 2 = rarely, 1 = never)									

In School A, Melissa asserted she never allowed students with HI to explore the value and meaning of learning science for themselves and their society (Table 7.11 Questions 1 and 2). Differently, Susan in her questionnaire and interview stated that she provided students with a reflective journal, a place to write down their daily reflection entries. Susan added, students could write something good or bad that happened to them and that they could self-reflect and learn from the past experience in this journal. Susan asserted that a student's journal helped her to monitor what happened with students related to learning activities. In School B, Shirley asserted she sometimes asked students about what values and meaning they saw in learning science (Table 7.11 Questions 1 and 2), while in School C, data from interview and questionnaire indicated that students were asked to reflect in SLC on what they had learned, what the added values were that they had learned, and what shortcomings they faced. School C also offered experiential learning and provided each student with a Student Organiser (SO) in which to write their reflections.

7.5 Theme 4: Other Factors that may Contribute to or Hinder the Way in which Science Teachers Create Science Classrooms that are Inclusive for All Across Cases

Theme 4 describes other factors that contribute to and hinder the inclusivity of science teaching and learning, including challenges and barriers to creating a science classroom inclusive for all.

7.5.1 The Understanding of Inclusive Education Across Cases

7.5.1.1 Students' perspectives towards science

Data showed that students in School A, Alex and Angie admitted that they enjoyed learning science. Nanda and Amy, students with VI in School B, asserted that they had a positive perspective towards science. They liked science, but Nanda preferred biology over physics, and Amy preferred physics over biology. The evidence from interviews with two students with LD in School C indicated that both students held different perspectives towards science. Felix responded negatively to science, while Ben showed a positive response. Ben asserted he liked science because it was easy, while Felix asserted that he did not like science because it contained arithmetic.

7.5.1.2 Students' views on inclusion

This sub-theme explores SWD's views on inclusion based on interviews with six SWD. Student from School A, Alex said an inclusive school was a school for those with special needs, while Angie had no idea about the inclusion or inclusive terms. Nanda and Amy in School B said inclusion meant acceptance for all students, including those who have disabilities. Amy added an inclusive school has a regular curriculum like other schools, while a special school has a lower level in term of curriculum. Felix and Ben, students with LD from School C, asserted that they knew the meaning of inclusion but that it was hard to explain.

7.5.1.3 Teachers' view on inclusion

Data from the interviews confirmed teachers had similar opinions about inclusion. Most of them mentioned that inclusion is welcoming SWD in a regular classroom. Others added the definition of inclusion as: teaching with heart (Lilly), letting SWD have a normal life (Melissa), "diverse, varied and survive" (Ann), a diversity (Sarah and Linda), a negotiation and a home for every student (Donna). Susan, however, asserted she did not know the definition of inclusion but realised she was teaching inclusive classes. Lilly and Melissa asserted that most teachers in School A already knew the meaning of inclusive and what needed to be done when they welcomed SWD. Lilly added that if any discrimination occurred, it worked to benefit the SWD. All these participants agreed that their school was inclusive, even though they had not measured its inclusivity and did not know how to measure it.

Another important finding mentioned by Julie, the support teacher from School A, in her interview, was that a special school was important for students with special needs as a stepping stone and preparation for them to enter an inclusive school, because the inclusive school could be hard for them. Especially for students with HI, Julie said they would not face difficulty with language if they were first schooled in a special school, to be trained to lip-read. Julie also emphasised that an inclusive school could not necessarily accept all SWD, but it could welcome students having an intelligence in the average and above average range but not the below average range.

7.5.2 Support Teacher Roles and Collaborative Work with Science Teachers Across Cases

Schools A, B and C were provided with one support teacher each who collaborated with the science teachers in different ways and at different levels. The support teachers in Schools A and C had a special education background, while the support teacher in School B had a science education background. Table 7.12 shows the support teacher roles in each school and how they collaborated with the science teacher.

Table 7.12 Support teacher roles across cases

<table>
<tr><th>Support teacher roles</th><th>School A</th><th>School B</th><th>School C</th></tr>
<tr><td>Planning</td><td>• No collaboration between support teacher and science teacher in planning instruction.
• The collaboration was made in the way support teacher advised in choosing appropriate teaching strategies for SWD in informal discussion.</td><td rowspan="3">No collaboration was made between support teacher and science teachers or among science teachers. They worked independently to provide science learning for students with VI.</td><td>Collaboration between support teacher and science teacher was made in planning instruction though weekly meetings each Friday.</td></tr>
<tr><td>Instruction</td><td>• Support teacher did not always come to work with students with HI in their classroom.
• Support teacher assisted science teacher in delivering materials to SWD by one-on-one method.</td><td>Support teacher worked with SWD when requested.</td></tr>
<tr><td>Assessing</td><td>Support teacher sometimes offered assistance to SWD in doing exams or assignments.</td><td>Support teacher worked with SWD in doing their exams and assignments.</td></tr>
</table>

7.5.3 Teacher Training and Support Across Cases

Interviews indicated Schools A, B and C provided training and support for science teacher development, especially training for the inclusive classroom. Although School A provided some training and support for teachers who catered to SWD, Melissa asserted that she still found difficulties in implementing the inclusive classroom. As School B was not provided with a teacher who had a special education background, the principal of this school asserted he always sent the teachers for training and workshops to develop their skills in catering to SWD. Similarly, School C provided training and workshops for teachers who catered for SWD even though science teachers in this school pointed out that the training and workshops provided were not adequate in supporting them to teach SWD. School C also had a CSIE which organised training and development programs for teachers.

7.5.4 Physical Building Access Across Cases

Observations of the physical buildings in Schools A, B and C showed that Schools A and C were accessible for SWD, including for visually impaired people and wheelchair users, but School B was not fully accessible because it had a second floor with no lift provided. Another important finding was School A had a special designated room, namely the 'inclusion room', a place for the support teacher to teach SWD. This room had been divided into two rooms, one for the support teacher's office and the other room equipped with roundtable and media for teaching SWD. The support teacher would take a student with a disability out of the regular class to the inclusion room for special assistance or additional lessons.

7.5.5 Parents' Involvement Across Cases

Findings from the interviews confirmed that each school involved parents in promoting systems of inclusive education in different ways and at different levels. In School A, every semester, parents were invited to attend the semester meeting and discuss any issues related to their child's development, including a program for parents on how to manage children with disabilities. In School B, parents were invited to attend the annual meeting although only a few of them attended and gave the responsibility for their children to the school. In School C, a place to gather parents, students and teachers was the SLC, held twice each semester, in which parents were invited to see children's performance and reflect on what their children had learned. Parents of students in School C were also invited to general meetings, as described earlier. Another finding indicated that parents of SWD in Schools A and C were often over-involved in the science teaching and learning, for instance by doing their children's homework and tasks.

7.5.6 Policy and Supportive Program Across Cases

Analysis from the interviews indicated that all participants asserted their school offered a supportive policy, culture and structure to promote an inclusive environment. In Schools A and B, all students with various conditions would be accepted without exception to be educated in these schools, but in School C prospective students would only be catered for if their parents had a similar vision and mission as that of the School. Each school also applied a policy that every student was promoted to the next grade and allowed to graduate with their peers although they might not have adequate knowledge and skills. School A had a special Division of Inclusive Education, which worked to produce policies to support the inclusive education program, such as running diagnostic tests for SWD, training in lip-reading for students with HI, offering sport and art programs for SWD; collaborating with the support teacher in academic areas for SWD. As an SPIE that basically served students with VI, School B ran special programs, i.e. Reading and Writing Braille, DLA, OM, Massage and Reflexology and Quran Recitation. School C had many supporting programs (Appendix 10) that embedded inclusive and multicultural philosophies. School C also provided a Centre for Studies on Inclusive Education (CSIE), for literature or references, research, publications, and training in the field of inclusive and multicultural education.

Lilly admitted that School A had a special program for SWD which involved the community. She said every semester the SWD were invited to join a community program, such as a study tour to a certain site, and they were asked to learn something that had been set by the inclusion program. In addition, the community centre sometimes had been invited to the school to give a small talk to motivate SWD. Besides, this school invited alumni who had graduated from the school and had been successful to share a success story with their junior peers.

7.5.7 Challenges and Barriers in Creating Science Inclusive Classrooms Across Cases

Data confirmed that all teacher participants asserted that they still faced challenges and barriers in promoting and implementing an inclusive system. Table 7.13 documents the challenges and barriers identified by the participating teachers in each school.

Table 7.13 Challenges and barriers faced by science teachers in implementing an inclusive system

Challenges/barriers	School A	School B	School C
SWD ability and behaviour	• Handling students with HI or deaf who had language barriers was difficult, in terms of how to best communicate with them. • Hard to build self-confidence of SWD. • Some teachers have no idea about inclusion and how to handle SWD.	• Handling students with VI and slow learners is difficult. • Students with VI sometimes are moody and hard to supervise. • Difficult to deliver materials to students who have low cognitive ability.	• Students with LD mostly have less motivation and sometimes moody. • Hard to tackle student who has tantrums and is temperamental. • The range ability of students and the types of disabilities make it harder to choose appropriate learning approach.
Support	• No special media for students with HI. • Only has one support teacher and only on Fridays and Saturdays	• Learning media for students with VI is limited. • Practical for students with VI cannot be conducted. • No support teacher for science.	• Limited support teacher. • Administrative workload is huge. • Making varied tests needs an effort and takes time.
Inclusive climate	Building the social acceptance of disabled students with their non-disabled peers.	Parents are not involved in creating an inclusive culture (at home).	Parents do not understand their children and do not always fully accept their child's condition.
Policy	• Gap between policies on inclusion and implementation. • Workshop and training sometimes limited to the inclusion board members.	Trainings for maintaining inclusive classroom are limited.	

7.6 Summary

Findings indicated that the majority of science teacher participants held low expectations towards SWD. Only one science teacher in School C asserted she held the view that high expectations towards students with a LD were essential for them to make learning more engaging in science. Science teachers in Schools A, B and C reframed the standards as learning objectives in similar ways by breaking-down the standards into learning objectives and applying a Revised Bloom's Taxonomy when creating learning objectives. Adjustment to learning objectives for SWD was made by science teachers in Schools A and C by considering the students' ability and their cognitive levels then down-grading the general learning objectives, whereas science teachers in School B preferred established learning objectives for students with VI at a lower cognitive level. Findings also reveal that each science teacher in all three schools utilised the learning objectives as a guide to plan and create instruction and assessment. Findings indicate Schools A and C applied different Criteria for Minimum Passing Grades (KKM) for SWD, which meant a lower standard was applied to them; whereas in School B, KKM were set in typical ways as suggested by the Dikpora.

Findings demonstrated each science teacher had similar strategies but at different levels and degrees in the way they practised pedagogies to support recognition learning for SWD. Each science teacher: linked prior knowledge to new information in the form of apperception, either by reminding about previous lessons or showing real examples from daily life; demonstrated various examples to gain students' understanding of science; highlighted and emphasised essential science concepts; and offered a variety of learning media and formats depending on the student's disability type. Although no special learning media were provided for students with HI in School A, science teachers offered various ways of presenting science materials and emphasised visual aids and lip-reading to convey the materials. Science teachers in School B used mobile phones as media for learning and e-book formats, whereas Braille and tactile media were not often offered. School C, on the other hand, was more concerned with digital technology as learning media, with one science teacher utilising a computer for science concept simulation, while another provided web-based games such as KAHOOT to make learning more fun.

With regard to supporting strategic (skill) learning for SWD, science teachers in Schools A, B and C demonstrated various ways to different degrees. To build science process skills, science teachers presented an advanced organiser in the lesson's introduction by expressing how relevant and essential questions related to the topic would be learned. Each science teacher asserted they tried to get SWD to take part actively in the lesson by applying student-centred learning approaches, except science teachers in School B who preferred the lecturing method as the most appropriate way to teach students with VI, asserting they used this method as students tended to be passive learners. SWD in three SPIE were offered very limited practical activities in the laboratory. Findings indicated that to help

SWD interact and respond to the science materials and learning activities, science teachers in School A optimised visual aids and lip-reading; science teachers in School B utilised screen readers installed in their mobile phones; while science teachers in School C used individual worksheets which were designed based on individuals' needs. Flexible opportunities to demonstrate SWD comprehension were offered by each science teacher, such as brief reports, oral presentations and projects. Another assistance offered by science teachers to help students enhance their science skills was by providing opportunities to practise with supports in the form of additional time to complete the task and peer tutoring activities. Another instance was science teachers in Schools A and B offering after-school lessons. Findings also revealed that each science teacher provided clear, informative and in-time feedback to help SWD reflect on what they had and had not understood.

Findings highlighted that science teachers in Schools A, B and C practised pedagogies to help SWD in affective learning. Challenges were offered by all science teacher participants in the form of difficult questions, to increase students' motivation to learn science. Students also were provided with few choices of content and tools. In School A, a science teacher offered a summary of each lesson and printed captions when videos that were shown to students had no subtitles. In School B, science teachers utilised the WA chatting application as the best tool to help students with VI access the materials. Science teachers in School C preferred digital and computerised technology as tools to enhance the choice of learning. Findings demonstrated that each science teacher tried to create a comfortable and relaxed atmosphere; provide additional time for private consultation; utilise WA for media communication; and offer individual approaches and assistance.

In term of assessment, findings showed that science teachers in these schools monitored students' knowledge development more frequently than their skill and affective developments. Schools A and B mostly applied paper and pencil-based tests, while School C utilised more alternative testing, such as project-based tests. To monitor strategic learning progress, each science teacher in the three schools offered that SWD could submit their assignments electronically, except one teacher in School B who preferred Braille format. For affective learning, science teachers in School C offered more assessment techniques than did those in Schools A or B.

The valuable findings in regard to other factors contributing to the creation of science classrooms inclusive for all were that all participants had positive views towards inclusive education. Most participants asserted that their school was inclusive because it accepted and welcomed SWD to be educated alongside their peers, except in School A where SWD were taught separately in a designated inclusion room.

Collaborative work between science and support teachers was limited in certain activities. In School A, the collaborative work was in the form of a discussion about the best strategy to teach students with certain disabilities and assisting students with HI in examinations. In School B almost no collaborative work was undertaken. In School C, collaborative work between science teachers and support teacher was made at the planning, instruction and assessment stages. Limited training and development programs were offered for science teachers in all schools to develop their competencies in inclusive teaching.

In terms of buildings and physical facilities, Schools A and C were accessible for SWD but not fully accessible in School B. Parents were involved with high intensity in School C, medium intensity in School A, and there was almost no involvement between School B and students' parents.

Last, findings also indicated that each science teacher faced challenges and barriers to promoting science inclusive practices for all, i.e. how to deal with student differences; create an inclusive climate among the school's members; the mismatch between government policy and its implementation, including the national examination policy affecting SWD; and dealing with parents who did not fully understand their child's condition.

Chapter 8
Discussion and Interpretation of Findings

This study aimed to investigate how science teachers create inclusivity in science teaching and learning in three Schools Providing Inclusive Education (SPIE) in the Province of Daerah Istimewa (DI) Yogyakarta Indonesia. Investigating the science teachers' experiences in creating inclusivity for students with disabilities (SWD) revealed insights about how to expand knowledge of inclusive science teaching for SWD, including what challenges and barriers should be addressed.

In this chapter, the major insights that have arisen from the cross-case analysis of the findings from each of the three case studies are discussed with reference to current literature. The cross-case analysis in Chapter 7 indicates science teachers in Schools A, B and C provided various approaches which they believed were inclusive, to different degrees and with different intentions in creating science teaching and learning. The descriptive findings indicate science teachers teaching students with hearing impairment (HI) in School A applied an integrating model, science teachers teaching students with visual impairment (VI) in School B operated a segregation model, while science teachers teaching students with learning difficulties (LD) in School C employed a model that was more inclusive than that operating in the other two schools.

This Chapter provides a more detailed discussion of the four major findings: setting goals for SWD, practising pedagogy for a specific disability, monitoring and assessing SWD's learning progress, and other factors contributing to and hindering the inclusivity of science teaching and learning practices.

8.1 Research Question 1: Goal-setting for Students with Disabilities

Data analyses from the first research question indicated science teacher participants had an inexperienced way of goal-setting for SWD. Little evidence was found that showed how science teachers defined SWD's learning needs, created specific learning goals, prepared and implemented effective pedagogy, monitored SWD's progress and determined whether SWD achieved those goals (Bakar et al., 2014) in the goal-setting process. SWD's learning needs were identified through limited personal conversations with students and parents.

Individual aspects of SWD (e.g. their abilities and disabilities) were not fully taken into consideration when setting expectations and learning objectives required for achieving inclusivity. The teachers set lower expectations and learning objectives for SWD, resulting in science goals that could be described as exclusive. Learning objectives that were determined from the content standards (SK and KI)[15] did not allow SWD to fully access the general science curriculum alongside their peers without disabilities.

Overall, this finding may suggest that to ensure the general science curriculum should and can be accessed completely by all students including SWD, the first step is to set goals that are inclusive and appropriate on an individual basis, otherwise access is limited.

8.1.1 Establishing Expectations for Students with Disabilities

Teachers and principals in the three schools studied had similar expectations towards SWD, which they believed could facilitate students' social development and enable them to live better in society. The participants viewed non-academic development more highly than academic development. This finding suggests that SWD were seen in exclusive ways, of being potential burdens on society, which was why the participants emphasised the need for SWD to develop in social and behavioural ways rather than emphasising the benefits of attaining high levels of science learning. This finding echoes the Cameron and Cook (2013) study that reported that expectations for students with (mild) disabilities focused on behaviour skills, self-confidence and academic performance, while students with (severe) disabilities were expected to improve their social development.

Meeting science learning expectations is a challenge for most students and teachers (Brigham et al., 2011) and even more of a challenge for SWD, as was admitted by each science teacher in this study. Generally SWD in the three SPIE were expected to have a very basic level of understanding of science concepts, including basic arithmetic. In other words, science teachers in this study held low expectations towards SWD, with the exception of one teacher teaching students with LD. Another teacher who was teaching students with HI stated she would hold high expectations for SWD who operated at the middle–upper cognitive level. The science teachers' practices in lowering their expectations

[15] SK (or *Standar Kompetensi* = Standard Competency) and KI (or *Kompetensi Inti* = Core Competency) are the types of the content standards in Indonesian curriculum

towards SWD influenced their teaching strategies to being less than optimal and affected their attitudes towards SWD in less positive ways. Some research literature has alleged that when expectations towards SWD increase, teachers' beliefs, attitudes and practices will change. de Boer et al. (2018) explained that teachers with high expectations apply more effective teaching practices; and that these teachers offer guidance in learning, provide more feedback and more time to assist students, and provide a positive and warm environment to manage student behaviour. When SWD are given more advanced opportunities to learn, they can make more progress.

By setting lower expectations, science teachers in the three SPIE tended to make inaccurate predictions and exhibit biased expectations of SWD's ability to learn science. This behaviour indicated that the science teachers believed SWD could not be expected to perform at the same level in the academic arena as their peers without disabilities. It also implied that science teachers had applied very minimal analytical activity in getting to know their SWD well and in ascertaining what the SWD's academic potential and abilities really were. In this study, SWD were seen as being a homogeneous group, all of whom had lower abilities in science, which can only be interpreted to mean that, in the main, the science teachers in this study held biased perspectives. According to Timmermans et al. (2015), biased expectations are created by systematic differences between teacher expectations (expectations of students too high or too low) and students' prior achievements, which can lead to inaccurate determinations.

The science teacher participants held low expectations towards SWD because they assumed that SWD had low levels of cognitive development resulting from their disabilities; which was a biased perspective. Most believed that having a disability was an obstacle to students optimising the cognitive functions required for achieving high academic performance in science. This finding supports the study by Rubie-Davies (2009) who stated that teachers can be biased or prejudiced towards or against SWD and can tend to stereotype them; which was also in evidence in the three SPIE. Peterson et al. (2016) referred to "prejudiced attitudes" (p. 124) which are very close to discrimination; that is, treating a person unfairly because of who he or she is or because he or she possesses particular characteristics. Further, according to Timmermans et al. (2018), stereotyping behaviour towards SWD will have negative effects on students' outcomes. Science teacher participants also admitted that the learning achievement of SWD was lower than their peers. Consequently, it may be inferred that this could have been due in part to low expectations being applied to SWD, as well as teacher participants having a less inclusive understanding of SWD.

A substantial body of literature confirms that teacher expectations can have positive or negative effects on students' performances (Dabach et al., 2018). That view is substantiated by this present study that found that lowering expectations for SWD resulted in lower student achievement. Some scholars (Hornstra et al., 2018; Peterson et al., 2016; Rubie-Davies, 2009) would agree with this current finding, propounding that when science teachers set lower expectations for SWD, they are likely to reduce opportunities for them to learn to their maximum capacity. Teachers with low expectations for students' achievement tend to present experiences that are less cognitively demanding, accept lower work standards and spend more time repeating and reinforcing information.

Findings of this current study clearly show that expectations for SWD were lower than those for their peers, which affected their achievement in science, and those less cognitively demanding learning experiences were reflected in the science teaching and learning processes in all cases in this study. In addition, it can be reasonably assumed that the Peterson et al.'s(2016) assertion that middle school students were able to detect teachers having high or low expectations of them, based on the teachers' language and verbal cues during their interactions with them, can be applied in this study. Consequently, it is reasonable to assume that the lower expectations for SWD in this study influenced the learning performance of SWD attending SPIE in Indonesia and indicate that inclusive practices were not being fully implemented.

8.1.2 Reframing Standards as Learning Objectives for Students with Disabilities

Findings indicate that the science teacher participants in the three SPIE had similar ways of reframing the content standards into learning objectives (i.e. cognitive, psychomotor and affective). However, the science teachers were, in the main, inexperienced in unpacking the processes required for reframing the standards to the most appropriate learning objectives for SWD, with the result that the students were unable to fully access the science general curriculum. While the study by Soukup et al. (2007) found there were very limited studies on how SWD accessed the general curriculum, the findings of this study mirror the research by Halle and Dymond (2008-2009); Roach et al. (2009); Ryndak et al. (2008-2009); Spooner et al. (2006), all of whom argued that access to the general curriculum was limited for SWD. Roach et al. (2009) highlighted that SWD "need access to the instruction provided in general education classrooms with accommodations and/or modifications that will allow them to progress towards grade-level content and achievement standards" (p. 520). In addition, the findings from the three schools under investigation reveal that minimum appropriate adaptations were made by science teachers, especially in schools that were educating students with HI and VI. In support of this finding, Ryndak et al. (2008-2009) suggested that researchers, administrators, policymakers and stakeholders must develop and hold a common understanding about the construct of access to the general curriculum, and that for all students in the general education context, "general education classes, school settings, classmates, teachers, instructional and non-instructional activities and materials, and interactions during those activities" (p. 202) are critical to accessing the general curriculum.

8.1.2.1 Writing learning objectives

The analyses of science teachers' lesson plans revealed that learning objectives determined from the standards were clear and specific, although the interviews indicated that the objectives provided were not always set by the teachers themselves but were taken from other lesson plans offered in open sources, such as textbooks, open websites, or the Science Teachers Working Group (or *Musyawarah Guru Mata Pelajaran*/MGMP). The ways science teachers in this study approached the creation of learning objectives implied that they did not fully understand the teaching and learning processes they carried out and they were not fully aware of the relationships between learning outcomes, planning and the delivery of educational activities. One teacher who was teaching students with LD even commented (interview) that establishing learning objectives or creating lesson plans was less important than the teaching process itself which teachers should flexibly adapt to certain situations when they taught SWD. Her comment could suggest that some science teachers were not necessarily goal-directed and they established goals only for administrative purposes.

The finding of this study implies that when science teachers determine clear and specific learning objectives (e.g. using action words properly) for the SWD in their science classes, it will facilitate the selection of strategies that enable the achievement of the objectives. The Hughes (2017) study agreed, explaining that teachers need to choose action words carefully, as good objectives contain a specific verb and avoid unclear terms such as "understand the meaning of" (p. 615). A specific action verb stated in the learning objectives would also correspond to the most appropriate assessment techniques to capture students' knowledge and skills (Adams, 2015).

The analysis of lesson plans revealed that science teachers in the three SPIE in this study were more concerned with identifying cognitive goals rather than psychomotor and affective goals. This generally happens with the majority of science teachers in Indonesia because the end goal of learning science is for students to pass the National Examination (or *Ujian Nasional*/UN) which places more emphasis on cognitive learning. In addition, the content standards of the Indonesian science curriculum have a larger portion of cognitive aspects than psychomotor and affective ones. Moreover, the science teachers also had difficulty setting psychomotor and affective learning goals. One teacher, for example, stated that the goals for affective learning were the responsibility of the religion teacher or the civics education teacher.

This study found that some science teacher participants categorised learning objectives into essential and non-essential groups. The essential objectives were depicted as statements that were derived from the standards which described significant and important learning that students had achieved and could reliably be demonstrated at the end of a course, while non-essential objectives were described as achievement in additional aspects of the grade levels. Classifying objectives into these two groups is important to assist SWD in reaching the more essential objectives. In the Indonesian context, essential learning objectives are defined as learning targets that are closely linked to the Graduate Competency Standard (SKL) and National Examination (*Ujian Nasional*/UN). Interviews revealed that when some science teachers taught students at Grade 9, they would focus on reaching the essential learning objectives that led to the UN.

The analysis of the questionnaires illustrated that the way science teachers in the three SPIE established learning objectives was by using the ABCD and/or SMART strategies. The ABCD strategy is recommended by the government and commonly used by Indonesian teachers, as noted by Uno (2010) and Zulkarnaen et al. (2016), whereas the SMART strategy is not commonly applied in Indonesia. Although in the questionnaire teachers asserted that they had applied the SMART strategy, contradictory information obtained in the interviews indicated that they had not really understood this strategy.

Nevertheless, Jung (2007) recommended that the SMART strategy was useful for planning learning that supported SWD. Therefore, this finding suggests teachers should consider the SMART strategy in helping them identify the learning intentions and success criteria for individuals with disabilities, which would reflect an inclusive teaching approach.

8.1.2.2 Aligning learning objectives with teaching methods and assessment

Science teachers in this study were unskilled in setting objectives that offered a range of learning options that would enable SWD to achieve their goals. These science teachers established content-based objectives that were narrowly linked to their teaching methods and assessments. Rose et al. (2002) declared that, theoretically, when objectives are too closely linked to methods, the logical result is that some students face obstacles that prevent them from working towards these goals, whereas others do not have an adequate level of challenge. Therefore, stating individual measurable and achievable learning objectives is important because students function at different levels. In other words, some students do not benefit from, let alone participate in, learning because these goals may be too high for them and too low for others. In summary, when objectives are too highly specified, they will limit the possible ways to achieve the learning objectives and will restrain the number of students who can even try to achieve them. Following a goal-based plan (rather than a content-based plan) helps to lessen the impact of dynamic external influences. Further, goal-based planning offers learning activities and assessments that provide choices and multiple teaching methods.

This study confirms that learning objectives were used as a basis for selecting teaching methods and assessments. Science teachers tried to link the objectives and put in place plans to achieve these objectives in the teaching and assessment methods selected. However, these did not always give SWD optimum instructional support. Aligning teaching methods and assessments with course expectations is much easier when the teacher has written objectives that can be measured from the start. Measurable learning objectives also enable teachers to design effective learning opportunities and appropriate assessment tasks. Anderman and Anderman (2009) noted that when science teachers establish measurable and achievable learning objectives, it helps students to understand when they need to adjust and/or modify their ways to achieve their goals and learning outcomes.

8.1.2.3 Accommodating students with disabilities' needs when setting learning objectives

Some science teachers in this study asserted that they accommodated SWD's learning needs when they reframed learning objectives from the standards. These teachers conducted personal learning conversations with both SWD and parents where they discussed what students needed in order to be successful in science lessons. These conversations were used to determine what best plan of action was required to achieve the learning objectives and to help the teacher provide learning strategies that matched the needs of the SWD. Discussions between science teachers, support teacher, parents and students were also carried out in order to work together to make the right decisions and develop appropriate strategies to address the difficulties faced by students with LD. Although personal accommodations for each SWD were offered, these were not adequate to support them in the science classroom and did not result in inclusivity. The use of appropriate adjustments and accommodations to meet students' learning needs can, however, boost SWD's motivation to learn science.

Learning objectives for SWD were communicated throughout the science classes in two of the three schools studied to assist SWD and remind them what they would achieve by the end of lesson. This finding implies that science teachers are aware that communicating learning objectives to students is important. It helps students to stay focused on what the end of the learning journey is, why it is important, how to achieve it and whether they might need assistance during the journey (Dean et al., 2012). In addition, the study by Reed (2015) found that having unclear objectives more often leads students to not focusing when responding, being more hesitant, using less advanced language, and engaging in learning for only a short time.

8.1.3 Modifying Learning Objectives for Students with Disabilities

The learning objectives for SWD were modified in two ways: by down-grading the standards and by focusing on the student's ability and cognitive level. Down-grading the standards or lowering expectations was discussed in Section 8.1.1, *Establishing Expectations for Students with Disabilities*.

Establishing SWD's ability and cognitive level was based on the student's initial assessment. To determine the SWD's ability and level of cognition, two schools ran diagnostic tests (e.g. literacy and numeracy tests) before the semester began and used the test results as a foundation to modify the learning objectives. The modified learning objectives were designed to provide organisational scaffolding for the SWD to help them understand the perspective being taken by the teacher.

To modify the objectives, a science teacher must know the range of abilities of students in the class and plan success for each student, which was not clearly shown in the three schools studied. Blackburn and Witzel (2014) stated that teacher understanding of a student's strengths and weaknesses as a learner is important in order to set their individual learning goals. Although all students will attend the same lesson, not all students will learn the same facts with the same level of complexity at the same pace. Simon and Taylor (2009) in their study found that students felt relaxed and appreciative when their teachers provided clear direction about how to focus their efforts, organise their learning, review facts and prepare for exams, and keep their lecture preparation on track. Modified learning goals are important because a teacher should employ strategies that are not intended to track students, "dumb down" the lesson, or lower expectations about what students can achieve (Orkwis & Mason, 2005, pp. 54-55).

Providing options and choices are positive moves but, at the end of the school year, the same standards (KI and KD) should be met by all students. In the Indonesian context, all students regardless of their ability or disability should achieve the Graduate Competency Standards (SKL) to graduate. Science teachers asserted (interviews) that, although they were working to establish goals that were more personalised and that matched with student's individual needs, in the end the outcome must be that students in Grade 9 pass the National Examination (UN). Therefore, science teacher participants in this study were more focused on enabling all students (including SWD) to pass the UN, and direct teaching methods such as drilling were in evidence. Contrary to this finding, the UDL suggests that to promote students becoming 'experts' about their own learning, teachers should support the students' learning journey through experiences and challenges that encourage them to communicate their learning needs and preferences and that involve them in designing better learning settings (Meyer et al., 2014).

8.1.4 Creating Minimum Criteria for the Passing Grade for Students with Disabilities

The minimum criteria for the passing grade (KKM) in schools teaching students with HI and LD were set differently for SWD and for 'regular students'. This strategy is not inclusive. Inclusion in terms of grading is not synonymous with lowering the passing grade for SWD. Willis (2007) advanced the idea of encouraging students to achieve to their own highest level of success in supportive classrooms and advocated for the success of all students. Science teachers in this study, however, set lower expectations for SWD and believed SWD could not achieve the standard grades expected of their peers.

8.2 Research Question 2: Pedagogical Practices for Students with Disabilities

The second research question sought the participants' views about pedagogical practices for including SWD in science teaching and learning within the framework of the UDL. Findings reveal that while science teachers in three SPIE practised good and effective teaching strategies, it was clear that they were not actually engaging SWD in an inclusive manner and while they were focusing on maximising the learning experiences for them, they were not enabling them to access and fully participate in learning alongside their similar aged peers. Inclusive teaching meets the diverse learners and their fluctuating needs and styles (Chester, 2011; Grace & Gravestock, 2009; Shaeffer, 2015). Science teacher participants in this study, while they modified expectations by downgrading them and employed some accommodations and adjustments and set learning goals for SWD, were constrained by Government Standards and did not fully enable differentiated instruction and inclusive teaching approaches that met the needs of diverse learners. Research in neuroscience, multiple intelligences, learning styles and differentiated instruction clearly confirms that there are no so-called 'regular' learners, as was also shown in this study. Each individual learner is unique, therefore scholars (Gargiulo & Metcalf, 2015, p. 25; Westwood, 2018, p. 60) agree that no one teaching strategy, curriculum content or set of objectives fits all or matches the learning characteristics of each student. These scholars believe strongly that every student learns in different ways and may perform differently in diverse environments.

This study suggests that science teachers should carefully select pedagogical approaches that are inclusive of SWD, recognise individual learning styles, and differentiate instruction in building students' knowledge, skills, motivation and engagement in science.

8.2.1 Supporting Recognition Learning to Build Students with Disabilities' Knowledge

Science teachers in the studied schools had similar ways of practising pedagogy to support recognition (cognitive) learning, although it was practised to different degrees and with different intentions. This study illustrates that to build SWD's knowledge, science teachers adopted good teaching strategies although science materials were presented with limited accommodations and adjustments to cater to the diverse needs of SWD. As students with differing abilities use different techniques to acquire and process sensory information and access learning materials, teachers need to provide information and these materials in multiple ways to meet the needs of all students. A study by Opfermann et al. (2017) found that presenting materials in multiple representations assisted learners "to foster learning, because in contrast to learning with single representations" (p. 18), multiple representations deal with different sensory difficulties and enable each student to access learning and build their knowledge. Clearly, the findings of this study indicate that more particular inclusive teaching strategies and multiple representations are needed to support students with specific disabilities. Building knowledge for SWD is essential to help them become resourceful and knowledgeable learners.

8.2.1.1 Activating background knowledge

Science teachers activated background knowledge to support recognition learning which, according to Rose et al. (2002), meant that they applied a top-down recognition process—building background knowledge and tying prior learned material to new ideas and concepts. In the Indonesian context, this is called an apperception: an introductory teaching approach to present information that helps students prepare for the lesson by building on prior knowledge and giving students a better idea of what the lesson they are to learn will be about. Science teacher participants asserted that activating background knowledge was aimed at digging out the knowledge that was already known by the students and linking it to the material they would learn. This belief corresponds with the findings of the studies by Hattan et al. (2015) and Förster and Liberman (2007) which concluded that the process of activating prior knowledge included pulling from memory what students already knew about an experience, a thought or the topic at hand. Prior knowledge can influence the brain in processing new information through building on a previous example or experience. Prior knowledge is also claimed to be one of the most important prerequisites for learning (Gurlitt & Renkl, 2009). Assessing prior knowledge also helps teachers to identify difficulties faced by students in their learning process (Hailikari et al., 2008) and underpins the construction of new knowledge (Strangman et al., 2004).

Students are diverse and some may have more prior knowledge, interests and learning experiences relevant to the topic at hand than others (Matthews et al., 2015). One teacher participant in this study, however, indicated some concern for SWD suggesting that some present with minimal relevant prior knowledge of science concepts due to their lack of scientific experiences. This comment suggests some misunderstanding of the abilities of SWD in accessing the general curriculum. This misunderstanding was discussed in the King-Sears (2008) study about access to the general curriculum for SWD. King-Sears concluded SWD "can learn more than they have previously had the opportunity to learn [from] the general education curriculum, and [that] their learning increases when the pace, focus and format of instruction is responsive to their learning needs" (p. 61). Therefore, activating and building on students' prior knowledge is critical and advantageous for all students (Pacheco et al., 2008), including SWD. Science teachers should be made more aware about the need to seek out the appropriate background knowledge held by SWD that enables success in science.

8.2.1.2 Providing real-life examples

Having established students' background knowledge, science teacher participants in the three SPIE presented new information in several ways by connecting the content to real examples. Some teachers used real examples to teach particular science concepts to SWD, such as mentioning urine to explain excretion, showing a video of global warming, bringing in a container of polluted water and fish to be observed, giving students tactile experiences of different types of roots and leaves, thus assisting them to acquire new knowledge based on existing understandings. This approach resonates with the findings presented in a study by Renkl (2014) that stated: "[l]earning from examples is a very effective means of initial cognitive skill acquisition" (p. 1).

It was a finding of this study that each science teacher did employ daily life examples in different forms of representation that were appropriate for and of benefit to SWD, and that real examples suited to a specific disability increased the student's participation in the science lesson.

Providing students with the opportunity to interact more directly with real science objects related to their topics facilitates a more streamlined medium for communicating with them. The Oliveira and Brown (2016) study acknowledged that providing concrete examples increased the effectiveness of science teaching and noted that interacting directly with real science objects affords a medium of communication in addition to assisting other functions in the teaching and learning setting. Consequently, it can be argued that providing real scientific examples is advantageous for SWD, as was in evidence in this study.

Drawing on the responses of the science teachers, real and concrete resources are viewed as essential for teaching and learning in order for SWD to gain understanding of abstract science concepts, especially when introducing specific science terms that require simplification and clarification of their meanings. Concrete examples, according to these participants, helped them to teach abstract concepts that were sometimes hard to explain to SWD. Oliveira and Brown (2016) agreed, stating that giving concrete examples was important when teaching concepts in science because they helped teachers illustrate, clarify or develop a particular science concept or discuss natural phenomena, thus encouraging learning and making science concepts more meaningful. This finding is also in line with studies of Finn et al. (2018); Rawson and Dunlosky (2016); Rawson et al. (2014); Zamary and Rawson (2018) who stated that using real examples was beneficial for students in gaining understanding about abstract concepts. Hence, it might be inferred that the use of real examples can promote inclusive teaching.

8.2.1.3 Highlighting critical features

Science teachers highlighted critical features in the design and delivery of their science lessons. These lesson features involved an introduction, the main body of instruction, and the closing session, which were presented in both verbal and pictorial ways. New concepts were introduced clearly and important concepts were reiterated. The teachers argued that highlighting critical features in a lesson helped SWD to stay focused on the important science concepts needed for understanding. This finding is consistent with research by

Boyle and Scanlon (2010); Rose et al. (2002). According to Boyle and Scanlon (2010), teachers can demonstrate a simple version of the concepts and use written cues to help students distinguish important concepts, whereas Rose et al. (2002) emphasised teachers needed to highlight the critical features of the lesson to make teaching and learning processes easier in guiding students to learn.

8.2.1.4 Providing multiple instructional media and formats

Science teachers studied used limited media and formats to make individualisation work for SWD. No media were specifically designed for students with HI. Braille and tactile science media for students with VI were limited. Worksheets were the primary format media used for students with LD. In contrast, the research literature highlighted that individuals learn information through different techniques and learning media (Pashler et al., 2008) and that each learner has different abilities to process sensory information (visual, aural, olfactory or tactile patterns) (Rose et al., 2002). Each SWD has a specific disability which requires the use of specific learning media in specific formats. With regard to this point, the science teachers in this study lacked awareness about the use of different media formats when designing and selecting instructional media for SWD, and they were provided with minimal assistance from support teachers.

Although science teacher participants were aware that vision was the primary modality for receiving information by students with HI, and the teachers provided visual media that could be accessed by all students, there were no special media provided to students with HI outside those available to all students. Data analysis indicated that the media used were not fully sufficient in supporting students with HI to learn science. Two science teachers of students with HI indicated that visual cues helped students with HI to gain understanding. This is in line with the work of Shah and Freedman (2003) who propounded that the advantage of using visualisation in learning, i.e. to provide an external representation of the information, to process the information deeply and to maintain learner attention by offering more attractive information, made complex information easier to understand.

Science teachers who worked with students with VI offered tactile, 3D models and electronic formats of science learning media to assist them, although in minimal ways. Ediyanto and Kawai (2019) concurred with this use. They conducted a review of 17 articles and concluded that science learning should be accessible for students with VI when they were provided with appropriate support such as tactile and kinaesthetic learning, auditory learning, assistive technology and experiences through orientation and mobility (O&M). Similarly, Kumar et al. (2001) suggested that Braille, adaptive electronic media, large print, tactile images, real objects and assistive technology enabled access to learning science for students with VI.

Despite the fact that learning media for SWD were limited in the three SPIE, the literature propounds that providing more than one sensory mode is critical for giving SWD the opportunity to build their knowledge. Mayer (2003) discussed the multimodal learning environment, arguing that it offered more opportunities for presenting the elements of teaching and learning. In particular, for lower-achieving students, presenting materials in various modes may help them to learn more easily and increase their attention, leading to an improved learning performance (Chen & Fu, 2003; Moreno & Mayer, 2007). The key advantage in having a multimodal design is that it: "allows students to experience learning in ways in which they are most comfortable, while challenging them to experience and learn in other ways as well" (Picciano, 2009, p. 13). Previous studies (Ainsworth, 2006; Rau & Matthews, 2017; Schnotz & Lowe, 2003; van der Meij & de Jong, 2006), however showed that that multiple (visual) representations were not always more effective for promoting learning. When students are first presented with a new representation, they face complex learning tasks that force them to understand how to encode the information and relate to the domain it represents (Ainsworth, 2006; Schnotz & Lowe, 2003). Other scholars have highlighted that when representations are not used in the "right" way, they may fail to enhance students' learning (Rau & Matthews, 2017, para 1), leaving students confused and producing problems in interpreting between representations (van der Meij & de Jong, 2006).

8.2.2 Supporting Strategic Learning to Build Students with Disabilities' Skills

In order to build SWD's skills, various teaching approaches were applied in different ways by each science teacher participant. Nonetheless, the teaching approaches still require further enhancement in order to make science teaching more inclusive of SWD. As important as ascertaining prior knowledge is to learning, building skills among SWD is essential in helping them to act skilfully and become goal-directed learners.

8.2.2.1 Providing flexible models of science process skills

Science teachers used various techniques in supporting the development of Science Process Skills (SPS) among SWD. *First*, data demonstrated that all science teachers began class with an advanced organiser. These participants asserted that science consists of many abstract concepts and that most students assumed science was hard to understand. This response is in line with the Atomatofa (2013) study. Atomatofa stated that "secondary school students see science as abstract, invisible and do not seem to clearly understand scientific concepts" (p. 82). Hence, students come to class with concepts that are sometimes wrong, and there is a need before the lesson begins for science teachers to introduce aids like organisers to act as anchors and help in correcting students' prior concepts. An advanced organiser is a certain type of cognitive organiser "to enable students to learn new ideas or information by meaningfully linking these ideas to the existing knowledge" (Gidena & Gebeyehu, 2017, p. 2227) in order to help them both arrange and interpret the new incoming information (Pitler & Stone, 2012).

In this study, two types of organisers used by the science teachers were question organisers and descriptive organisers (Roohani et al., 2015).

Questioning was used extensively as an advanced organiser in each of the schools under study. One teacher asserted that questions were delivered to probe students' prior knowledge of a new topic, while another teacher reported that, through questioning, students came to know the purpose and objectives of the new learning. Questions, according to Swart (2010), are useful for thinking and stimulating reasoning. To activate advanced organisers, each science teacher asserted that they delivered the intended learning objectives at the beginning of the lesson, followed by a series of questions relating to the learning objectives. Ferguson (1998) pointed out that learning objectives acted as an advanced organiser, making students focus on the essential learning experiences that would assist them to become established in the relevant knowledge and skills to be achieved. On the other hand, descriptive organisers were adopted to begin the lesson in each school. Real-life examples relating to the topic under study were the science teachers' first choice of descriptive organiser. Ros and Lizenberg (2006) argued that advanced organisers augmented the students' cognitive structures and helped them to interrelate prior knowledge with new content. The way in which science teachers in this study offered real-examples is described in Section 8.2.1.2, *Providing real-life examples*.

Second, science teacher participants teaching students with HI and LD asserted that they implemented a student active learning approach to increase SWD's participation as a form of inclusive practice. One strategy matching a student active learning approach is science inquiry-based learning. However, each participant in this study lacked detailed evidence that demonstrated they applied inquiry-based learning to gain the SWD's participation. Nevertheless, participation in science learning is essential for SWD to understand the concepts being studied, to help them to learn from one another, and in making right decisions and reaching their full potential. A study by Melber (2004) alleged that an inquiry-based learning approach can contribute to making science classrooms more inclusive for SWD because it requires students to engage cognitively, while Trundle (2008) stated that inquiry-based learning enabled SWD to learn more broadly than through reading and writing. Another student active learning approach applied for students with LD involved excursions/outdoor-learning/field-trips. This approach was supported by Wahyuni et al. (2017) who concluded that the application of outdoor learning was effective in developing SPS and problem-solving abilities. Similarly, DeFina (2006) stated that a field trip can provide a valuable learning experience and serve as an effective teaching tool when well planned, organised and supervised.

Contrasting perspectives and approaches about gaining the participation of SWD in science were held by teachers working with these students in this study. While some science teachers asserted that students with VI tended to be passive learners and could not actively engage and participate well in science lessons, one support teacher viewed things differently. The support teacher asserted that she encouraged students with VI to engage in observation outside their classroom to learn science in a real way. She argued that inquiry-based instruction can be applied to students with VI. Her comments are supported by the study of Rooks-Ellis (2014) who argued that inquiry-based instruction was possible for students with VI, because using the senses to obtain data, explore concrete objects, question and test findings should become a natural occurrence for gaining greater understanding.

SWD in the three schools investigated were rarely involved in practical activities using a laboratory. The science teachers' statements in the interviews revealed their lack of awareness of how to involve SWD in science practicals. Rather than looking for ways to engage SWD, each science teacher allowed them to do nothing while practical sessions were taking place. Alternatively, substitute assignments were provided in the inclusion room, as was the case in schools teaching students with HI. Interestingly, a number of studies have reported that teaching SPS by engaging SWD in practical learning in the laboratory is very possible. The studies by Kruea-In and Thongperm (2014); Shahali et al. (2015) indicated that SPS should take place in a laboratory. Other scholars have argued that SPS can be taught through multimedia-based practicals (Yu & Chun, 2012), virtual laboratories (Çalişkan et al., 2015; Yang & Heh, 2007), outdoor learning (Wahyuni et al., 2017) or textbooks (Aziz & Zain, 2010), where SWD's learning needs can be accommodated. Therefore, it may be inferred from the findings of this study that science teacher competency in providing laboratory activities for SWD needs to be enhanced in order for equal access to science learning experiences to be achieved.

Third, there is little evidence from this study to show that science teachers accommodated students' learning styles and pace of learning, although they acknowledged that each SWD learnt in a different style and at a different pace. This finding indicates the teachers had a theoretical disconnect between their knowledge about the learning style of SWD and the pace at which they went through the required sequence of classroom activities, and how they put this knowledge into practice. Understanding the particular learning needs, style and learning pace of SWD can help teachers to select appropriate teaching methods that enable SWD to succeed and attain their learning goals. In line with the Pankowski (2018) point of view, determining SWD's learning styles can help teachers develop curriculum that meets students' learning needs, while Landrum and McDuffie (2010) concluded that there was very little evidence indicating that the consideration of learning styles was useful in planning and delivering instruction for SWD. This finding infers that although determining the learning style of SWD is important, science teachers need to carefully determine SWD's strengths in order to establish a baseline from which appropriate teaching methods can be selected for them.

Science teachers in this study had difficulty in assisting students to identify what the best ways for them to learn involved, although the teachers made every effort to communicate personally with each student by asking each student what he or she needed. It was found that extensive communication between science teachers and the support teacher was a more successful way of finding out better ways for students with LD to learn.

8.2.2.2 Providing various methods for responding to and interacting with science materials

Varied methods for responding to and interacting with learning materials were reported by participant science teachers. There was a tendency to repeat any question asked by students in the class before giving a response, as well as offering written and verbal announcements concerning class times, activities, and homework. In addition, some teachers pre-taught the specific language and concepts required to ensure that the students had the prerequisite prior knowledge for each activity that was to be undertaken.

Students with HI generally depended on their vision (Downs et al., 2000) to lip-read the teacher or to watch an interpreter, so as Brackett (1997, p. 357) explained, it is critical to consider the physical aspects of the classroom. Dodd-murphy and Mamlin (2002); Mastropieri and Scruggs (2010); Pakulski and Kaderavek (2002); Simpson et al. (2013) agreed that students with HI must have an unobstructed line of vision to maximise their learning. This arrangement is called "getting close" (Hyde, 2013, p. 267). Science teachers working with students with HI in this study organised for them to sit at the front of the lecture theatre so they could easily see what the teacher was saying. The teachers, however did not make any other appropriate physical adjustments, did not engage a sign language interpreter, but did provide some academic support (i.e. summary materials, visual aids). Bamu et al. (2017) also found that adequate adjustments for academic support, classroom placement, including sign language interpreters for students with HI, had in the main not been made in regular schools. Background noises were also not controlled by teachers working with students with HI in this study. Downs et al. (2000) and Dodd-murphy and Mamlin (2002) cautioned that students with HI may be very sensitive to background sound which tends to interfere with speech (whether or not they are using an assistive listening device); therefore, background noise should be minimised. Class sizes should also be smaller to reduce noise (Rekkedal, 2016). Reduction to 20 students per class was evidenced in classes that included students with HI in this study.

Further, physical prompts (such as touching, waving) were used to gain the attention of students with vision and hearing impairments. This strategy is supported by research carried out by Simpson et al. (2013) and Swift et al. (2008) who claimed that physical prompts were useful for students with VI. Adequate time was also needed to enable students with VI to respond to and complete class activities. The literature states that students with VI may need to use speech-to-text software, Braille, or enlarged print technology to access materials, and teachers need to remember that using such media requires a longer time than that required for reading regular print (Mastropieri & Scruggs, 2010; Swift et al., 2008).

8.2.2.3 Offering alternative project formats for demonstrating skills

Science teachers in the three schools studied offered SWD two main alternative project formats, i.e. oral presentations and written reports, in expressing skills and doing tasks and assignments. This finding indicates that the teachers focused on two areas, communication skills and writing skills. As described in Section 8.2.2.1 *Providing flexible models of science process skills*, SWD in this study were rarely involved in practical activities, resulting in the basic science process skills such as observation, classification, measurement, inference and prediction not being taught in an appropriate way. Although many scholars believed that science for SWD was possible, the findings of this study show that science teachers offered very minimal opportunities for SWD to express their basic process skills. Nevertheless, by providing various ways for SWD to express skills, science teachers were enabling more inclusive teaching.

8.2.2.4 Providing opportunities to practise with support

Science teachers in the three schools studied offered support in the form of accommodations and scaffolding that enabled SWD to practise what they had learned. Accommodations in the form of extra time to practise recalling and utilising information were provided by each science teacher in each school. Timing was considered by the science teacher participants to be a way to accommodate the learning needs of SWD in their schools. They noted that extra time was granted to ensure those students were not unfairly penalised for having to use alternative means to access materials or to finish their work, however not many SWD used the extra time provided. Harrison et al. (2013) agreed in their research that time accommodation was one that was appropriate for SWD, elaborating that time accommodation can be in the form of altering the organisation and the amount of time allocated for tests, tasks or activities.

Another support provided was to organise for the SWD to work with peers without disabilities in a peer tutoring arrangement. Science teachers in each school agreed that peer tutoring was beneficial for teaching and learning, including for SWD. In line with previous studies, peer tutoring can boost academic and social skills in inclusive settings (Talbott et al., 2017), promote positive attitudes towards the subject being taught and towards the teachers and collaborators (McDuffie et al., 2009), increase self-esteem as well as interest levels (Wood et al., 2010), reduce intimidation compared with the whole class setting (Topping et al., 2003), provide feedback and practice for SWD to increase their vocabulary (Mackiewicz et al., 2010), and be a low-budget form of instruction (Talbott et al., 2017). Although no detail was provided on how the peer tutoring was conducted in the three SPIE, Alzahrani and Leko (2018) found that the effectiveness of peer tutoring depended on the engagement level between peers, and Utley et al. (1997) found it was contingent on the preparation by the tutor and the way in which he or she equipped himself of herself with specific skills of instruction.

In this study, the science teacher and support teacher participants working with students with LD argued that peer tutoring was beneficial for such students. This echoes the views of scholars such as Michael (2016) who argued that, for students with LD, peer tutoring helped them to actively participate in the classroom, and Stenhoff and Lignugaris/Kraft (2007) stated peer tutoring allowed students with LD to get individual attention and immediate feedback during independent practice and increased the time of engagement between tutor and tutees. However, "the greatest challenge in peer tutoring procedures for students with LD is that they may have problems with expressive communication skills" (Tsuei, 2014, p. 115) and they often experience difficulty meeting basic language requirements, by showing grammatical errors both spoken and written (Scott & Windsor, 2000), as was also evidenced in this study.

Another finding was expressed by one teacher working with students with VI and who applied mnemonics—"procedures are intended to provide a retrieve link between stimulus and response information, thus … [facilitating] later recall" (Mastropieri et al., 1988, p. 49)—as a scaffolding for students with VI. That teacher used peg words and keywords to make some words easy to memorise for a new concept. Such words are called linguistic mnemonics (Lubin & Polloway, 2016).

8.2.2.5 Providing ongoing and relevant feedback

Science teachers offered feedback during science lessons to reduce the difficulties faced by the SWD. The preferred feedback was in verbal form by commenting on what students had done and in written form on the students' assignments. The importance of relevant, ongoing feedback was recognised by a number of researchers. Carnell (2004) noted feedback can be used to enhance the learning process in such a way as to tell students their strengths and weaknesses in a particular topic. It can also help SWD to correct misconceptions, confirm correct responses, and provide additional practice, thus assisting them to move to the next step. Feedback lets students know whether they are practising in effective ways and helps them to identify which practice needs to be altered (Rose et al., 2002). Feedback can improve learning because it provides students with direct and specific suggestions concerning their work, such as in a test result or in homework answers (Cunha et al., 2018).

Feedback provides information to help students learn, because feedback offers evaluative information and may demonstrate the gap between the actual student performance and the intended outcomes (Askew & Lodge, 2004). Feedback to SWD in this study was essentially in the form of verbal one-way communication—from teachers to students—to inform students' progress in learning. The literature states that when feedback is informational rather than evaluative, students are "more likely to use it to confirm their self-efficacy as learners and as a guide for future learning" (Cowie, 2005, p. 139). Teacher comments need to be specific (Hardavella et al., 2017) to what the student has done in order to give the student the opportunity to reflect on what points need to be reinforced. Feedback also must be timely (Goodwin & Miller, 2012) or, if not timely, it will decrease the window of opportunity for learning as students may forget or need more time to recall what they have done. Feedback between teacher's assessment and the follow-up action is also critically connected as a form of "formative effect" (improvement is made) (Hargreaves et al., 2004, p. 21). "Given the demonstrated benefits of formative feedback, it is important that all students have equitable access to occasions when they are able, and feel willing, to interact with their teacher about their learning" (Cowie, 2012, p. 686).

8.2.3 Supporting Affective Learning to Build Students with Disabilities' Motivation and Engagement

Science teachers working with SWD in this study employed pedagogy that supported the affective learning of SWD and encouraged them to make choices and accept challenges to build their motivation and engagement in science learning, leading to them becoming purposeful and motivated learners.

8.2.3.1 Providing adjustable levels of challenge

Findings from this study show that science teachers created limited ways of offering challenges to SWD. Most forms of learning challenges were those that involved distributing difficult questions and problems that had been adjusted for SWD. Instead, challenges should be presented in various ways. The literature review states that, based on Vygotsky's theory, students learn best in their "Zone of Proximal Development" (ZPD) (Bodrova & Leong, 2017; Foote et al., 2013; Mooney, 2013), where challenges are provided beyond their current capability but not out of reach. It can reasonably be presumed that the minimal level of challenge reported by the participants in this study indicates that SWD were less challenged and less engaged in thought-provoking science learning. Adjustment to higher levels of difficulty and challenge for students with different abilities is essential for keeping students engaged (Rose et al., 2002; Thomas, 2009). While a challenge provides some benefit for SWD in motivating them to learn, the level of challenge needs to have a strong connection with goal-setting and engagement (Rose et al., 2002), which in turn leads to a high level of performance (Drach-Zahavy & Erez, 2002) and has a positive impact on achievement (Senko et al., 2013). The limited ways in which challenges were offered to SWD in this study clearly showed that for them to be more engaged in effective learning, science teachers needed to consider how to revisit goals and engage them in more thought-provoking science challenges and learning. There is a definite link between goal-setting, expectations, levels of challenge and engagement that science teachers should be aware of in order to maximise learning for SWD.

8.2.3.2 Offering choices in content and tools

Minimal choice in content and use of tools to facilitate learning for SWD was reported by most teacher participants. Offering SWD choices in content and tools is essential because they will boost students' motivation and engagement in learning; and when students are motivated they can learn more. Allowing SWD to choose their preference for content and tools helps them to choose the most appropriate devices for facilitating their learning. Previous studies have noted that having a choice of material is critical. Glasser's Choice Theory (cited in Suarez (2009)), for example, highlights that empowering middle schoolers with selecting their own level of material yields three main advantages: to motivate students, to enhance achievement, to give students an opportunity to make a decision (p. 314). In addition, Rose et al. (2002, p. 114) stated that "variability of media, formats, organisations, level of details and degree of depth enable students a choice and redundancy".

The limited choices of content and tools that were available for SWD in this study, without a doubt, impacted on their motivation, engagement in science learning, task performance and progress. Writers in the field agree that choice about a particular modality enables SWD greater access to the given science information, thus increasing comprehension about what is being studied as well as gaining SWD attention and engagement. Fadel (2008) stated, "students engaged in learning that incorporates multimodal designs, on average, outperform students who learn using traditional approaches with single modes" (p. 13), because a multimodal design allows students to select the learning material that best suits their preferences (Doolittle et al., 2005), and increases their control over the way in which they progress through the materials (Karagiorgi & Symeou, 2005). When students are allowed to choose their learning material preferences, they are better engaged in learning, making learning experiences more holistic (Picciano, 2009).

Choices offered in the form of technology (such as built-in calculators, spell checkers or text-to-speech translation) were not provided in all schools studied. Hence, this study might infer that science learning can be optimised when choices of technology that enhance the effectiveness of learning are provided. One of the schools in this study provided an abundance of technologies to assist students to learn, but this did not necessarily result in it establishing an inclusive environment. The other two schools investigated were rich in contextual and community resources, which it can be argued can be just as beneficial to establishing an inclusive environment. Further, offering the students opportunities to choose content and tools can increase their excitement for learning processes and also be beneficial to establishing an inclusive environment.

8.2.3.3 Offering a choice of rewards

Rewards were not commonly seen in classroom observations or reported in interviews in this study. The participating science teachers in the main did not address the advantages of using rewards as a motivation for learning science. In fact, only one support teacher working with students with VI offered rewards, asserting that by so doing she had boosted students' motivation to learn science. Her argument is supported by some researchers (Chen et al., 2009; Deci et al., 2001; Filsecker & Hickey, 2014) who have stated that the simplest way to motivate students to learn is by offering rewards. However, few studies exist that report on the use of rewards as a way to motivate students to learn science in the Indonesian context. In his study, Pettasolong (2017) indicated that the phenomenon of Indonesian teachers giving rewards to students, other than by assigning scores, generally did not exist but rather that they gave more impetus to students who made mistakes. His study implied that in Indonesian culture teachers did not use rewards as a strategy for encouraging students, as was also evidenced in this study.

8.2.3.4 Offering a choice of learning context

Learning contexts were defined by teacher participants as situations that could impact how something was learned or what was taught. Factors that can affect learning (either positively or negatively) were described as non-threatening and welcoming environments, noise situations, classroom routines, task arrangement, and game-based learning. These factors were offered in all schools studied and SWD were given opportunities to choose their preferred contexts. Giving choices of learning context is critical because not all students are interested in learning science, and letting the students choose their learning context can help them to identify their strengths and interests and give them more control over their learning, thus leading to building their motivation to learn. Learning contexts, however, "should be relevant and recognisable for students" (Taconis et al., 2016, p. 1). Schmidt et al. (2018) expressed concern that a choice of personal context should have a positive impact on student's engagement, be relevant and support the direction taken by the participants. A context-based learning environment can help students to identify connections between science and daily occurrences (Bennett, 2003), gain student's understanding of science (Fensham, 2009), and foster motivation (Bennett et al., 2007).

8.3 Research Question 3: Assessing and Monitoring the Progress of Students with Disabilities

The results of this study contribute to an understanding of how the learning progress of SWD in SPIE in DI Yogyakarta Indonesia is assessed and monitored. Generally, science teachers in this study demonstrated limited ways of providing accurate, fair and equal assessments for SWD. They assessed SWD mostly by way of paper-and-pencil types of tests based on planned learning objectives that were designed to measure students' cognitive development in science. Rose et al. (2002), however, argued that a paper-and-pencil based test is neither fair nor accurate. To produce inclusivity, multiple assessments should be offered to accommodate each student's learning needs (Chakraborty & Kaushik, 2019).

The science teacher participants discussed how measuring and monitoring the progress of learning became an issue when a particular assessment applied to SWD in relation to timing, assessment forms and methods. Science teachers teaching students with HI asserted that they found difficulty in providing modified assessment for these students. The teachers applied exactly the same form and method of assessment for all students, while additional time was not provided for students with HI to facilitate managing their language difficulties. Simplified sentences and instruction in the assessment forms were also not used. For students with VI, the teachers lacked awareness that these students had a range of vision loss from low vision to totally blind, however, their learning progress was monitored using the same format: teacher read the questions aloud and students answered them in Braille. Nevertheless, low vision students would benefit if assessment was offered in a large print format. Bourke and Mentis (2014) agreed, remarking that particularly for SWD, measuring their learning outcomes "can create tensions for teachers to rationalise when, and for what reason, to use a particular assessment approach" (p. 385). Some considerations (e.g. type of disability, time and place), however, were applied by some other science teachers when they designed assessment for SWD, although social and cultural backgrounds were not considered. Salvia et al. (2017) stressed that student's social and cultural backgrounds, individual differences and disabilities are critical considerations when selecting the tests that are "technically adequate" and relevant to improve instructional outcomes (p. 11).

8.3.1 Measuring Knowledge Development Progress

8.3.1.1 Aligning assessment with learning objectives

Science teachers aligned learning objectives with assessment and developed tests designed to measure students' knowledge development in science. However, the intended goals and the types of assessments to be achieved by all students, including those with disabilities, were limited and varied according to the nature of the student's disability. Munzenmaier and Rubin (2013) agreed that assessments should be developed from learning objectives. They commented that "to ensure that activities and evaluations are valid and properly aligned to instructional goals and content, assessments should be developed from objectives" (p. 8). In the Indonesian context, the alignment between learning objectives and assessment is created using the Revised Bloom's Taxonomy (RBT). The science teachers in this study aligned both teaching methods and assessment with the RBT, as indicated in their lesson plans. Chandio et al. (2016) supported this move, stating that "Bloom's Taxonomy should be incorporated in both teaching-learning process and assessment practices" (p. 218). The RBT is also useful for the teacher to "plan objectives, activities and assessment that allow students to learn different types of knowledge using a variety of processes" (Blackburn & Witzel, 2014, p. 68).

Further, the alignment between assessment and learning objectives in this current study is consistent with previous research, which has contended that alignment between assessment and learning objectives is a critical factor in good instruction. Wiggins and McTighe (2001) have stated that, without proper alignment, achieving intended outcomes will be limited because the students will not be learning for what will be assessed. When the assessment does not align with the objectives, it is difficult to accurately represent a student's achievement according to the intended learning objectives. "Assessment practices must send the right signals to students about what they should be learning and how they should be learning it" (Biggs & Tang, 2011, p. 191). Therefore, assessment should be designed in such a way that when students focus on the assessment, they will learn based on the objectives stated to them.

8.3.1.2 Using alternatives to the traditional quizzes and exams

Some of the science teacher participants in this study produced alternative assessments and applied modifications to measure the students' ability and understanding. In some cases, science teachers provided surprise quiz and project-based assessment as alternates to the traditional exam. Students' learning progress was also monitored using check lists, worksheets, or orally ('a personal approach'). With the shift in paradigm in assessment from traditional methods to alternative ways, called alternative assessment or authentic assessment, Ling (2016) stated schools are reducing paper-and-pencil based tests and developing more creative methods in the ways in which they assess their students. Alternative assessments offer activities that ascertain "what students are able to do with the knowledge and skills obtained through learning", highlighting their strengths and abilities rather than their weaknesses or what the students do not know (Oliver, 2015, p. 3), which is closely linked to inclusivity. Inclusive assessment is not only about evaluating students, it is also about developing on-going activities that facilitate students' and teachers' understanding of the progress made in learning and whether or not the topic learning objectives have been met. Inclusive assessment also employs varied forms of assessments that monitor and assess learning more realistically than do paper-and-pencil based tests. SWD need "alternate forms of assessment that provide evidence of their learning and help education systems address their learning needs through improved and targeted pedagogies" (Chakraborty & Kaushik, 2019, p. 6).

The teachers who applied alternative assessments in this study implied that they understood the benefit of alternative assessments, which Letina (2015) asserted can provide better information and give a more comprehensive picture about students' knowledge, skills, attitudes and competences that have been established during the teaching and learning process.

8.3.1.3 Giving instruction on the assignments

The teachers participating in this study provided clear instructions when giving assignments, either orally or in writing. Obviously, they were aware that clear instructions are critical to ensuring that SWD understand what is expected of them in their assignments, although some suggested that unclear communication would sometimes occur. Nevertheless, the science teachers realised that instruction should be made as clear as possible and acknowledged that, for example with students with HI, the use of lip-reading or presenting instructions in written form could assist. Science teachers also asserted that, by repeating instructions given verbally, they were able to ensure that SWD understood what was expected of them in completing their assignments.

8.3.1.4 Creating a grading rubric to ensure objectivity when assessing

Science teachers participating in this study did not always provide a grading rubric or, in other words, the rules that were to be used in guiding the scoring (Jackson & Larkin, 2002; Popham, 1997) in order to ensure objectivity when assessing SWD. This finding implies that, for some teachers, a grading rubric in assessment was not considered necessary, whereas for other teachers a grading rubric was considered to be important in the assessment procedure. The teachers who did not employ a grading rubric asserted that the grading process using a rubric was time consuming, they lacked knowledge about how to do it in a proper way, and training for professional development in the assessment area was not available. They discussed the additional time needed in creating the rubric then applying it to the students' tasks, and tallying and recording students' scores in the gradebook, an assertion also propounded by Anglin et al. (2008). Although Jackson and Larkin (2002) asserted that rubrics assisted students in accomplishing the intended learning goals, thus helping them to learn, Popham (1997) stated that there were four weaknesses of rubrics, i.e. "task-specific evaluative criteria, excessively general evaluative criteria, dysfunctional detail, and equating the test of the skill with the skill itself" (p. 73-74). Therefore setting each rubric with three to five evaluative criteria where each criterion represents a key element of the skills that are being assessed, is an alternative way to set an appropriate rubric (Popham, 1997).

8.3.2 Measuring Skill Development Progress

The way science teachers working with students with LD offered all students freedom to choose the format in which tasks were submitted indicates this school adopted an inclusive assessment approach. Students were more likely able to demonstrate their skills when teachers used familiar formats and tools were appropriate to their learning needs and styles (Rose et al., 2002). Providing students with various means of expression to demonstrate what they know, means teachers accommodate their differences. Nevertheless, these options were on limited offer in the other schools which had limited ways to assess the skills development of SWD and this implied that science teachers in those schools had little awareness about an inclusive skills assessment process to measure students' progress in learning. This limitation in skills assessment was closely linked to the teaching strategies offered by science teachers to build SWD's science skills.

8.3.3 Measuring Affective Development Progress

Only one school studied provided various techniques in measuring and monitoring SWD's affective learning progress, such as self-assessment in the forms of reflective journal, reflective individual interview session, and a mini-conference. What students had learned, the difficulties they had faced, and what values and meaning they could acquire, were explored though those self-assessment techniques. Providing assessment techniques in a way that SWD can realise how much they have learned and how learning experiences have given value and meaning to them, leads to inclusivity. Bourke and Mentis (2013) agreed that self-assessment was a tool for inclusion because it helped students to develop a sense of "identity" and "belonging" compared with practices of assessment that usually "serve to exclude and marginalise them" (p. 854). In addition to self-assessment, this school also offered experiential learning, and teacher participants argued that this approach benefited all students including SWD. This view concurs with the studies by Peterson (2011) and Wozencroft et al. (2014). Peterson (2011) stated that experiential learning increased SWD's social and academic achievement, reduced poor behaviour and contributed to the development of critical thinking and problem-solving skills. In addition, Wozencroft et al. (2014) propounded that experiential learning fostered positive student attitudes towards SWD. When the assessment and monitoring of students' affective learning was offered in a variety of ways, as indicated by science teachers in this school, it implies that inclusivity was on the way to being implemented.

8.4 Research Question 4: Other Factors that may Contribute to or Hinder the way in which Science Teachers Create Science Classrooms that are Inclusive for All

Some factors were identified as contributing to or hindering the way in which science teachers in the three schools participating in this study created science teaching and learning that was to be inclusive for all.

8.4.1 The Understanding of Inclusive Education

Teacher and principal participants had limited understanding of the genuine nature of IE. A majority of participants had been influenced by the concept of special education as being the way to educate SWD; one support teacher even argued that a special school was the best place to prepare SWD for entering an inclusive school. The understanding of participants in each of the three schools was directed towards including SWD in regular schools in order to provide more equitable access to their right to an education that was free from discrimination. This finding mirrors the Efthymiou et al. (2017) study which stated, "[i]nclusive education is the basis for the elimination of educational and social exclusion and is a medium for the abolition of discrimination against people who are different, to allow them to achieve social inclusion in the broadest sense" (p. 5). IE for SWD in this study was not yet understood as an effort to improve the quality of educational services but was rather seen as a process of placing SWD in the general classroom. Rahardja (2010) maintained that placing SWD in general classrooms was not a guarantee that inclusion happens, whereas Haug (2016) argued that the perspective of SWD placement in general classrooms was the dominant criterion of inclusion. The lack of a clear understanding of what IE involves can lead to the labelling of students who face difficulties in learning as being students who need "additional" and "differences" in treatment, creating a situation where exclusion often occurs in the name of inclusion (Florian, 2010, p. 63), as demonstrated in the three SPIE studied.

This study confirms that defining inclusion is a problematic issue, because it can be used in many ways and for different purposes. Some sources consider IE to be an approach to increasing the number of SWD being educated in general schools while at the same time maintaining special schools, such as the approach practised by schools educating students with HI and VI in this study. In particular, teachers in these schools argued that the success of the inclusion depended on the students' types of disability and how their abilities met the general classroom activities. This viewpoint was supported by the Nurhayati (2012) study advocating that SWD in Indonesia should adapt to the school. Schools catering for students with HI promoted inclusion using an imprecise portrait (simply as integration) where SWD were included in the general classroom (Sanagi, 2016) but were withdrawn in individual or small groups at specific times to be given additional work, which reflects a different interpretation from that of the Western concept of IE. For Westerners, IE must be understood as being about more than an individual student's placement in a classroom (Srivastava et al., 2015). This requires a shift in the whole of school philosophy in order to eliminate the barriers to participation and provide genuine equitable education for everyone. The interpretation of IE in the Western sense was nearly understood and practised in the one school catering for students with LD.

The idea of integration as a form of IE was evidenced by the way science teachers in this study included students with HI in science classrooms. For some SWD, a feeling of belonging and being included in a learning group was more likely to result from placement in a resource room referred to as the inclusion room, rather than in a general classroom. According to Warnock (2005), inclusion is not about physical attendance but more about having a sense of belonging felt by all school members. However, this study confirms that SWD are generally more comfortable with peers who have similar interests, abilities and disabilities than with the more general same age peers, which in turn hinders real inclusion.

8.4.2 Support Teacher Roles and Collaborative Work with Science Teachers

The findings of this study verify that collaborative work between the science teachers and the support teacher needs to be enhanced in order to promote and develop inclusive learning practices in science classroom settings. The existence of a support teacher is critical, as indicated by science teachers at the school providing education for students with VI. These teachers reported they faced challenges and difficulties in implementing inclusive teaching without collaboration with the special education teacher. Research by Solis et al. (2012), who advised that instruction could be run with or without the additional support of the special education teacher, seems to contradict the finding of this study. Through collaboration, the dual expertise of each teacher can be combined to develop a better way of teaching SWD. Support teachers can share their expertise in the disability field while science teachers focus on science content.

The absence of the special education teacher in the school educating students with VI in this study seemed to be hindering the way science teachers created inclusivity. For this school, O'Shea and O'Shea (1998) would have recommended the implementation of four strategies: providing ongoing professional development and consistent in-service training to staff members; reciprocity, adaptations and instructional modifications; family meetings to clarify assessment, classroom performance and adaptations being made; and enabling students without a disability to work with their peers with disabilities. Nevertheless, such strategies were not in evidence in the school in this study that was operating without the assistance of a special education teacher.

Two schools studied had experience in co-teaching SWD illustrating that, while the science teacher has a role and responsibility to instruct the entire class, the support teacher plays a valuable part in assisting SWD to participate and learn. The study by Scruggs et al. (2007) indicated that "general education teachers typically employ whole class, teacher-led instruction with little individualization, whereas special education teachers function largely as assistants in support of special education students and other students in need, within the existing classroom context" (p. 411). In addition, Kloo and Zigmond (2008) emphasised that the general teacher is the person who has understanding about the "structure, content, and pacing" (p. 13) of the general curriculum while the special education teacher identifies and supports the needs of SWD. Co-teaching in two schools studied mostly was conducted in the planning and instructing stages, while partnerships between the science teacher and the support teacher in the ways in which they assessed SWD were very limited. This finding is similar to the Olore (2017) study which mentioned co-teachers spent more of their time working together to discuss student concerns and make instructional changes than they did on working together to develop lesson plans and share resources.

8.4.3 Teacher Training and Support

Schools and local government provided little training and support for teachers in educating SWD, with the result that science teachers had inadequate training and support to implement the IE policy effectively—a major hindrance to IE. This finding is in line with the studies conducted by Avramidis and Norwich (2002); Dapudong (2014) which showed that science teachers did not possess adequate knowledge and skills regarding special needs and IE. Moreover, Norman et al. (1998) indicated that only a limited number of general teachers (including science teachers) had any training in teaching SWD, as well as a limited number of special education teachers having any training in science teaching. Teachers' training for IE and how to run classrooms that include SWD is essential. Saiz Linares et al. (2016) argued that when schools are proposed as being inclusive, initial training concerning the nature and meaning of inclusion is an important factor that needs to be considered.

As for in-service training programmes, there was very little evidence to indicate that regular or subject teachers in the Indonesian context were provided with adequate training programmes on IE. Kurniawati et al. (2016) stated that those programmes that were available for existing special education teachers responsible for SWD, in either inclusive or special schools within Indonesia, were not sufficient for improving teaching and learning practices for SWD.

8.4.4 Physical Building Access

School's buildings and rooms did give access to SWD, though to varying degrees. It could be presumed that since these schools were designated as SPIE, they had been allocated a budget to build and equip the physical environment in such a manner that that it was accessible for all SWD. However, in general, SPIE in Indonesia are not fully accessible and do not meet the recommended standard of building for people with disabilities, as mentioned in studies by Bakhri et al. (2017); Muazza et al. (2018); Sartica and Ismanto (2016).

Another important finding is that School A had an assigned resource room, namely the 'inclusion room', a place where the support teacher could withdraw SWD from their classrooms to be taught separately, reflecting this school was not fully inclusive. Although a body of research argues that a resource room is beneficial for SWD—where students are able to get individualised instruction that best suits their personal learning styles and that the student's time spent in this kind of instruction is of a higher standard than that given in a team-taught class—students could become more dependent and isolated from the general school population (Vaughn & Klingner, 1998) and suffer in terms of their self-esteem (Jones & Hensley, 2012). In addition, the development of a resource room would appear to be more financially expensive than the process of inclusion (Hornby, 2014), of interest was that the principal of School A allocated a special budget to the building of such a room.

8.4.5 Parents' Involvement

Parents of SWD in the school which identified as implementing an integration model in this study, tended to leave the responsibility of educating their children with the school. This situation was highlighted by Simpson et al. (2013), who identified parents of SWD as having difficulty in navigating the special or general education system. Consequently, these parents were rarely involved in the development of instruction for their children, which was a hindrance for IE implantation in this school.

The two other schools by contrast had issues in dealing with parents who failed to acknowledge their child's condition and became over-involved in the science teaching and learning process. Simpson et al. (2013) stated that over-involved parents wanted to be involved and to control all aspects of their children's lives, including their education, and did not allow their children to live their own lives. However, some participants in this current study highlighted that family involvement was important for creating a successful learning journey for SWD. This finding is supported by previous studies (Blackburn & Witzel, 2014; Cumming et al., 2018; Mires et al., 2018; Simpson et al., 2013) where family involvement was shown to be a critical factor in maximising the success of SWD.

8.4.6 Policy and Supportive Program

Policies and supportive programs offered by each school participant reflected that the concept of inclusion was implemented in that school. The first school studied was more selective in accepting SWD and offering programs to support them. The two schools that accepted all SWD tended to place them in a general classroom with minimal support, hindering IE from being successful. This finding is consistent with that of a previous study by Muazza et al. (2018) in one province of Indonesia, which stated that there was no special preparation provided for the admission of new SWD and there was a lack of government attention given to the provision of appropriate infrastructure. Further, the programs offered by these two schools that were especially dedicated to SWD, led to the practice of labelling. "The existence of a label can provide a group identity for people with disabilities" (Lauchlan & Boyle, 2007, p. 40) that can have the potential to negatively impact them through bullying, and through lowered expectations as well as stigmatisation. Being stigmatised does not necessarily arise from the processes of identification or labelling but can be linked to the fact that SWD differ in some way from other children because of their special need or disability. Farrell (2014) suggested that the identification and labelling of SWD can be avoided by focusing on the whole child and his or her "social experiences" (p. 65).

8.5 Summary

Findings from an investigation into science teachers' experiences in the teaching and learning of SWD in three different SPIE have been discussed in the light of the existing literature. Some findings support and echo previous studies while other findings contradict them.

First, the way most science teachers set goals for SWD did not reflect the intention of IE that allowed equitable opportunities for success to arise. SWD had lower expectations placed on them than their peers without disabilities and consequently were prevented from fully accessing the learning objectives used to guide the learning in the general science curriculum.

Second, little evidence was found to indicate that the science teacher participants practised an inclusive teaching approach, engaged SWD in learning, and maximised learning experiences for them. Rather, their teaching approaches reflected sound good teaching practice in general. Nevertheless, of the three cases investigated, the school educating students with LD had implemented the strategy of co-teaching involving both the science teachers and the support teacher more intensively than did either of the two other schools, indicating inclusivity was being practised.

Third, SWD learning progress was monitored predominantly for cognitive learning in the form of paper-and-pencil based tests, indicating it was not accurate and not fair for SWD. However, teachers teaching students with LD offered alternative assessment and affective assessment in more variety, demonstrating that inclusive assessment was being implemented.

Fourth, factors that contributed to the creation of inclusive science classrooms were: teachers and schools having the willingness and positive attitudes towards educating SWD; those that had participated in training for inclusive teaching; teachers working and collaborating with each other and with support teachers; schools that ensured that the buildings were accessible; teachers and schools offering a variety of programs that built an inclusive culture and encouraged parents to be supportive.

Factors that hindered inclusion in the science classroom were teachers and schools having a narrow understanding of inclusion, such as simply placing SWD in SPIE with teachers who had had limited training on inclusive pedagogy and without access to support teachers to co-plan and direct the teaching for SWD. Further, some programs offered to students with HI and VI generated a system of labelling SWD, while some parents had difficulty acknowledging their child's disability and yet others became over-involved with their child because of having a disability.

This thesis has focused on the teaching of SWD within the Indonesian education system, specifically in the field of science education. It has shown that Indonesia still has significant work to do if it is to meet the UNESCO Education for All (EFA) goals by 2030. This work includes identifying ways to make all stakeholders from government to school levels understand the genuine meaning of IE. This study recommends professional teacher training on IE needs to be conducted to give teachers a better grounding in how to implement the IE concept using pedagogical approaches that support their SWD. It also advises that teachers should focus on SWD's strengths rather than their disability or disabilities and be cognisant of the fact that not all SWD have the same disabilities. Further, SWD should be given the same access to and participation in learning as their peers.

Chapter 9
Conclusions and Recommendations

This qualitative collective case study investigated issues related to the inclusivity of science teaching and learning in three Schools Providing Inclusive Education (SPIE) in the Province of Daerah Istimewa (DI) Yogyakarta Indonesia. The preceding chapter presented the discussion and interpretation of the findings related to the four major research questions that guided this study, focusing on the participants' views and experiences in setting goals for students with disabilities (SWD), practising pedagogy, assessing and monitoring SWD's progress, and other factors contributing to and hindering the creation of a science classroom that is inclusive of all. This final chapter is organised into four sections and includes the conclusion, implications of the study, limitations and delimitations of the study, and recommendations for further research.

9.1 Conclusion

The findings of this study revealed that the inclusive education (IE) movement in Indonesia has begun with a focus on bringing special education into the general education classroom. The findings show that science teachers' practices and approaches to creating inclusivity in their classrooms were different in each of the three schools studied. Science teachers in School A practised an inclusive-special education (integration) model, science teachers in School B adopted a more special education approach (segregation model), while science teachers in School C implemented a more inclusive education model.

While all three schools were designated inclusive schools, each catered for students with different disabilities (hearing, vision and learning difficulties) and their approaches varied in regard to inclusive science teaching and learning. School C was clearly moving rapidly towards an inclusive approach although considerable constraints were faced by the principal and teachers, hindering them from becoming fully inclusive of all students. School A operated under an inclusive-special education model that mirrored the dual philosophies of special and inclusive education driven by the school's policies and practices. SWD in this school were mainly the support teacher's responsibility and educated separately in a designated inclusive room. School B, on the other hand, displayed special education practices and a very specialised approach to science pedagogy and access to the science curriculum. The few examples of inclusive science teaching in this school were caused by the limited understanding of school's stakeholders and limited training for teachers in the area of inclusive teaching.

Science teachers in the three SPIE generally held lower expectations for SWD than they did for their classmates without disabilities. Overall, the science teachers established similar ways of reframing standards into learning objectives that offered minimal a range of learning options and accommodations that would enable SWD to achieve their goals. Learning goals and objectives were modified by minimising criteria for passing grades. Good and effective pedagogy was practised but approaches reflected special education methodology rather than inclusive education. In terms of assessment, science teachers demonstrated limited ways of providing accurate, fair and equal assessment for SWD and were more focused on cognitive rather than skill and affective assessments. Science teacher participants in the three SPIE applied similar ways to support cognitive learning, but School C exhibited a better way of capturing the SWD's progress in skill and affective developments than Schools A and B.

Factors that contributed to and hindered inclusive practices in the three SPIE had a major influence on how inclusive science teaching and learning occurred. The positive attitude of all principal and teacher participants regarding SWD and inclusive education was swayed, however, by their belief that inclusion was simply a means of placing SWD in regular classrooms. Insufficient training in working inclusively in their classrooms and minimal support teacher provision in two of the three schools, clearly impacted on the inclusivity of science teaching and learning practices.

The interpretation of IE by the participating Indonesian schools was diverse and essentially depended on the principal's and teachers' understanding and the school's readiness to adopt the inclusive system. Factors that are critical to generate an inclusive climate are a supportive and respectful environment, inclusive leadership, access to the general curriculum, meaningful participation in everyday classroom activities, a sense of belonging and shared ownership of all students in the school. These elements were still in a developmental stage in these schools investigated. Inclusivity cannot be implemented partially and it requires an internal system that recognises the importance of resource allocation, identification of learners' needs, engagement and learning outcomes monitoring.

All are equally important and relevant to support the transition to a more IE system in Indonesia. In summary, this research reflects the current situation in some schools in this country and provides strong support for the implementation of IE and for addressing the barriers that hinder making IE a reality for all.

9.2 Implications of the Study

The investigation into the inclusivity of science teaching and learning practices in SPIE in DI Yogyakarta has implications related to theory development, practical and policy concerns (including ways to address the hindrances and overcome the barriers), and research methodology. The number of SPIE has increased significantly supported by related regulations at both the provincial and district levels, however, the context of IE policy as the main guideline for policy implementation leads to diverse and even narrow perspectives on the concept of inclusion. The main implication is that many of SPIE face difficulties in running IE optimally. Much progress has been made, but much remains to be done in achieving the basic and universal rights to education for all peoples.

9.2.1 Implication for Theory Development

The findings of this study present new insights into how inclusivity is practised in the different contexts of three SPIE in Indonesia. Many schools have had difficulty adapting to the change required by the move to more inclusive practices because of the high percentage of students receiving special support in general educational settings (Sigurdardóttir, 2010), like Schools A and B. Each SPIE has its own policy, and stakeholders approach IE according to their knowledge and skill, which oftentimes does not fully match the inclusive philosophy and results in different approaches by each SPIE to educating SWD and building an inclusive setting. The narrow understanding of stakeholders toward inclusion, inadequate collaboration between science teachers and support teachers, and limited professional teacher training in inclusive teaching approaches also impact the way science teachers educate and support SWD. From this present investigation, a number of relevant pedagogical practices such as goal-setting, pedagogical practices, and assessing and monitoring the progress of students with disabilities clearly need to be addressed. In addition, factors that are contributing to and hindering the way science teachers create science classrooms inclusive of all students in DI Yogyakarta

Indonesia are clearly impeding the move to inclusion and require further investigation and intervention.

This research is important and adds to the body of knowledge on inclusivity and inclusion in education in Indonesia. *First*, it imparts an understanding that goal-setting is important for SWD to maximise their access to the general curriculum. More specifically, the way science teachers set expectations for SWD, reframe standards into learning objectives, modify learning objectives and create the minimum criteria for passing grades, clearly provides answers as to why SWD have little engagement in science classrooms and have low performance and achievement in science.

Second, this study raises awareness that inclusive science teaching means providing various kinds of science media that SWD can interact with, various methods that give SWD opportunities to demonstrate what they have learned, and various learning activities that can maximise SWD engagement. This study also adds to the understanding that inclusive science teaching can be successful when collaborative actions occur between science teachers and support teachers.

Third, this study suggests that monitoring and assessment in the three domains of learning, cognitive, psychomotor and affective, are important to establish a full picture of SWD learning outcomes. The use of paper-pencil based tests employed by science teachers in this study failed to provide an accurate picture of the learning progress of SWD because it did not recognise that each learner has unique learning strengths and capabilities. Various forms of assessments should be offered to accommodate SWD.

Another important theoretical contribution to the literature on inclusivity in science teaching in Indonesia relates to how the UDL framework can be applied to investigate inclusivity in science teaching and learning. Little research has been conducted utilising UDL in science and this study provides evidence that the UDL framework can guide science teachers to design classrooms that are flexible and accessible. Theoretically, UDL-based instruction links learning networks in the brain with learning activities (CAST, 2018), facilitating effective instruction that is designed to not only benefit SWD but all learners. What seemed to be missing in the available literature were explicit examples of how to use this framework to measure and create science learning that is inclusive of all. In addition, limited studies exist on how to employ the UDL framework to examine inclusivity in science teaching and learning, particularly in Indonesia and other Asian countries. This present study provides evidence to show that inclusivity of science teaching and learning can be examined by combining the three principles of UDL (multiple means of representation, multiple means of action and expression, and multiple means of engagement) with the four pillars of curriculum (goal, method, media and assessment of learning). This combination produces a framework to guide science teachers in catering for SWD in their classrooms as they implement inclusive science education. Therefore, it is of value for teachers, stakeholders, policy makers and other researchers to consider the UDL as a framework of research and practices.

9.2.2 Implications for Practice and Policy

The findings of this study have provided evidence related to the factors that contributed to and hindered inclusive practices for SWD in the science classrooms of the three SPIE studied. The findings have the potential to influence school stakeholders, including teachers, principals and policymakers who are grappling with policy changes and the focus on schools being inclusive of all students. While positive views of IE were evident from the data and SWD were welcomed in the science classrooms, actual inclusion was not in evidence and clearly work is needed to train teachers and build sound structures to implement true inclusion for SWD in science. Embedding inclusive philosophical in each school program is critical. Clearly, teachers also need to build their capacity and resourcefulness, embrace change and proactively increase their knowledge about how to ensure that inclusive science teaching and learning occurs in their classrooms. This investigation revealed that only teachers in School C knew about the UDL. The UDL provides guidance in how to design a curriculum that is accessible and flexible for all students, not only for SWD. Therefore, it is recommended that training on the UDL would be a positive start to educating teachers about how to make their science classrooms more inclusive and facilitate the shift from the special education model.

This study generates several implications for science teachers.

First, evidence from previous studies shows that SWD can be successful in science learning when teachers establish goals that are leading to purposeful, resourceful and strategic learning. Science teachers need to hold high expectations for SWD and provide learning objectives that are clear, attainable and measurable in the way they can access the science curriculum to promote meaningful and successful science learning for SWD. To set clear, achievable and measurable goals for SWD, science teachers need to consider the nature of the students' strengths, abilities and learning needs before designing the curriculum and pedagogical approach. Cooperation and collaboration with other professionals are needed to undertake deep analytical work and establish the best approaches to work with these students. This analysis would assist science teachers to design relevant adaptations/modifications to curriculum instead of totally adopting the national science curriculum.

S*econd*, the literature asserts that inclusion for SWD would be successful if teachers applied inclusive teaching approaches and carefully selected appropriate methods that work for SWD based on their learning styles, pace and types of disabilities. Applying student-centred instruction such as inquiry and problem based learning is possible and suitable for teaching science for SWD. Research supports co-teaching that offers collaborative actions between science teachers and support teachers, noting that learners are diverse and no specific teaching method works best for all. This finding and those of the present study imply that science teachers need professional learning opportunities to assist them to select the best teaching strategies to provide meaningful science learning experiences to SWD. The UDL framework can assist teachers to design these strategies and meaningful learning experiences before they start to teach.

The *third* implication relates to assessment, which is an important aspect of learning. Assessment is a tool to check whether the learning goals are achieved by students or not. The findings of this study indicate that science teachers were more concerned about cognitive rather than skill and affective learning domains. It suggests that teachers need to consider the other two domains of learning to monitor SWD's learning progress and establish the whole picture of SWD learning outcomes. To create inclusive practices, science teachers need to maximise and vary means for SWD to express their understanding, skills and attitudes. Science teacher competency in assessing students (not only with disabilities) can be trained through sustainable workshops as part of their career development.

It is clear from this study that the move to include SWD in regular classes is an important but insufficient provision to ensure inclusion occurs. This situation, apart from having implications for science teachers to practise a more inclusive teaching approach to enable all students to have access to the general science curriculum, has noteworthy implications for Principals and the Department of Education about providing substantial support for science teachers. Professional training and workshops on inclusive teaching, as well as appointing support teachers and paraprofessionals, are greatly needed to create inclusive settings. Without this support, misunderstanding and confusion could remain for science teachers and lead to greater exclusion or marginalisation of SWD, as was reflected by science teachers' methods of setting goals, implementing teaching approaches and assessing SWD. Principals also need to develop an inclusive approach to their leadership where they work with staff as teams and act as role models to teachers and other school members in working inclusively and building an inclusive school. In addition, universities and teacher education facilities could take a role in training educators to understand the philosophy of inclusive education and ways to include diverse learners including SWD in all aspects of learning.

The research literature raises two key matters of concern in relation to policy. *Firstly*, policies in local government and at school level are non-existent and the misinterpretation of IE is demonstrated in many policies that purport to be about inclusion but really reflect aspects of exclusion and marginalisation. Robinson (2014) argued that teachers must be careful when removing SWD from their regular classes (to receive additional support) to prevent students from feeling marginalised, as evidenced in School A. *Secondly*, inclusive ideas and approaches stated in policy and legislation are not reflective of implemented practice, therefore a stronger link between policy and practices is needed. IE policy in Indonesia is not well-shaped because of insufficient resource allocation and inadequately equipped in-service teachers in general schools. As this study confirms, special education in the form of integration continues to be practised in Indonesia. The practice of excluding SWD through parallel systems of 'special' and 'integrated' education needs to move to an IE system that focuses on education for all. This move is a necessary, fundamental and long overdue step.

9.2.3 Implications for Research Methodology

The qualitative collective case study methodology applied in this current study involved studying three cases in significant depth and in real-world contexts. This methodology was selected to answer the *how* and *why* questions in relation to science teaching and learning for SWD. Yin's analysis method helped with interpreting the data to identify similarities and differences in each case. Four dimensions of credibility, transferability, dependability and confirmability were applied to ensure the trustworthiness, which provided the opportunity for replication and analytic generalisation or argumentative claims. The analytic generalisation produced by this study built the nuances relevant to the theoretical concepts that emerged (Yin, 2018). Case study research also enabled new theories to be generated through a process in which findings were extended from one case to another as data were collected and analysed. Dooley (2002) explained that the process of continuously restating and refining over time can be referred to as "the multiple case study" (p. 336).

The findings from this study add support to existing qualitative research on science teaching and learning practices for SWD. Science teachers' views about how they set goals, reframed standards into learning objectives, modified individual learning objectives and established minimum criteria for the passing grade for SWD in certain types of SPIE bring new information to the literature on inclusive science teaching and learning at middle school level for SWD. The move by schools in this study to engage in inclusive practices in science teaching and learning, the SWD's experiences and their voices on how they learned science and what kind of environment supported their learning raised issues that need further consideration by other researchers investigating inclusive science practices in developing countries. The present study reported participants' real-life perspectives and experiences about how science teaching and learning was designed, implemented and assessed to facilitate access to and participation in learning and minimise barriers to education for students with VI, HI and LD.

9.3 Limitations and Delimitations of The Study

Although the present study makes its contribution to knowledge in the field of science teaching and learning practices in three SPIE, the study did have several limitations and delimitations.

First, IE is a relatively new educational approach to teaching SWD in Indonesia. Searching through the many databases showed research in IE and particularly in science education and science teaching and learning for SWD in Indonesia is significantly limited. In addition, there was limited access to documents for further analysis related both to the exact number of SWD as provided by official bodies and to teachers' documents related to their instructional approaches.

Secondly, the study was conducted by employing a qualitative collective case study approach which very much relied on the primary data source, the participants, and their responses regarding the studied phenomenon. The quality of the collected data required for the study was determined by the participants' answers to the questionnaire, the questions during the individual and focus group interviews, the classroom observations and the instructional documents provided by science teachers. To encourage openness and honesty in participants' responses, confidentiality was maintained during the entire process of data collection. In addition, the complexity involved in analysing qualitative data, particularly to interpret the hidden meanings in those data, was highly dependent on the researcher (Fink, 2000) and his/her perspective (Sadala & Adorno, 2002).

Thirdly, the small number of participants meant that the findings cannot be generalised. Participants (science teachers, support teachers, principals and SWD) in this study cannot be considered as representatives of other middle schools throughout DI Yogyakarta and even beyond Indonesia. Therefore, generalisations of the findings from the study may only be applied on a limited basis to schools with very similar environments and contexts to this study (middle schools located in DI Yogyakarta).

In order to anticipate the time and budget constraints during the data collection process, the scope of this study was delimited so that it became more manageable. The study was delimited to science teachers who were teaching SWD, support teachers, principals, and SWD who were learning science in Grades 7-9 in three SPIE in rural and urban areas of DI Yogyakarta. Schools A and C are administered by the Ministry of Education and Culture (MOEC) and located in rural areas, whereas School B is administered by the Ministry of Religious Affairs (MORA) and is situated in an urban area.

The study was also delimited to a qualitative investigation that focused specifically on the phenomena being explored rather than a quantitative approach that questioned "the pre-given (taken for granted) variables" (Aspers & Corte, 2019, p. 155). Compared to a quantitative study, this qualitative study enabled the researcher to gather and analyse thick data on the phenomena of IE in Indonesia, particularly in the science classrooms, resulting in the formation of new understandings of IE as it was practised in that those particular settings in the Indonesian context in 2018.

The terms used to refer to SWD were delimited. As described in Chapter 2, Indonesia has many terms for SWD which generated a dilemma for the researcher in terms of how to write about the students in this thesis. I made the decision that the expression SWD better described them than would ‘students with special needs’; and that ‘students without disabilities’ was a more inclusive term to use than ‘non-disabled students’, ‘regular students’ or ‘normal students’.

9.4 Recommendations for Future Research

The abovementioned limitations and delimitations, along with the findings of this study, suggest several recommendations for possible further research.

The *first* recommendation is that, to obtain a more comprehensive picture of the inclusivity of SPIE in Indonesia, a similar study should be conducted involving larger school sample sizes, i.e. schools at different levels (primary or senior secondary schools) and in different provinces. A study involving schools of different types, levels, and geographical locations may generate different results or may confirm the findings of this study, which can facilitate generalisation to a wider population of schools with various characteristics. A larger sample size could provide a broad picture of inclusive science teaching and learning practices across Indonesian middle schools for example, leading to a move to shape more appropriate IE practices for Indonesia.

The *second* recommendation relates to the different ways of practising IE in each school studied and indicates that future research is needed to investigate factors that might cause different practices in IE.

The *third* recommendation is that quantitative studies or mixed-method approaches could be implemented to explore the relationship between factors that affect inclusivity in educational practices. Quantitatively, the inclusivity could be measured with instruments such as the index of inclusion and then qualitatively with frameworks other than UDL.

The *fourth* recommendation is that further investigation is needed in the area of pedagogical approaches that are appropriate for SPIE in the Indonesian context. The literature suggests that inclusion requires some basic teaching principles, i.e. differentiation, accommodation and universal design. Therefore, future studies on these three principles would be valuable, especially when the latest curriculum, K13, which it is claimed provides a more flexible space for teachers to design learning, is implemented. In addition, an evaluation of the implementation of K13 for an inclusive setting would be valuable and essential.

The *fifth* recommendation relates to the fact that this study only involved SWD in a limited number and thus their voices were heard in less depth. Student voices from minority groups (including those with disabilities), according to Lodge, Devine, & Deegan, 2004 (cited in Fleming (2015)) have become a very minimal priority and tend to be excluded and more marginalised than the voices from other groups. Consequently, involving student's authentic perspective to measure the degree of inclusivity is critical (Nilholm & Alm, 2010). Research investigating children's views and experiences would be beneficial in gaining a better understanding of inclusion and developing effective inclusive practices to attain more socially just schooling (Messiou, 2008). Research "can be a powerful means to inform school staff about educational developments (e.g., inclusive education) by identifying biases and issues in school practices" (Andriana & Evans, 2020, p. 8).

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Appendices

Appendix 1
The differences between Curriculum 2006 and 2013 (K13)

Element	Aspects of Difference	Curriculum 2006	Curriculum 2013
Teacher	Authority	Close to absolute	Limited
	Competency	Must be high	Should be high. However lower competencies are still helped by the existing book.
	Responsibility	Heavy	Light
	Time effectiveness to do learning activities	Low (too much time needed for preparation/planning)	High
Students	Learning outcomes	Depend on teacher as a whole	Not only depend on teacher as a whole, but also the books provided by the government.
Curriculum	Frame and structure	basic structure (group of subjects) Curriculum structures of each grade Competency Standards (SK) and Basic Competencies (KD)	Basic structure (group of subjects) Curriculum structure Syllabi Subject guide Core competencies (KI) and Basic Competencies (KD)
	Focus of competency	Put more emphasis on the aspect of knowledge.	Graduates competence aspects are on the balance of soft skills and hard skills that include attitudes, skills as well as knowledge competencies.
	Amount of lesson	The amount of lesson hours per week are less and the number of subjects is more than K13.	The amount of lesson hours per week are more and the number of subjects is less than KTSP
	Specialisation	Major specialisation starts from grade IX	Specialization starts from grade X
Process of syllabus design	The teachers' role	Close to absolute (only limited by SK-KD)	Develop the syllabus provided by the government
	The government's role	Only on SK-KD	Absolute
	The district government's role	Designing supervisor	Implementation supervisor
Lesson plan design	The teachers' role	Close to absolute	Small, to develop the existing plan on the textbook
	The district government's role	Supervisor of the designing and monitoring	Supervisor of the implementation and monitoring
Learning implementation	The teachers' role	Absolute	Close to absolute
	The district government's role	Monitor the appropriateness with the plan (variation)	Monitor the appropriateness with the textbooks (in control)
	Learning process	The standard for the process of learning consists of exploration, elaboration, and confirmation.	In every theme of the learning process in elementary and all subjects in secondary schools are

Element	Aspects of Difference	Curriculum 2006	Curriculum 2013
			conducted with a scientific approach (5Ms).
	Assessment	The assessment is more dominant in aspects of knowledge	Standard assessment using authentic assessment, which measures the attitudes of all competencies, skills and knowledge based on the process and results.
Quality guarantee	Government	Difficult, since too many variations	Easy, since direct to same basis
Book	Publisher's role	Big	Small
	Material and process variation	High	Low
	Price variation	High	Low
Book provision	Publisher	Strong	Weak
	Teacher	Close to absolute	Small, just for enrichment book.
	Government	Small, for proper usage in school	Absolute for textbooks.
		Technology, information and communication as subject	Technology, Information and communication is not a subject but as the learning media.

Appendix 2
Indonesian Regulations of Inclusive Education

Number/Year/Name	Concern	Level
Indonesian Constitution of 1945	Article 32 paragraph (1) which affirms "every citizen shall have the right to education"; Article 32 paragraph (2) stipulates that "every citizen shall be obliged to follow basic education and the government shall be obligated to finance it";	National
Law No. 23/2002/Child Protection	Article 51 which affirms that "children with physical or mental disabilities are given equal opportunities and accessibility to obtain general and special education".	National
Law No. 20 of 2003/National Education System	Article 5 paragraph (1) which emphasizes "every citizen has the same right to obtain quality education"; Article 11 states that the government and regional governments are obliged to provide services and facilities and guarantee the implementation of quality education for every citizen without discrimination. Based on this article students with special needs have the right to receive the same educational services as students in the form of special education. Article 15 states Special education is the provision of education for students with disabilities or students who have extraordinary intelligence held in an inclusive manner or in the form of special education at the primary and secondary education level. Article 32 paragraph (1) states Special education is education for students who have a level of difficulty in following the learning process because of physical, emotional, mental, social, and/or possessing intelligence potential and special talents.	National
Law No. 19/2011/The Endorsement Ratification of the Convention on the Rights of Persons with Disabilities (CRPD)	The Indonesian government signed the CRPD on March 30, 2007 in New York. The signing shows the seriousness of the Republic of Indonesia to respect, protect, fulfil and promote the rights of persons with disabilities, which in turn are expected to fulfil the welfare of persons with disabilities.	National
Circular of the Director General of Primary and Secondary Education Management of the Ministry of National Education Number 380/C.C6/MN/2003	Every district/city is required to organize and develop inclusive education in at least 4 (four) schools consisting from elementary, middle school, high school, vocational school.	National
Ministerial Regulation No. 70/2009/ Inclusive Education for Students Who Have Disabilities and Have Potential Outstanding Intelligence and/or Talent	Article 1 states that inclusive education is a system of education that provides opportunities for all students who have abnormalities and have the potential for intelligence and/or special talents to attend education or learning in one educational environment together with students in general.	National
Government Regulation No. 17/2010/Management and Implementation of Education	Articles 127 to 142 concerning the implementation of special education and special service education.	National
The Regulation of Minister of Education and Culture on Special Education No. 46/2014	Article 4 states that a special education is carried out in an inclusive manner. This regulation becomes the basis for the provision of education for learners with special needs to learn and obtain education in public schools.	National

Number/Year/Name	Concern	Level
Law No. 8/2016/Persons with Disabilities	Article 10: every person with disabilities has rights to get quality education in education units in all types, lines and levels of education in an inclusive and special manner; Article 40 – 42: government at national and local levels should provide and/or facilitate educations for people with disabilities, through inclusive and special education.	National
The regulation of Governor of Special Province of Yogyakarta (DIY) No. 4/2012 of Protection and Meeting Rights for People with Disabilities states that	Article 6: education for SWD is operated in inclusive and special education systems.	Province
The regulation of Governor of Special Province of Yogyakarta (DIY) No. 21/2013 of the Implementation of Inclusive Education	Article 3: Every education unit must accept students with special needs.	Province
District Regulation (perda) Bantul No. 11/2015/The Fulfilment of The Rights of People with Disabilities	Article 5: Education for Persons with Disabilities is carried out by the Regional Government and/or the community through an inclusive education system. Article 6: (1) Inclusive education functions to provide educational services for students with disabilities who have difficulty following the learning process due to physical, mental, emotional, intellectual and/or social disabilities. (2) Students with disabilities consist of persons with disabilities as referred to in Article 2 paragraph (3).	District
Mayor Regulation (perwal) No. 47/2008/Schools Providing Inclusive Education (SPIE)	Article 2: the purpose of implementing inclusive education is to provide educational services through an adequate learning process for students with different backgrounds and needs in an educational unit. Article 3: the objectives of inclusive education are: a. the fulfilment of the right to a good education and provide the widest possible access for children's stews, including children with special needs, b. the realization of a fair and quality learning system in accordance with the skills, potentials and needs of individual students.	District

Appendix 3
Letter for Contacting Gatekeeper,
Letter of Introduction, Information Sheet, and Consent Form

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Appendix 4
Interview Guide

Research Questions	Interview Questions for Science Teachers	Interview Questions for Students with Disabilities	Interview Questions for Support Teachers	Interview Questions for Principals
Introductory Questions	How do you feel when welcoming SWD into your classroom? Prompts: Tell me what you know about the disabilities that students in your science class have. How well prepared do you feel for welcoming SWD in your classes?	How do you feel when studying Science in your classroom? What is your opinion of your Science teacher's knowledge/understand about your disabilities?	Tell me about the disabilities of the SWD you support. How well prepared do you feel when supporting SWD in science classes?	When did this school begin welcoming and including SWD? What have been the most challenging experiences you have faced in leading an inclusive school? Do you have an inclusive practices leadership team? How are they are working?
Addressing sub-research question 1 In what ways do science teachers develop inclusive science curriculum and instruction for SWD?	How do you develop inclusive science curriculum and instruction for SWD? Prompt: How do you establish the learning objectives that clear, specific, measurable and achievable for SWD? How do you address options for diverse learners' needs? Describe how you plan and present information, concepts and carry out assessment. Describe the formats you use for presenting information, concepts and assessment. How do you provide SWD with guidance and support for effective goal-setting?	Does your Science teacher provide guidance to support Science learning? What special materials and technology does your Science teacher use to ensure that you can access the curriculum? How does studying science using special materials and/or technology make you feel?	How do you communicate and collaborate with the science teacher in preparing science curriculum and instruction for SWD? How do you ensure your modifications to curriculum will give the student access to learning and build the SWD's knowledge and understanding?	How do you ensure that Science teachers develop inclusive science curriculum and instruction for SWD? Have you supervised the curriculum documents? Are Science teachers currently implementing any inclusive practices models? Co-teaching, Consultancy, Collaborative? If so, how are they are working?

Research Questions	Interview Questions for Science Teachers	Interview Questions for Students with Disabilities	Interview Questions for Support Teachers	Interview Questions for Principals
Addressing sub-research question 2 In what ways do science teachers adapt pedagogy (learning strategies), select varied and accessible learning media, and use multiple assessment forms to evaluate SWD's academic performances?	How do you provide SWD with multiple pathways to learn Science, offer accessible material and capture their performances? Prompts: How do you activate the students' prior knowledge to support their comprehension? What teaching methodologies do you use and strategies do you adopt for SWD to build their skills, express what they know and participate actively in your class? What special material and technology do you use to ensure SWD have chances to access those materials and build their knowledge? How do you provide appropriate assessment to measure SWD's learning outcomes (cognitive, psychomotor and affective domain)?	Do the teaching methodologies your teacher engages in assist you to build your skills and help you to express what you learn? Do you actively participate in the classroom? How does your science teacher enable you to actively participate in science learning? What teaching strategies do your teacher use? How does your science teacher assess your learning outcomes? Are these forms different from those of your peers?	How do you communicate and collaborate with science teachers in supporting SWD in science classes, enabling access to learning, modifying teaching strategies, adapting media, and offering various assessment forms? How do you ensure your support will result in SWDs' access to learning, skill development and positive learning outcomes?	How do you ensure that science teachers provide access to learning, accessible materials, appropriate teaching methods and encourage SWD to actively participate in their classes?
Addressing sub-research question 3 In what ways do science teachers take advantage of students' interests, to persuade and	How do you motivate SWD to gain interest in and feel challenged to learn Science? Prompts: How do you make science learning relevant to the	What does your science teacher do to build your motivation and engagement in learning science? What does your science teacher do to take advantage of yours's	How do you communicate and collaborate with Science teacher in building motivation and engagement for	How do you ensure the science teacher take advantage of SWDs' interests, persuade and motivate them to learn, and

Research Questions	Interview Questions for Science Teachers	Interview Questions for Students with Disabilities	Interview Questions for Support Teachers	Interview Questions for Principals
motivate them to learn, and give them appropriate challenges?	SWD's lives and society? How do you provide various levels of challenge and support? How do you set the SWD's personal goals to increase their self-motivation?	interests and give you challenges?	SWD to learn Science? How do you ensure your advice and support can result in Science teachers taking advantage of SWDs' interests motivating them to learn and challenging them to engage in scientific thinking?	give them appropriate challenges in their science classes?
Addressing sub-research question 4 How do science teachers make the classroom inclusive for all students including students with disabilities?	How do you ensure your classroom inclusive for all students, including SWD? Prompts: How do you define "inclusion" (i.e., inclusive practices)? What is your own definition? What do you currently know about inclusive practices? Collaborative Teaching Support Models, co-teaching approaches, scheduling SWD based on support needs? Do you have joint planning time with support teachers who share instructional responsibilities for the same students? What resources are available (instructional coaches, mentors, special programs) to help meet the	Do you have opportunities to freely express your skills, talents and preferences? In what ways? Does your teacher involve your parents to find your progress in learning Science? In what ways?	How do you define "inclusion" (i.e., inclusive practices)? What is your own definition? What do you currently know about inclusive practices? Collaborative Teaching Support Models, co-teaching approaches, scheduling SWD based on support needs? Do you have joint planning time with Science teachers who share instructional responsibilities for the same students? What resources are available (instructional coaches, mentors, special programs) to help meet the support needs of SWD? Do you believe your science class	What do you currently know about inclusive practices? Are any of your support teachers co-teaching? If so, what approaches are they using? Do Science teachers and support teachers who share instructional responsibilities for the same students have joint planning time? What resources are available (instructional coaches, mentors, special programs) to help meet the support needs of SWD? Do you involve and collaborate with parents' of SWD to find the appropriate ways for SWD to learn science? How?

Research Questions	Interview Questions for Science Teachers	Interview Questions for Students with Disabilities	Interview Questions for Support Teachers	Interview Questions for Principals
	support needs of SWD? How do you collaborate with parents regarding student's progress in learning Science?		where you support is inclusive? Why? How do you measure its inclusiveness?	
Closing questions	What have been the most challenging experiences and barriers you have faced so far in teaching SWD? What do you expect for your students after they have learned Science? How does the inclusion of SWD impact on the other students in classroom? What do you see are the benefits for you and all students of having SWD in your Science class? What support do you have to develop your skills in managing your classroom that welcome SWD? Do you believe your class is inclusive? Why? How do you measure its inclusiveness?	What have been the most challenging experiences you have faced so far in studying Science? Do you feel included in your science classes? Tell me why. Do you know what an inclusive classroom is? Do you believe that your classroom is inclusive of all students? Why do you think this?	What have been the most challenging experiences you have faced so far in supporting SWD in science classes? What do you thing future outcomes will be for your students after they have learned Science?	What do you expect for SWD after they have learned in this school? What support do you provide for teachers to increase their competency in managing and including SWD? What do you believe to be the impact, if any, on the other students, teachers and staff by welcoming SWD into the school? How do you define "inclusion" (i.e., inclusive practices)? What is your definition? How inclusive do you believe your school is? How do you monitor and assess the inclusiveness of your school? What do you believe is needed to make your school more inclusive of SWDs?

Appendix 5
Qualitative Questionnaire for Science Teachers

(Reproduced with permission)

We are investigating what kinds of science teaching and learning practices are welcoming to students with disabilities. There are no right or wrong answers to these questions. Whatever you think is the best answer.

Instruction:

Please indicate your response by ticking (√) the appropriate box for each statement and giving a reason and example for your choice.

A. Representation

1. When setting up learning objectives and goals for students with disabilities, I …

   a. consider the knowledge domain (cognitive)

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   b. consider the skills domain (psychomotor)

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   c. consider the attitude domain (affective)

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   d. categorize the objectives into two groups: need-to-know (essential) and nice to-know (important, not essential)

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   e. use a "SMART" (Specific, Measurable, Achievable, Relevant, and Timely) strategy

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

f. use an “ABCD” (Audience, Behaviour, Condition, and Degree) strategy

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

g. other strategies I use are …

2. Please give examples of ways, in which you present information using the following types of modalities.

a. Text	
b. Graphics	
c. Audio	
d. Video	
e. Others	

3. Which of the following options do you provide when structuring material to build knowledge for students with disabilities? I …

a. attach new ideas to prior knowledge

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

b. highlight key concepts and explain how they relate to course objectives

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

c. begin each class with an outline of material to be covered

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

d. conclude every session with a summary of key points

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

e. represent key concepts graphically as well as verbally

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

f. present the real-life example related to the material to make learning applicable

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

g. make learning "active", participatory and use student-centered learning approaches

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

h. other options I use are …

4. When creating assessments that accurately measure knowledge development of students with disabilities I …

a. create assessments straight from the learning objectives, even before outlining course content

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

b. use alternatives to the traditional quizzes and exams

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

c. give instruction on the assignments both in writing and verbally

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

d. provide clear expectations

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

e. provide clear feedback

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

f. create a grading rubric to ensure the objectivity when assessing

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

g. other examples of assessment activity are …

B. **Action and Expression**

5. Which actions do you usually undertake when describing objectives in ways that are measurable and achievable for students with disabilities?

a. Set goals and objectives for students with disabilities that guide instruction and assessment

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

b. Define high expectations to all students at the beginning of the course while communicating my eagerness to make "appropriate accommodations" for SWD.

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

c. Other actions I use are …

6. Which of the following options do you provide for students to express what they know?

a. Use alternative project formats, e.g.: (tick as many as appropriate)

☐ short report ☐ short videos	☐ others, please specify

☐ vlog ☐ oral presentations ☐ newspaper articles ☐ photo essays ☐ web publications ☐ blog	

b. Adopt instructional technologies to increase communication and allow for alternate ways of expression

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

c. Other options I use are …

7. Which of the following options do you use when building skills for students with disabilities?

a. Begin class with an advanced organizer (using an essential question) that I will address all through the class

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

b. Give them additional time to do their tasks, so that SWD can practice recalling and utilizing information

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

c. Allow them to grasp material in their preferred learning style

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

d. Allow them to grasp material at their own pace

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

e. Assist them to identify how they learn best

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

f. Invite them to answer the question to check whether they have understood the task at the end of class

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

g. Capture students' attention to pique their interest in the topic

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

h. Allow them to work in pairs with non-disabled students e.g. in the laboratory where physical and/or sensory effort may disadvantage SWD

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

i. Other option I use are …

8. In what ways, do you employ assessments to measure skill development?

a. Allow SWD to submit assignments electronically, as appropriate

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

b. Give prompt, progressive and informative feedback to support learning and self-assessment

- ☐ Always
- ☐ Frequently
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Please give reasons for your choice, giving an example where appropriate.

c. Other ways I employ to measure skill development are …

C. Engagement

9. In what ways, do you establish objectives that motivate students to learn?
   a. Invite SWD (in their own way) to speak to me on the off chance that they have learning challenges

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   b. Implement "appropriate accommodation" for SWD in my class

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   c. Accommodate the personal interests and/or values of SWD when writing objectives

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   d. Other ways I establish objectives are …

10. What alternatives do you provide for students to interface with instructional materials?
   a. Ensure that examples and content used in class are pertinent to people with disabilities

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   b. Provide captioning or transcripts for videos

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   c. Check for ancillary electronic materials (CD-ROM and web content) to go with the course book

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

   d. Other alternatives I provide are …

11. In what ways, do you build students with disabilities' motivation and engagement?
    a. Create a welcoming class environment

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

    b. Utilize innovation to expand class correspondence, e.g.: WhatsApp Group, FB Group, or mailing list

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

    c. Create some "energy" (e.g., humour, anticipation, suspense, ice breaker) during teaching and learning to increase attention and recall.

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

    d. Offer available time in adaptable formats (e.g. face-to-face, email or telephone) for extra support.

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

    e. Other ways to build their motivation are …

12. What assessments do you use to monitor emotional well-being (affective development)?
    a. Have SWD explore the value and meaning of their learning experience for them selves

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

    b. Have SWD explore the value and meaning of their learning experience for society

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

    c. Utilize experiential learning activities (for example, a reflection paper) to explore improvement in the affective domain

☐ Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never	Please give reasons for your choice, giving an example where appropriate.

d. Other assessments I use are …

* adapted from CAST© (2011) and ACCESS: "From Theory to Practice: UDL Quick Tips", Colorado State University (available online at http://accessproject.colostate.edu/documents/)

Appendix 6
Qualitative Observation Field Notes Form

Date : ______________________________

Time : ______________________________

Location : ______________________________

Teacher and SWD activities	Observation running notes
A. Opening /introduction Overview of the lesson/learning goals and planned outcomes	
B. Teaching strategies used to meet the needs of diverse learners 1. Pedagogy – how information is presented, and teaching strategies are adapted for the SWD in the class 2. Activation of SWDs' prior knowledge 3. Ways SWD's are engaged in learning 4. Ways information is made accessible to SWDs 5. Ways concepts and terminology are explained to meet the needs of SWDs	
C. Options offered 1. Alternate expectations for physical response 2. Alternate options for time lines and timing 3. Choices for expression 4. Tools for composition and problem solving 5. Ways performance is supported	
D. Materials provided 1. Alternate formats 2. Technology 3. other	
E. Guidance and support for effective goal-setting 1. Strategies 2. Materials 3. Modifications	
F. Engagement 1. How science learning is made relevant to SWDs 2. Provision of levels of challenge 3. How students are motivated to learn 4. How students are challenged	
G. Closure 1. Challenging experiences noted 2. Barriers to science learning observed 3. Impact on other students 4. Benefits for SWDs 5. Support provided	
H. Assessment 1. Forms of assessment used 2. Modifications to assessment instruments	

Appendix 7
The Results of Coding, Categorising and the Appearance of Themes and their Relationship to Research Questions

Research Question	Codes	Category	Theme
Sub-research question 1: How science teachers establish expectations, goals, objectives and the passing grade for SWD?	Expectation to SWD Individual goal setting	Expectations and goals	Setting goals for students with disabilities
	SK/KI KD Lesson plan Syllabi	Reframing Standards	
	Considering the knowledge domain (cognitive) Considering the skills domain (psychomotor) Considering the attitude domain (affective) Categorizing the objectives Use a "SMART" strategy Use an "ABCD" strategy	Individual Learning Objectives	
	KKM for regular KKM for SWD Time for setting KKM	Criteria for the Minimum Passing Grade (KKM)	
Sub-research question 2:	Type of Instructional material Alternative for auditory Alternative for visual Customizing display Assistive technology Method for navigation Method for responding Optimize access	Instruction to Support Recognition Learning	Practical pedagogies for students with disabilities
	Attach new ideas to prior knowledge Highlight key concepts Represent key concepts graphically as well as verbally Guide information process Memory transfer begin each class with an outline Conclude every session Present the real-life example Make learning "active" & participatory Student-centered learning approaches Advanced organiser Additional time Allow to work in pairs Preferred learning style Multiple media for communication Scaffold practicing Tool for construction & composition Provide clear feedback	Instruction to Support Strategic Learning	
	Allow SWD to participate Authentic activities	Instruction to Support Affective Learning	

<table>
<tr><th>Research Question</th><th>Codes</th><th>Category</th><th>Theme</th></tr>
<tr><td></td><td>Individual choice
Minimize threat
Provide challenges
Relevant to daily life
Relevant to SWD pace
Varied in activities
Vary the level of sensory stimulation
Vary demands and resources to optimize challenge
Collaboration and communication
Mastery-oriented feedback
Vary support
Facilitate coping skill
Guide personal goals
Provide coach/mentor
Scaffold coping
Self-assessment
Self-reflection</td><td></td><td></td></tr>
<tr><td rowspan="3">Sub-research question 3:</td><td>Create assessments straight from the learning objectives
Use alternatives exams
Create a grading rubric
Dealing with national examination for students with disabilities</td><td>Assessment for Recognition Learning</td><td rowspan="3">Assessing Students with Learning Disabilities Progress</td></tr>
<tr><td>Provide clear instruction
Measuring skill development</td><td>Assessment for Strategic Learning</td></tr>
<tr><td>Monitoring emotional well-being</td><td>Assessment for Affective Learning</td></tr>
<tr><td rowspan="5">Sub-research question 4: How do science teachers make the classroom inclusive of all students including SWD?</td><td>Teacher acceptance of SWD
Teacher perception on SWD
Teacher expectation towards SWD
Teacher perception of inclusivity
Self-perception
Student expectation of learning science
Student perception on science
Student perception on inclusivity</td><td>Understanding Inclusive Education</td><td rowspan="5">Factors to create Science Classroom Inclusive for All</td></tr>
<tr><td>Support teacher roles
Science teacher and support teacher roles in planning instruction
Science teacher and support teacher roles in instruction
Science teacher and support teacher roles in creating and administrating assessment</td><td>Support Teacher Roles</td></tr>
<tr><td>Training for science teacher
Training for support teacher
Training for inclusive teaching</td><td>Teacher Training and Support</td></tr>
<tr><td>Physical building
Accessibility of infrastructure</td><td>Infrastructure</td></tr>
<tr><td>Effect for other students
Effect for teachers and staff
Institutional barriers</td><td>Policy and program</td></tr>
</table>

Research Question	Codes	Category	Theme
	Monitoring of science inclusive practices School support for SWD School support for teacher		
	Parent come to school Parents were asked to help their child learn at home Parents view about their child Parents expectation about their child	Parent Involvement	
	National exam (UN) Students differences Students' ability range Students' behaviour	Challenges and Barriers	

Appendix 8
Ethics Approval

Content removed for privacy reasons

Appendix 9
The Documents Analysis on the Learning Objectives Establishing in Schools A, B and C

School	Basic Competencies	Learning Objectives	Purpose of the Standards
A	Explain the relationship between processes that occur in the lithosphere and atmosphere with health and environmental problems.	The students will **explain** the notion of global warming.	Recognition
		The students will **mention** the causes of global warming.	Recognition
		The students will **explain** the impact of global warming.	Recognition
		The students will **explain** how to combat global warming.	Recognition
	Analyse the occurrence of environmental pollution and its impact on the ecosystem.	The students will **explain** the meaning of environmental pollution.	Recognition
		The students will **explain** various types of environmental pollution.	Recognition
		The students will **explain** the meaning of water pollution through investigation.	Recognition
		The students will **investigate** the influence of clear and polluted water on the condition (movement) of fish	Strategic
		The students will **construct** ideas on how to overcome and reduce water pollution.	Strategic
B	Describe electric charges to understand the signs of static electricity and their relation to everyday life.	The students will **distinguish** positive electrical charges and negative electrical charges.	Recognition
		The students will **distinguish** static electricity and dynamic electricity.	Recognition
		The students will **explain** the process of lightning	Recognition
	Explain the pressure of substances and their application in everyday life, including blood pressure, osmosis, and capillarity of transport tissues in plants	The students will **explain** the concept of pressure	Recognition
		The students will **analyse** the relationship between force and surface area on the amount of pressure	Recognition
		The students will **explain** the law of Archimedes	Recognition
		The students will **apply** Pascal's law to objects in everyday life	Recognition
		The students will **link** the theory of substance pressure with the process of transporting substances to plants and blood pressure	Recognition
		The students will **apply** the principle of gas pressure on objects in everyday life	Recognition
		The students will **analyse** the application of Archimedes' law to	Recognition

School	Basic Competencies	Learning Objectives	Purpose of the Standards
		floating, floating and sinking objects	
		The students will **analyse** the pressure of liquid at a certain depth	Recognition
		The students will **analyse** the principle of pressure on the process of capillarity in the transport of substances in plants	Recognition
		The students will **analyse** the application of substance pressure in the manufacture of water rockets	Recognition
		The students will **present** data on the results of liquid pressure experiments at a certain depth	Strategic
		The students will **present** experimental data on the application of the pressure principle to the capillary process in the transport of substances in plants	Recognition
		The students will **present** data on the results of experiments applying pressure in water rocket experiments	Recognition
	Analyse the concepts of temperature, expansion, heat, heat transfer, and its application in daily life, including mechanisms to maintain body temperature stability in humans and animals.	The students will **explain** the definition of temperature.	Recognition
		The students will **investigate** various types of thermometers.	Cognitive
		The students will **determine** the scale of temperature by taking temperature measurements using a thermometer.	Psychomotor
C	Analyse the concepts of vibration, waves, and sounds, in everyday life including the human hearing system and sonar systems in animals Presenting the results of experiments about vibrations, waves, and sounds	The students will **explain** the meaning of vibration	Recognition
		The students will **investigate** pendulum vibration occurrence	Strategic
		The students will **calculate** the frequency and period of vibration swing	Recognition
		The students will **explain** the meaning of waves	Recognition
		The students will **investigate** wave occurrence	Strategic
		The students will **explain** the meaning of vibration	Recognition
		The students will **compile** search results about radar systems in the form of posters/papers	Recognition

Appendix 10
School C Programs

School C has a vision: "children grow and develop as character learners, respect diversity, love the homeland and local wisdom, and show awareness as citizens of the world", while the mission of the school C is (Oktaviana & Kurniasari, 2017, p. 4).

1. organising inclusive education that develops children according to their potential and needs;
2. providing learning that encourages children to respect religious, economic and cultural diversity;
3. providing learning that encourages children to appreciate the wealth of the nation and local potential;
4. providing learning that prepares children as active and open-minded citizens of the world.

School C has goals, which are (Oktaviana & Kurniasari, 2017, p. 5):

1. providing opportunities for children to learn and develop themselves according to their potential and needs;
2. becoming a resource centre for the community about the development of inclusive education;
3. growing empathy and tolerance of children towards diversity in religion, economy, culture and special needs;
4. holding learning activities that explore local wisdom;
5. facilitating children with learning that fosters love for the nation and state;
6. providing inquiry learning that encourages children to become active, creative, independent, explorative, disciplined and responsible learners;
7. holding learning activities that explore world culture;
8. providing knowledge and learning experiences based on appreciation and exceptions to the environment and nature preservation;
9. creating a learning climate for all citizens.

The target of school C is "facilitating students to become hands on, mind on and heart on the ever-changing world to be a part of the world community". Hands on means facilitates and encourages children to become human learners and continues to be interested in learning enthusiastically through direct experience; mind on means encourages children to keep thinking, have strong curiosity, solve problems, think critically and are challenged to innovate; and heart on means encourages children to become lifelong-learners, reflective and have sensitivity to a world that is constantly changing and caring for the environment (Oktaviana & Kurniasari, 2017, p. 6).

All people in School C are learners, be as a student, a teacher, a staff or even and including parents. They strive to build a community of lifelong-learner who seek to improve life, to make the world a better place (page 6). Learner in School C are developed to be (Oktaviana & Kurniasari, 2017, p. 6):

1. Inquirers: School C develops skills for inquiry and research.
2. Thinkers: School C exercise the sensibility and skills to think critically and creatively, to approach an issue with knowledge and understanding so that they can make reasoned, ethical decisions.
3. Reflective: School C respond to their experiences thoughtfully.
4. Caring: School C shows empathy, compassion and respect. They have a commitment to service and act to make a difference in the lives of others and in the world around us.
5. Communicators: School C is able to express their selves and what they have in mind in more than one language, using various means of communication. They collaborate with others, listen carefully and contribute actively to reach a common goal.

6. **Inclusive: School C realizes and celebrates diversity in life by accepting themselves as they are and other individuals with whatever uniqueness each person bring into his/her life.**
7. Open-minded: School C hold their own culture and personal history with self-esteem, as well as the values and cultures of others. They have an open mind towards different things in life and are willing to approach it critically so that they can grow from the experience.
8. Responsible: School C takes responsibility of their actions and their consequences. They act with integrity and honesty and with respect for other individuals.

In addition, School C has several supporting programs, namely (Oktaviana & Kurniasari, 2017, pp. 15-20):

1. Orientation Days is an orientation activity for new students as a means of introducing profiles, programs, activities, environment and school residents. This activity is carried out for 2-3 days at the beginning of each school year.
2. Morning Carpet and Reflection, which is led by all class members (students, teachers) alternately according to the agreement. The Morning Carpet is an opportunity to start the day by praying and sharing something that can provide insight, inspiration and motivation for the whole class that is done in the morning in the classroom with the homeroom of each teacher. Reflection is an opportunity to end the day by praying and recounting the reflections of something that has happened during the whole day studying in the school which can provide enlightenment, inspiration and motivation for the whole class. If there is an error in reflection, it can do reconciliation/negotiation so that there is no conflict in the future. Reflections are also carried out every day, at the end of the study period, in each class.
3. Monday Assembly

   Every Monday, all School C members gather in the hall to attend the Monday Assembly. This forum is held as a means to:
   a. cultivate understanding and pride in local and national cultural identity;
   b. discuss issues of national and global;
   c. internalize the values of life;
   d. train students' public speaking skills;
   e. appreciate the achievement/attainment of students.

   The forms of activities carried out were gathering together in the hall, opening, singing nationalities, national songs/School C songs, Pancasila reading, student achievements according to the themes raised, teacher reviews, prayers and closing. Students and teachers in charge of the appropriate schedule. Students on duty must prepare presentation material no later than 5 days before the time of arrival because the presentation material needs to be consulted with the accompanying teacher to be approved or revised.
4. Literacy policies implemented by:
   1. making all subjects as part of literacy skills, including skills to do library research, compile reports and bibliographies to avoid plagiarism.
   2. Literacy time, which is a special time for students to read in class, is carried out in a scheduled manner with reading choices that students like, as long as the reading material is in accordance with interests, age and ability to read, and does not contain pornography, violence and touch on the issue of race and religion.
   3. Commemoration of International Literacy Day every September 8 with various activities.
5. *Area Pertumbuhan*, is a typical School C program that focuses on themes around the introduction and development of student personality and skills. The *Area Pertumbuhan* is also one of School C's ways to realise the goal so that students are able to be hands on, mind on and on the phenomena that occur in local and global communities by involving aspects of creativity, action and community service.

6. Outing, regularly, schools make visits to places that can be a source of learning for children. Through this activity, students are invited to experience learning directly and obtain primary information that will enrich their learning experience.
7. Student Led Conference (SLC), is a form of celebration of student learning achievements during the learning process and also as a milestone for developing learning strategies for the smoothness and success of the next process. School C learning does not only involve teaching in the form of transfer of information and knowledge from the teacher to students, but also in the form of training for students who become active, creative, independent learners who are able to think critically and solve problems. Providing opportunities for students to reflect on their learning attainment is one way to train and develop themselves because they are trained to reflect realistically and determine whether they have experienced satisfactory development. When reflection has been done, the next step is evaluation, goals and objectives can be prepared by the students themselves, with the support and guidance of teachers and parents.

   In order for students to be able to reflect and evaluate well, these skills must be continuously trained. So, schools/teachers and parents need to take an active role in encouraging children to do it regularly, through habituation:
   a. Organisational skills: students need to be encouraged to organize and manage work and learning material by maximizing use:
      - Student organizers (SO) are filled in and checked every day. In addition to functioning as an agenda, SO is also used as a journal so students can record the learning process they passed as a reflection material to measure their self-development,
      - Folders match subjects large enough to load handouts, notebooks, modules, assignments, etc.),
      - Notebooks as needed (when using a binder, labelled/partition to separate each subject),
   b. Reflective skills: students need to learn that the value they get does not just happen and is not given by the teacher, but rather is a consequence or result of their efforts
8. Community Service and Live In, both programs are aimed at achieving the goal of "facilitating students to become hands on, mind on and heart on an ever-changing world and to be a part of the world community". Through these programs, students are given the opportunity to learn to serve others through hands-on experience, develop critical thinking in overcoming various problems (mind on) and sharpen their sensitivity and empathy for various conditions in society (heart on). Students will carry out community services and live in which are coordinated by the school for a certain period of time. Activities can take the form of visits and social actions, both short visits and stays, in schools, orphanages, nursing homes, study centres, community communities, hamlets and other relevant places.
9. Leadership Camp is an annual program carried out for 5 days outside of school to form and train the spirit of leadership, so that students become superior individuals who are able to become leaders for themselves, have strong character and have ethics to be able to give meaning to fellow humans and life. This program is also an application of the Interdisciplinary Program Unit (IDU Program), so that learning continues to occur, even carried out intensively and integrative through each activity and task given.
10. Caring for Mangrove, as a tangible manifestation of Education for Sustainable Development (ESD), School C is periodic and consistent, namely at the end of the semester (twice a year), taking an active part in greening and environmental care in the form of purchasing seeds and planting mangroves. This program is a continuous and integrated program with a fundraising for mangrove program. Fundraising for mangroves was carried out as a form of fundraising for Caring for Mangrove activities. This activity was carried out to train and foster the spirit of social entrepreneurship as well as to foster an awareness of the environment that is integrated into several subjects (IDU).

11. School C Fair is a celebration at the end of each semester followed by an exhibition of student work that has been made for one semester back. This semester closing activity is intended to provide space for students to rejoice in celebrating their learning achievements, for performances and creativity through celebratory stage or exhibition halls, and to give awards for various student achievements for one semester, both academic and non-academic.
12. Swimming Carnival is the peak event of the swimming learning process in a sports class that is held from the beginning to the middle of the second semester. For several months, students have learned and practiced swimming skills. The aim is to encourage children's love for sports and healthy lifestyles, provide opportunities and experience to compete in a healthy manner, improve cohesiveness between students and between classes in the school environment, and spend quality and enjoyable time with all school members.
13. Work Experience is a program to encourage students to study outside of school both in government and private institutions. Experience is one approach to learning that is able to train socio-economic-cultural skills. This program is carried out for 10 days of learning with the aim that students can gain learning and work experience so that competencies in social, economic and ability to solve problems can be achieved. This activity is an IDU program from a variety of subjects.
14. Intensive Camp/Interreligious Program, is an annual program that is held for 10 days outside the school to form and train leadership, respecting interfaith differences so that students become superior, independent and capable of managing diversity and resilience to become leaders for themselves and community. This program is also an application of IDU.