Faculty of Humanities

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Addressing secondary students' academic diversity and the role technology plays

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Declaration

To the best of my knowledge and belief, this thesis does not contain material previously published by any other person except where due acknowledgment has been made.

This thesis does not contain material that has been accepted for the award of any other degree or diploma at any university.

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Abstract

Providing all students with an education responsive to their academic readiness is both an important and difficult task. To meet each student where they are academically, teachers may need to adjust educational content, pedagogy and assessment in accordance with the student's prior knowledge, learning pace and academic performance. To achieve this, teachers need to collect and analyse robust student data to inform their teaching and provide a range of learning resources and activities, which can be a time-consuming process. With the introduction of new technologies in the classroom, teachers now have access to technology that can track each student's progress in real time, as well as large amounts of diagnostic, formative and summative assessment data. However, as these live tracking technologies are relatively new, there is little understanding as to how, or if, they are being used to address academic diversity. As a result, this research investigated how two intelligent tutoring systems, Education Perfect and Mathspace, were used to address lower secondary students' academic diversity. A single case study was undertaken at a Western Australian (WA) public high school. The principal, plus four French language and four mathematics teachers who had exposure to Education Perfect and or Mathspace, were interviewed. Their qualitative responses were cross-analysed with students' (N=199) quantitative data, collected through an online survey. It was found that teachers were aware of the academic diversity within their classrooms, which was at times significant and considered it important to address. They did this via a variety of resources, techniques and activities, although there were barriers in doing so, including the most significant barrier, the Australian Curriculum, as well as a lack of teaching and preparation time, large class sizes and lack of student motivation. Most of these barriers were overcome when using Education Perfect or Mathspace. The French language teachers considered Education Perfect to be an effective tool for addressing academic diversity, enabling lower secondary students to be motivated, independent learners. Mathspace was less successful at achieving this, although mathematics teachers considered the student data provided by the software programme to be insightful. Further research is needed into the impact of the Australian Curriculum on addressing academic diversity and the long-term impact of intelligent tutoring systems on students' learning outcomes, independence and motivation.

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List of acronyms and abbreviations

ACER	Australian Council for Educational Research
AC	Australian Curriculum
AITSL	Australian Institute for Teaching and School Leadership
ATAR	Australian Tertiary Admission Rank
DoE	Department of Education
FT	French teacher
HOLA	Head of learning area
ICT	information and communications technology
IQ	intelligence quotient
ITS	intelligent tutoring system
MT	Mathematics teacher
STEM	Science, Technology, Engineering and Mathematics
WA	Western Australian
ZPD	Zone of proximal development

List of key findings

List of assertions

1. Introduction

1.1 Background

There is a broad spectrum of student diversity within schools and classrooms (Tomlinson et al., 2003). These diversities include students' prior knowledge, learning pace and academic performance (Goss et al. 2016; Masters, 2013; Tomlinson et al., 2003) and are collectively referred to as academic diversity (Tomlinson, 2003; Tomlinson et al., 1997; Woodward & Ono, 2004). Within some Year 7-10 mixed-ability classes (classes that are not streamed), academic diversity can span as many as five to eight year levels (Goss et al., 2015; Siemon, 2001). Despite this significant range, there are expectations that each student's level of academic readiness will be appropriately catered for (AITSL, 2017a). Lower secondary teachers can face a number of barriers to effectively addressing this academic diversity, including curriculum requirements, standardized tests, large class sizes and a lack of teaching time (Bondie, 2019; Ricketts, 2014; Robinson, 2017; Smeeton, 2016; Tomlinson et al., 1998). This can result in a *one-size-fits-all* approach to teaching, resulting in some students not being appropriately challenged or supported (Goss et al., 2015; Masters, 2013; Subban, 2006; Tomlinson, 2014).

There are many pedagogical strategies and resources that teachers can use to address the academic diversity within their classes, such as worksheets, textbooks, seating arrangements, group work, project-based learning, and information and communication technologies, but these strategies range in effectiveness (Birnie, 2015; Robinson, 2017; Tomlinson, 2014, Tomlinson & Kalbfleisch, 1998). One resource that attempts to address academic diversity for all students is intelligent tutoring systems (ITSs). These are software that endeavour to mimic human tutors and are usually accessed via computers and smartphones. They provide content and instruction targeted at a student's level of readiness while also assisting with the explanation of concepts and material when students are answering questions (Ma et al., 2014; Steenbergen-Hu & Cooper, 2013).

Novel technologies are sometimes adopted by schools and teachers without any knowledge of and insight into the impact that the technology has on teachers' practice or students' learning. The implementation of new technology can be due to a top-down government or school-wide approach, subjective norm and/or a belief that new technology will improve student learning (Kearney et al., 2018; Teo, 2014). Another factor that brought the influence of online learning to the forefront of educational dialogue was the impact of the COVID-19 virus on education in 2020, which led to large numbers of students having to continue their education from home. This resulted in a fast and significant shift towards online learning (Leask & Hooker, 2020; Mathspace, 2020d; Rizun & Strzelecki, 2020; Viner et al., 2021). With this abrupt and somewhat forced shift towards the online world, our understanding of ITSs and other types of e-learning, and their impact on students' learning, have rapidly become more important.

1.2 Research objectives

The primary objective of this research is to understand how information and communication technology (ICT) programmes such as Education Perfect and Mathspace are used by teachers to address academic diversity among students and, in turn, the impact of ICTs on students. The following overarching research questions (RQ) helped guide this research:

RQ 1: How do principals and secondary French and mathematics teachers perceive and cater for students' academic diversity?

RQ 2: How do secondary French and mathematics teachers use and perceive Education Perfect and Mathspace for addressing students' academic diversity?

RQ 3: What are students' attitudes towards Education Perfect?

1.3 Significance of the study

This research aims to contribute to the body of knowledge regarding students' academic diversity and the role technology can play in differentiated learning. More specifically, this research builds on: the lack of knowledge surrounding teachers' awareness of, and attitudes towards, the academic diversity within their classroom; the body of literature regarding how teachers address academic diversity and the barriers faced; and teacher and student attitudes and use of ITSs, or ITS-like software, and how they consider ITSs as a tool for addressing academic diversity. Most significantly, this thesis appears to be the first peer-reviewed study into Education Perfect and Mathspace; two computer programmes used by thousands of schools and millions of students worldwide (Burke, 2020; Education Perfect, 2020a). Understanding how students' academic diversity is addressed within a digitally enhanced environment can provide insight into best practice, and the barriers and enablers involved. From this, schools and teachers can be informed of the strategies and technologies that best address academic diversity. This could be achieved through professional learning, policy change, and changes to teacher training programmes and courses. Findings regarding the technologies used by students and teachers may lead to a better understanding of the benefits, costs and required improvements of such technologies. Although this research focuses on understanding school and teacher policy/practice, any findings and subsequent implications are most significant for the students, as they would be most impacted by any change.

1.4 Thesis outline

Chapter 2 discusses the literature regarding the range in students' academic performance and how this is addressed by schools and teachers, as well as the barriers faced. The impact of ITSs on students' learning outcomes is then investigated, with reference to Education Perfect and Mathspace in particular. The research methodology and design are discussed in Chapter 3. Chapters 4, 5 and 6 present the findings for this research. Specifically, Chapter 4 considers students' data, and their attitudes and beliefs regarding the academic diversity in their class, how this diversity is addressed and Education Perfect. Chapters 5 and 6 present the principal's and teachers' interview responses. Chapter 5 focuses on the principal's and teachers' understanding and awareness of academic diversity at the school-wide and classroom levels. How they address this diversity and the barriers faced are also investigated. Chapter 6 presents the principal's and teachers' comments about the role technology such as Education Perfect and Mathspace plays in addressing students' academic diversity. The benefits and barriers of these software platforms for students are addressed, as well as teachers' use of the software. Chapter 7 discusses the findings presented in Chapters 4, 5 and 6, cross-analysing student and teacher responses to help draw conclusions from the research, which are then compared to existing literature. Recommendations for future research are then discussed. Finally, Chapter 8 summarises the key findings from the research with respect to the overarching research questions and reiterates recommendations for further research.

2. Literature review

2.1 Introduction

This literature review focused on two major topics: academic diversity and intelligent tutoring systems. There was a focus on synthesising studies within the context of Australian schools and education. Literature focusing on different contexts, such as another country, was included when Australian-based research was sparse. Existing gaps in the literature are highlighted, which helped direct the focus of this research.

Firstly, it is important to note that this literature review started with the terms ‘differentiation’ and ‘differentiated instruction’ in order to understand how schools and teachers were addressing the range of students’ academic performance, prior knowledge and pace of learning. However, the research surrounding the terms differentiation and differentiated instruction, within an educational context, appeared too broad for the scope of this research and included ill-defined terms such as *student’s needs*, *abilities* and *interests*, as well as *classroom environment* (Bondie, 2019; Haelermans et al., 2015; Levy, 2008; Mills et al., 2014; Morgan, 2014; Tomlinson, 2001, 2015). The term *academic diversity* was used to encompass these ideas. This in turn assisted with answering the overarching research questions and is discussed further below.

As outlined in the previous chapter, this research attempts to understand how schools and teachers both perceive and address academic diversity, and the role ITSs play. The following literature review investigates these two major topics by breaking them into two sections: section 2.2 focuses on academic diversity and section 2.3 focuses on ITSs. Section 2.2 begins with an investigation into the range of students’ academic performance, the expectation to provide quality education to all students, and why the term ‘academic diversity’ needs to be used throughout this research (2.2.1). Section 2.2.2 provides further insight into why academic diversity needs to be addressed. Sections 2.2.3 and 2.2.4 investigate how academic diversity is addressed at the classroom and school levels respectively, and the barriers faced.

Literature surrounding ITSs was analysed and peer-reviewed articles, including meta-analyses were found. Section 2.3 begins with a description of ITS technology, including its functions and purpose. The impact of ITSs on student learning is then presented (2.3.1). Education Perfect and Mathspace are introduced in sections 2.3.2 and 2.3.3 respectively, along with information about their development and claims regarding the programmes' functions and impact on students and teachers. The barriers and cons of ITSs, and technology generally, are presented in section 2.3.4. The chapter is then summarised in section 2.4.

2.2 Academic diversity

2.2.1 Defining and understanding academic diversity

Schools and classrooms can be diverse in student ability, needs, and interests (Goss et al., 2016; Morgan, 2014; Parsons et al., 2013; Rock et al., 2008; Tomlinson, 2015). Although Australian students commence primary and secondary schooling at approximately the same age as each other (approximately 6 and 12 respectively), their prior knowledge, cognitive abilities and rates of learning can vary due to differences in socio-economic status, parents, self-efficacy, natural-born ability, access to quality early childhood education and past academic achievement (Berger & Archer, 2016; Carroll et al., 2008; Gibbs et al., 2019; Goss et al., 2016; Sirin, 2005; Smith et al., 2018; Teese et al., 2007). These differences lead to a significant range in students' academic performance (Goss et al., 2016; OECD, 2016; Masters, 2016; Smith et al., 2018; Subban, 2006; Thomson et al., 2018; Thomson et al., 2016).

Masters (2013) used data gained from Australia's 2008 National Assessment Program – Literacy and Numeracy (NAPLAN) to make comparisons between schools. He found the highest and lowest performing students in Year 3 (and subsequent Years) can differ by as much as six year levels of achievement. One report by Australian think tank Grattan Institute converted Victorian students' Years 3, 5, 7 and 9 NAPLAN data into 'equivalent year levels' worth of achievement (Goss et al., 2016). When making comparisons between schools, Goss et al. (2016) found the range in academic achievement between students in the top 10% and bottom 10% grew from approximately 3.5 years in Year 3 to approximately eight years by Year 9. When analysing data within a typical school, students were found to differ by as much as seven year levels of academic achievement by Year 9 (Goss et al., 2016). This supported Siemon (2001, p. 10): there exists a '"seven-year gap" in mathematics performance of students in the middle years of schooling.'. Siemon (2001, p. 10) also suggested that 'in any one "mixed-ability" [mathematics] class from Year 5 to 9 there is as much variation in performance as there is in the whole of Years 5 to 9'. Another report by the Grattan Institute found that the learning gap within some classrooms can widen throughout primary and secondary education to a range of 'five to eight year levels within a single class' by Year 9 (Goss et al., 2015, p. 1).

Siemon (2001, p. 10) claimed, 'something quite radical needs to be done if the learning needs of individual students are to be adequately addressed.' With significant diversity in students' cognitive abilities and prior knowledge within their classroom, teachers 'are responsible not only for meeting the diverse needs of all students but also for ensuring improved educational outcomes' for all (Maeng, 2017; Rock et al., 2008, p. 1). Geoff Masters, the CEO of the Australian Council for Educational Research (ACER) outlines several strategies required to address Australian students' decline in academic performance, including: 'diagnosing where students are in their learning'; 'personalising teaching and learning; 'monitoring learning progress over time'; and 'sharing progress with parents and families.' (Masters, 2016, p. 3-4).

The expectation to provide quality education to students of all abilities is also held by the Australian Institute for Teaching and School Leadership (AITSL), which is a statutory body that regulates the teaching profession. It believes there is 'strong' justification for meeting the diverse learning needs of students within every classroom (Parsons et al., 2013, p. 1). AITSL has developed the seven (AITSL, 2017a) Australian Professional Standards for Teachers, which outline 'what teachers should know and be able to do'. (AITSL, 2017c, para. 1) Standard 1.5 requires teachers to 'differentiate teaching to meet the specific learning needs of students across the full range of abilities' (AITSL, 2017d). To progress from provisional to full teacher registration, a beginner teacher must demonstrate they are operating at the 'proficient level' career stage by incorporating differentiated teaching strategies in their classroom practice (AITSL, 2017b; Teacher Registration Board of Western Australia, 2017, para. 1). Further career stages, including highly accomplished and lead, require teachers to prove they can evaluate differentiated teaching and learning programmes with the use of student assessment data (AITSL, 2017d).

AITSL refers to *differentiation*, also known as *differentiated instruction*; common terms throughout educational literature (Morgan, 2014; Saiying et al., 2016; Subban, 2006; Tomlinson, 2001). A potential issue with these terms, however, is their lack of focus and clarity, especially when trying to implement them in real-world scenarios (Bondie, 2019; Haelermans et al., 2015; Mills et al., 2014). For example, differentiated instruction is often described as adapting content, process, product and environment in accordance with students' needs, abilities and interests (Levy, 2008; Morgan, 2014; Tomlinson, 2001, 2015); too many terms and ideas to effectively focus on and address from both a researcher and teacher perspective. Tomlinson (2014) says differentiated instruction is guided by 'an environment that encourages and supports learning; quality curriculum; assessment that informs teaching and learning; instruction that responds to student variance; and leading students and managing routines' (p. 20). Carol Ann Tomlinson, a well-known proponent of differentiated instruction, dedicated the first chapter of her book (*How to Differentiate Instruction in Academically Diverse Classrooms*, 3rd Edition) to outlining 'What Differentiated Instruction Is – and Isn't' (Tomlinson, 2017, ch. 1). This speaks to the lack of clarity around the terms differentiation and differentiated instruction. There has also been disagreement on whether or not differentiated instruction should include individualized learning (Barrett-Zahn, 2019; Tomlinson, 2017).

The term academic diversity has been used in educational literature to encompass students' prior knowledge, rate of learning and level of academic performance (Tomlinson et al., 1997; Tomlinson, 2003; Woodward & Ono, 2004). It has been used throughout this research to provide a narrower focus on students' academic diversity as opposed to the terms differentiation and differentiated instruction, which can include student needs, interests and abilities. However, because academic diversity sits within the umbrella term *differentiation*, the literature review addresses studies that have investigated academic diversity within the overarching topic of differentiation.

2.2.2 Reasons for addressing academic diversity

Should teachers not attempt to address the academic diversity in their class, which can be significant, there is a risk they will be 'teaching to the middle'; a practice that is unresponsive to students' prior knowledge and abilities (Rock et al., 2008; Siuty et al., 2018). Teaching too far above or below a student's current level of readiness/ability risks developing boredom, disinterest and confusion, ultimately leading to poorer educational outcomes (Subban, 2006; Tomlinson & Kalbfleisch, 1998). The relatively common-sense idea of not teaching students content that is too difficult or too easy was formalized by Vygotsky (1978). More precisely, Vygotsky (1978) proposed there was a 'zone' teachers should aim for, defined by the limit of what a student can achieve with and without assistance from a more capable other; he referred to this as the 'zone of proximal development' (ZPD) (Galaige & Torrisi-Steele, 2019; Subban, 2006). According to Subban (2006), brain-based research has supported the ZPD theory by suggesting that students benefit from being appropriately challenged. Building on students' prior knowledge and providing cognitive tasks that are not too demanding are important for mastering new ideas and learning effectively (Agodini et al., 2009; Bransford, 2000; Deans for Impact, 2015; Kirschner et al., 2006; Sweller, 1988). This is the challenge teachers often face and are expected to achieve (Masters, 2016)

2.2.3 Addressing academic diversity at the classroom level and the barriers faced

To appropriately address students' academic diversity, reliable evidence of prior knowledge and learning must be obtained and used effectively (Goss et al., 2015; Tomlinson, 2001, 2014). This evidence can come from diagnostic and formative assessment data that can allow teachers to evaluate teaching programmes, which has been found to improve student achievement (Hattie, 1999; Hattie & Timperly, 2016). As secondary teachers typically teach many students at a time, obtaining and analysing diagnostic and formative assessment data to target teaching can be difficult, especially when students are academically diverse within each classroom.

Teachers can employ many different strategies in attempting to provide students with both an appropriately targeted content and pace of learning. These include: scaffolded learning resources, which start with step-by-step guidance and questions everyone can achieve, followed by a gradual removal of guidance and an increase in question difficulty (Colter & Ulatowski, 2017; Kirschner et al., 2006); practical activities with open-ended discussion, questions and exploration; whole class teaching through to individual assistance; and ICT resources, such as online learning programmes, simulations and videos (Birnie, 2015; Robinson, 2017; Tomlinson, 2014; Tomlinson et al., 1998).

Although addressing the academic diversity of all students is considered important, and is included in tertiary teaching courses under the term differentiation/differentiated instruction, effective practice is not commonplace as it can require a significant workload, even for equipped and well-informed teachers (Goss et al., 2015; Kirkpatrick, 2016; Morgan, 2014; Robinson, 2017; Rock et al., 2008; Subban, 2006). Kirkpatrick (2016) found teachers struggled with implementing differentiated instruction despite them thinking it may be the only way to appropriately address mixed-ability classes. Robinson (2017) found that 'although teachers were familiar with differentiated instruction as a practice,' many 'think they are using differentiated instruction when, in reality, they are not' (p. 102). Studies show teachers can experience too many obstacles to effectively differentiate content, process and product. These include a lack of planning time, confidence, professional development and administrative support, as well as large classroom size, an overcrowded and restricted curriculum, student learning difficulties and standardized tests (Australian Government Department of Education, 2014; Bondie, 2019; Ricketts, 2014; Robinson, 2017; Smeeton, 2016; Tomlinson et al., 1998). Consequently, a one-size-fits-all classroom is commonplace (Goss et al., 2015; Masters, 2013; Subban, 2006; Tomlinson, 2014).

A meta-analysis of studies undertaken between 2006 and 2016 found 14 papers investigating the impact of differentiated instruction on student learning. This meta-analysis by Smale-Jacobse et al. (2019, p. 1) concluded that the studies showed small to moderate positive effects on student achievement, but that more research was needed to fill the 'severe knowledge gaps … regarding the effectiveness and value of different approaches to differentiated instruction for secondary school classes.'. Maeng (2017, p. 1077) also claimed 'little empirical research on differentiated instruction exists'. Another meta-analysis, which included 21 studies from 1995 to 2018 reviewing the cognitive effects of differentiation in primary education, also found a small to moderate positive effect on students' performance (Deunk et al., 2018).

2.2.4 Addressing academic diversity at the school/department level and the barriers faced

To reduce the spread of academic diversity within the classroom, schools may place students with similar academic achievement into the same class; this is usually referred to as *streaming* or *ability grouping* in Australia (Forgasz, 2010; Saiying et al., 2016; Spina, 2018). This enables schools and teachers to set curriculum, assessment, achievement expectations and a pace of learning that is appropriately targeted to students' current level of understanding and readiness, leading to improved learning (Saiying et al., 2016; Tieso, 2003). Streaming has been a controversial strategy, with its opponents claiming it negatively impacts students' self-efficacy and academic success while increasing achievement gaps and educational inequalities (Belfi et al., 2012; Johnston & Wildy, 2016; Spina, 2018;). Two meta-analyses by Slavin (1987, 1990) found little to no increase in students' average achievement when streaming took place; a finding supported by Hattie (2009). Forgasz (2010) investigated streaming in 44 Victorian schools, with a focus on Years 7 to 10 mathematics cohorts. They found forms of streaming were fairly common, being more prevalent in higher year levels, and were supported by many secondary mathematics teachers. Forgasz's (2010) data suggested curriculum and pedagogy were adapted to the corresponding level of streaming, which appeared to benefit higher-achieving students' prospects of mathematics opportunities but limited those of lower-achieving students.

According to Spina (2018, p. 332), 'In Australia, little research has been carried out to investigate the pervasiveness of contemporary ability-based stratification practices in schools.' Johnston and Wildy (2016) have also called for more Australian-based research into teachers' perceptions of streaming on learning outcomes and the impact of streaming on disadvantaged groups. There were no peer-reviewed studies found on the impact of streaming French language classes within Australian secondary schools.

2.3 Intelligent tutoring systems and other information and communication technologies

Computers and other one-to-one devices have become commonplace in today's classrooms (Irish, 2017). Tomlinson (2014, p. vii) claimed 'Technology routinely opens classrooms to the world and to a world of ways to think about teaching and learning.' Advances in technology have provided new opportunities for teachers to address the range of academic diversity in their classroom. One such technology is ITSs: software programmes that attempt to imitate a human tutor by providing content, questions and assessment as well as real-time feedback and assistance (Ma et al., 2014). ITSs also attempt to be 'self-paced, learner-led' and 'highly adaptive' to students' current level of understanding (Steenbergen-Hu & Cooper, 2013, p. 970).

2.3.1 Impact on students' learning and engagement

VanLehn (2011) conducted the first meta-analysis on the effects of ITSs. His findings led him to conclude 'that ITSs are, within the limitations of this article, just as effective as adult, one-on-one human tutoring for increasing learning gains in STEM [science, technology, engineering and mathematics] topics.' (VanLehn, 2011, p. 214). Conversely, Kulik and Fletcher (2016, p. 44) claimed that 'reviewers have not yet reached a consensus on the size of ITS effects on student learning.' However, these meta-analyses, and other studies, have shown the potential ITSs have as an effective instructional tool (Boulay, 2016; Kulik & Fletcher, 2016; Ma et al., 2014; Steenbergen-Hu & Cooper, 2013).

In a study investigating a science teacher's use of technology to facilitate differentiated instruction, Maeng (2017) found 'no studies … that focus on how technology may support teachers' differentiation practices or explore the role of technology in facilitating formative assessment in a differentiated classroom' (p. 4). However, a study by Haelermans et al. (2015) investigated the impact of digital differentiation on students' academic performance. They found students using a digital platform that provided appropriately targeted content, after completing a pre-topic test, had a small, positive effect on student learning. Reason for this study being conducted came from the difficulty teachers face in continually providing appropriately targeted content to students. This supported findings by Deunk et al. (2018), who found 'using computerized systems as a differentiation tool … had small to moderate positive effects on students' performance' (p. 31). Deunk et al. (2018) also found a lack of research investigating technology as a tool for addressing students' academic diversity. There is great potential for research in this space, given the learning analytics and feedback potential of modern digital technologies (Newhouse, 2016).

Calder and Campbell (2016) found the beliefs and attitudes of reluctant 16 to 18 year-old learners towards numeracy change from negative to positive and enthusiastic after the implementation of numeracy-based applications (i.e. ICT apps). They believed the visual and dynamic components of the apps, which differed from prior learning experiences/materials, were significant factors in changing students' attitudes. Third-year university students were also found to have positive attitudes towards novel ICT (John et al., 2014). Given the term 'digital natives' has been used for students of the current generation, it may be unsurprising they have positive attitudes towards ICT. Newhouse (2016, p. 25) claims: 'Students prefer digital forms of assessment to paper-based forms provided that they are sure the technologies work, and they are given some experience with the specific technologies used and the form of assessment itself.' Gamified elements of ICT, such as coins/points awarded for completing work, exciting colours, animation and sounds, and competitive mini games have also been found to motivate and engage students (Alshammari, 2020; Ge, 2018; Kyewski & Krämer, 2018; Sailer et al., 2017).

An article by Beavis et al. (2014) investigated data from a project funded by the Australian Research Council called 'Serious Play: digital games, learning and literacy for twenty first century schooling'. They found teachers considered computer-based, gamified learning to be engaging, motivating and fun for students, which was believed to improve student learning. One teacher commented on the competitive element of digital games being engaging for boys in particular. There was also an awareness of the novelty factor for computer-based, gamified learning. If students were no longer engaged by the novel ICT, the technological tool may not be as effective for learning. Dalby and Swan (2019) claimed the literature has established that teachers are unclear of the benefits technology has on student learning. Despite this, and a lack of consensus on the impact of ITSs on student learning, ITSs and other e-learning software are used by millions of students in Australia and worldwide (Dodd, 2017; Education Perfect, 2020a; Mathletics, 2020). This may be due to their ability to provide 24/7 access to scaffolded, self-paced, adaptive and motivating software that is aligned with the Australian Curriculum (AC), as well as providing real-time formative assessment and feedback data (Education Perfect, 2020a; Mathletics, 2020; MathsOnline, 2020; Mathspace, 2020a; Scalise, 2007).

2.3.2 Barriers to technology in the classroom

ITSs have some opponents, and criticisms that include student control over feedback and hints, a lack of response to learner's emotional and behavioural states, a lack of student-student collaboration and significant software development time (Ahuja & Sille, 2013; Goodwin, 2012; Gross et al., 2015; Koedinger & Aleven, 2007; Malekzadeh et al., 2015). As ITSs attempt to imitate one-to-one tutors, they provide hints and tips for students to access when they are having trouble understanding or progressing with content/questions. This can lead to 'gaming' the software: a practice whereby students will 'succeed' by quickly accessing the help provided by the ITS to progress without learning the material. This has been found to reduce learning (Muldner et al., 2011). Despite efforts to detect and reduce gaming within e-learning software, some ITSs do not automatically detect it. This means teachers would need to manually check if this is occurring, if enough data was provided to do so.

Although technology uptake may be regarded as innovative, it can be overwhelming; leading to a lack of focus on pedagogical questions and learning goals (Ifenthaler, 2015) while leaving the 'promise' of 'improved student learning largely unfulfilled' (Mills et al., 2015, p. 141). A study by Bauer and Kenton (2005) and Beavis et al. (2014) found teachers who were considered technologically competent weren't readily utilising technology due to lack of class time spent on computers, the need for extra planning time, outdated hardware, lack of appropriate software, technical problems and deficient student skill levels.

A broader concern that has been identified is the impact of ICT on student learning capacity. Moledina and Khoja (2018) found the impact of using information via instant access ICT, such as

Google, has resulted in shallow learning and rapid attention shifting. They referred to this as *digital dementia*. It has 'been linked with increased distractibility and reduced learning in the classroom' (Loh & Kanai, 2016, p. 516). Although students may have gained knowledge regarding how to access information, they have less capacity for retaining it (Sparrow et al., 2011). The ICT hardware students use can also impact their thinking. Heflin et al. (2017) found students' critical thinking decreased when the students were using-mobile device technology when compared to keyboard-typed or paper-based, written work.

2.4 Chapter summary

This chapter has discussed the literature surrounding two major topics, students' academic diversity and ITSs. Because of the broad scope of differentiation/differentiated instruction, the term academic diversity was used to focus on students' academic differences, such as their range in prior knowledge, pace of learning and academic performance. Significant academic diversity was found to exist within schools and classrooms; an important issue to address so students' learning is not negatively impacted. Research has established a number of barriers teachers face in addressing academic diversity, such as a lack of planning time, confidence, professional development, large classroom size, curriculum restraints, student learning difficulties and standardized tests. Streaming classes was one practice used to address academic diversity at the school level.

The impact of ITSs on students' learning was investigated through the literature. There appeared to be a lack of consensus on the impact of ITSs, with effects ranging from significantly positive to slightly positive. This is likely due to the large range of ITSs available across the spectrum of educational topics. This meant there was potential for certain ITSs to address academic diversity, something considered lacking in the literature. Despite the barriers and cons to ITSs, they were found to be used by millions of students within Australia and worldwide, making them an important educational resource to fully understand. ITSs, Education Perfect and Mathspace, were found to have little to no peer-reviewed research into their effectiveness in addressing students' academic diversity in the classroom.

3. Research context and methodology

3.1 Introduction

Including both qualitative and quantitative data collection and analysis techniques, this research used a mixed-method approach. Within this approach, a single case study was conducted at a WA secondary school with teachers and students who had experience with ITSs. Details about the methodology and research context are discussed further in the following sections.

3.2 Case study approach

A case study investigates a phenomenon by collating 'multiple sources of evidence' (Gillham, 2010, p. 2) and identifying common themes, leading to a 'description of the phenomenon' (Fraenkel et al., 2012, p. 433). It is 'the preferred strategy' to answer '"how" or "why" questions when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context.' (Yin, 1994, p. 1; Yin, 2006). A case-study design was chosen because it is well aligned with the context of this research which is a real-life, contemporary phenomenon that is investigated by asking exploratory how, what and why questions. With overarching research questions seeking to explore/uncover answers, attempting to control or reduce the variables within this research by undertaking a more rigid research design would not acknowledge the complex ecology of schools and classrooms and may restrict findings. A case study requires the researcher to engage with participants, usually by interview or observation, to generate detailed data within the context of the phenomenon (Fraenkel et al., 2012) and is undertaken within the context of a particular case or cases; for example, an event, process, individual or institution (Creswell, 2018; Gillham, 2010). The case study for this research was a WA public secondary school.

In order to gain an in-depth understanding of a particular case, multiple forms of data are need to be collected (Creswell, 2018). A mixed-methods approach was used to collect data for this case study design. Mixed-methods is often used in educational research to answer the overarching research questions (Creswell, 2018; Creswell & Garrett, 2008; Ponce & Pagán-Maldonado, 2015). This meant data could be gathered from many individuals through quantitative means, and compared with data that is better contextualized and provides more detail of the participants' 'voice' via qualitative means (Creswell, 2018). One advantage of a mixed methods approach is the strengths of quantitative data helping address the weaknesses of a qualitative data, and vice versa (Johnson & Anthony, 2004).

There are a number of mixed methods approaches; this research undertook a convergent mixed methods design. A convergent design involves the simultaneous collection of qualitative and quantitative data. The data are then analysed separately and the results are compared to find any discrepancies (Creswell, 2018). The convergent mixed methods approach supported the case study design which aimed to compare different partipants' perspectives on different topics. Surveys were used to collect the quantitative data, with qualitative data collected via semi-structured interviews.

3.3 Pilot study

A pilot study was conducted to identify any ambiguities or difficulties faced with the interview and survey questions posed to participants. One semi-structured interview was conducted with a mathematics teacher who did not participate in the formal research. The interview was not audio recorded and only notes about problematic questions were documented during the interview. This pilot interview revealed issues with some of the overarching research questions and interview time; there were too many questions posed by the researcher, some of which were difficult to understand or too ambiguous. These questions were identified during the pilot interview and improved or removed for the formal semi-structured interviews.

During the pilot study, an online survey was conducted with a class of Year 8 mathematics students as per the ethical process (see section 3.8). Students were presented with the survey questions and design intended for the formal data collection with the addition of one question, asking, 'Were any of these survey questions difficult to understand? If so, which question/s?' This question was asked four times throughout the pilot survey. Respondents had the option of choosing from any of the 7 to 10 questions they had just faced as being confusing questions. Alternatively, they could have selected the last option, stating, 'I understood all of the questions'. There were three questions that appeared more difficult to understand than the rest, with 10%, 9% and 7% of students selecting them as difficult to understand. These questions were modified to improve students' understanding for the formal survey. All other research questions only found 0% to 4% of students having difficulty understanding the question.

3.4 Participant selection and participants

3.4.1 Case study school

In 2019–20, four private and three government metropolitan school principals and mathematics heads of learning area (HOLA) were contacted by email and telephone about their school's use of progress-tracking and/or ITS ICT. If they had used or were using these, or similar programmes, they were then asked if they would like to participate in the research. Issues such as teachers' shortage of spare time to participate or a lack of experience with the software meant six of the seven schools approached could not participate. Most schools approached met the criteria of using one or more of these ICT programmes, but only one school's staff had the time, experience with the ICT software and a willingness to participate.

This secondary school was built over 40 years ago in what was considered one of the least socio-economically disadvantaged suburbs in WA during 2016 (Western Australia Parliamentary Library, 2016). The school caters for students' subject interests in Years 7 through 12, providing access to mathematics, English, science, and humanities and social science subjects as well as opportunities in the arts, sport, design and technology. and languages other than English. From 2014 to 2019 there had been a consistent improvement in commonly used school performance metrics and the school had consistently achieved a: top-50 WA Australian Tertiary Admission Rank (ATAR) school placement; 100% WA Certificate of Education achievement; 100% Vocational Education and Training achievement rates; and high accolades awarded to staff and students.

The school had grown rapidly in recent years, increasing both staff and student enrolments. This increase had seen a corresponding rise in the demand for ICT, which had been met by upgrading Internet capacity and speed, as well as the instalment of classroom desktop and laptop computers to meet the school's goal of a one-to-one device policy: this was to ensure all students had access to a computer at any given time. Along with the procurement of ICT hardware, ICT software was introduced, trialled and/or upgraded in most subject areas. This software was being used both in and out of class by students and teachers and included programmes such as Education Perfect (previously known as Language Perfect), Quizlet, ProProfs, Stile, Kahoot, MangaHigh, Mathspace, Connect, Adobe Creative Suite, Phet, Quikr, Webex, Academy, OneNote, Office 365 and more. This software covered a range of educational needs including delivering content, facilitating teacher-student and teacher-parent communication, providing in-class formative and summative assessment, setting of homework assignments and assessment tracking, and the recording of student performance. Education Perfect and Mathspace were two software used by the school that could be considered ITSs.

3.4.1.1 Education Perfect

Education Perfect was founded in New Zealand in 2007 by brothers Craig and Shane Smith. CEO Alex Burke was appointed in 2020. Education Perfect started with the name Language Perfect and was an educational technology focused on language-based subjects (English, French etc.). The name was later changed to Education Perfect after broadening the scope of subject areas to include mathematics, science, humanities, health and physical education, and digital technologies (Education Perfect, 2020a). Worldwide, Education Perfect claims to have more than 1.2 million users across 2600 schools, having increased this figure from 1600 schools over the course of a single year to May 2020 (Burke, 2020; Education Perfect, 2020a). With more than 35,000 curriculum-aligned lessons, Education Perfect also claims to provide scaffolded content, allowing ‘all students to experience success, while providing rich opportunities for higher order thinking’ (Education Perfect, 2020b, para. 1) It also claims to save teachers ‘5½ hours per week compared to their previous planning and teaching methods.’ (Education Perfect, 2020a, para. 1)

Only one peer-reviewed article that discussed Education Perfect was found; an Australian science teacher’s one-page review of the programme (Ansourian, 2014). The science teacher described some of the features of Education Perfect they liked, such as links to the AC; spaced repetition; regular testing; customisability of the programme’s content; easy access and user friendliness; programme support; and formative assessment and feedback. This teacher also mentioned the self-paced nature of the programme, which enabled them to be free to help students who were having difficulty with questions. They reported that students ‘enjoyed working individually to consolidate their learning’. The ‘method of formative assessment appealed to [the students], rather than completing worksheets’, and they ‘enjoyed competing in the Science Championships, [asking] if they could have a Science competition every week.’ (Ansourian, 2014, p. 57). Another journal article, not peer-reviewed, supported Ansourian’s (2014) comments about the self-paced nature of Education Perfect being a positive feature for students (Hollis, 2018). Hollis (2018) also suggested the software programme lends itself towards a ‘flipped classroom’ style of teaching as teachers can easily administer work that students can access online before they come to class.

3.4.1.2 Mathspace

Mathspace was founded in Sydney in 2010 by Mohamad Jebara, Alvin Savoy and Chris Velis. CEO of Mathspace, Mohamad Jebara, says the company's objective is to provide students with 'the right help at the right time'; achieved by 'leveraging the best in technology to meet students where they are at and at the same time giving teachers the data insights to help them move away from a one-size fits all classroom to one that is highly personalized for each student.' (Mathspace, 2020b, para. 3). Mathspace claims to provide, through the use of algorithms, mathematical content and questions that adapt to each student's individual level of understanding and learning pace (Mathspace, 2020c). If students find questions too difficult, Mathspace provides tips, hints or more detailed explanations, with subsequent questions being of similar or lesser difficulty; a form of scaffolding. Students finding questions too easy are presented with more difficult questions and content.

3.4.2 Semi-structured interview participants

Initially, only the principal, mathematics teachers and their students were given the opportunity to participate. Despite four staff agreeing to participate, insufficient data could be collected from staff and students regarding the impact of Education Perfect and Mathspace in mathematics. It was later discovered that Education Perfect had been used more frequently in French language classes for at least three years prior to this study. An invitation for French language staff and students to participate was offered. From here onwards, French language staff and students are simply referred to as French staff and French students. All three French staff agreed to participate, as along with a recently retired French staff member. The additional data collected from these staff and their students regarding Education Perfect contributed greater depth and the quality data required for answering the research questions. This took the total number of interviewed participants to nine, including the school principal and HOLAs for both the mathematics and French departments.

The school's principal plus the French and mathematics HOLAs were asked via email by the researcher whether they would like to participate. The HOLAs were then asked to discuss participation in the research with their department's staff. HOLAs handed out information about the research and researcher's email so any staff who were interested in taking part in the research could email the researcher; this helped maintain anonymity. The teachers who showed interest in taking part in the research, as well as the principal and French and mathematics HOLAs, were given a hard-copy information letter and consent form to confirm their participation in the semi-structured interviews.

The school principal, the French HOLA, the mathematics HOLA, three other French teachers and three other mathematics teachers agreed to participate. Each participant undertook an hour-long, semi-structured interview. Details of the semi-structured interviews are discussed further below. The background information for each participant has been limited to help maintain anonymity. French and mathematics teachers have been coded with FT and MT to represent French teacher and mathematics teacher respectively.

The principal at this case study school had taught for more than 10 years and had the role of principal for more than nine years across multiple schools. The principal believed a significant part of their role was to employ outstanding teachers as they considered teachers to be the 'single biggest positive influence on a child' within a school. Other areas they considered important and were proactive in were assessment practices, ICT integration and upgrades, and being research literate on various education topics. The participating teachers are as follows:

- Mathematics teacher 1 (MT1) - At the time the study was conducted, MT1 had been teaching mathematics for more than 15 years. They had also spent six years working in and around organisations that develop and implement educational software products. MT1 had promoted the trialling of multiple mathematics software products as another tool for improving students' engagement and learning.
- Mathematics teacher 2 (MT2) - MT2 had taught a range of mathematics classes, from low ability Year 7 classes to specialist Year 12 classes, for more than 25 years.
- Mathematics teacher 3 (MT3) - MT3 could have been considered a beginner teacher, having taught for less than three years. They had taught lower school extension and mixed-ability mathematics classes as well as high-ability upper school classes.

- Mathematics teacher 4 (MT4) - MT4 had been teaching for more than 15 years across a range of mathematics classes. They had taught low and high-performing mathematics students across Years 7 to 12.
- French teacher 1 (FT1) - FT1 worked initially as a French language assistant and then as a French teacher in countries including Australia and England for more than 20 years. A significant portion of this time was also spent teaching German language (alongside French).
- French teacher 2 (FT2) - FT2 had taught across a range of subjects/topics including English, French, German, Japanese, Humanities and Social Sciences, Health and Technology for more than 45 years.
- French teacher 3 (FT3) - FT3 initially taught in England for more than five years, and then in Australia for more than 20 years. They had taught French, German and English, with most time spent teaching German.
- French teacher 4 (FT4) - FT4 had taught for more than 40 years across subjects including French, Italian, German, English, Geography, Humanities and Social Sciences, and English as a second language.

3.4.3 Survey participants

The French and mathematics teachers, including HOLAs, were given the opportunity to allow students in any of their Year 7 to 10 classes to complete an online survey. Teachers who agreed to participate provided their lower school students' parents/guardians with information and consent forms by email. The parents who agreed to let their children participate provided their child with access to the online URL link provided in the email sent by the teacher. Doing so meant parents/guardians provided consent for their children to participate. The URL took the students to a password-protected online survey with further information and consent measures for the student to read and complete. There was no additional selection process for student participants other than their French or mathematics teacher agreeing to participate, and their parent/guardian allowing them to access the password-protected online survey.

3.5 Quantitative data collection and analysis

All quantitative data was collected via an online survey. Mathematics students completed the survey during November and December of 2018; French students completed the survey during June and July of 2019.

3.5.1 Survey

The survey questions were developed during the pilot study mentioned earlier. All survey questions were created to align with the overarching research questions. During the pilot study, the survey questions were adjusted to improve students' understanding of the questions. The survey consisted of 43 questions which were divided into two major categories, academic diversity and Education Perfect, as well as a consent box to tick and two demographic questions (45 questions in total, see appendix 1 and appendix 2). These two major categories were each broken into three subcategories. Questions regarding academic diversity focused on: students' beliefs about the academic diversity within their class; how their teachers addressed this academic diversity; and academic progress and assessment. The three Education Perfect subcategories included: Education Perfect as a motivational tool; how user-friendly Education Perfect was; and the impact the software had on their learning (see table 1). Cronbach's alpha helped determine the subsets of questions and is discussed further in section 3.7. The same set of questions posed for Education Perfect were asked of mathematics students with respect to another online software programme, Mathspace. This data was omitted due to receiving only three responses for all Mathspace-related questions; a number too low to draw any meaningful or valid conclusions from.

The survey was distributed online for convenience, faster turnaround and to reduce data entry requirements, despite the potential risks to Internet surveys such as 'lower response rates and invalid data due to speedy entry facilitated by computers' (Fraenkel et al., 2018, p. 362). The URL for the Internet-based survey, made via the online survey instrument Qualtrics, was sent to all of the Year 7 to 10 French and mathematics students whose teachers had agreed to participate in the study.

Because both French and mathematics teachers, and their students, had the opportunity to participate in the study, there was a possibility some students would be given the online survey to complete twice. This was addressed by customising the online survey questions to have a French or mathematics context: for example, ‘In my French class, we learn about things I'm interested in’ differed to ‘In my mathematics class, we learn about things I'm interested in.’

Table 1: Student survey question categories and corresponding number of questions

Major category	Subcategory	No. of questions
Academic diversity	Academic diversity in the classroom	4
	Students’ perception of teacher’s ability to address academic diversity	11
	Academic progress and assessment	8
Education Perfect	Education Perfect as a motivational tool	7
	Education Perfect’s functionality	9
	Education Perfect’s impact on learning	4

Each survey item used a 4-point Likert scale: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Some questions included a fifth option labelled ‘This question does not apply to me’ as they were asking about specific circumstances that didn’t apply to all students; an important inclusion for survey items where the respondent has minimal experience with the topic (Chyung et al., 2017). A 4-point Likert scale was used, as ‘offering about four response options is optimal with children as respondents’ (Borgers et al., 2004, p. 30). There was no use of a neutral mid-point as they have been found to promote social desirability bias or become used as a ‘dumping ground’ when respondents are uncaring or ‘ambivalent about the topic’, reducing the reliability and validity of responses (Chyung et al., 2017, p. 19). Negatively worded questions were used throughout the survey to help remove acquiescence bias (Borgers et al., 2004) despite negatively worded questions being found to reduce response accuracy/validity due to misunderstandings with the question (Chyung et al., 2018). Strategies to improve Likert scale validity and reliability suggested by Chyung et al. (2018), such as using polar opposite questions and not using double negatives, were adopted. All questions required a forced response in order for students to progress through the survey as an attempt to increase the number of questions to which they responded. The demographic questions required students to disclose their sex, who their teacher was and their year level; this provided insight into response differences between these demographics. All responses were collected through Qualtrics. All data was entered into Excel for organisation and analysis. Copies of the data were separated by students' sex, class (French or mathematics) and year level to look for any significant difference between these groups.

Although the data remained separated by the SA, A, D and SD response frequencies for each figure presented in the findings, the SA and SD responses were commonly considered 'agree' and 'disagree' responses respectively for simpler/efficient comparison and analysis in the findings chapter. Maintaining the SA and SD responses throughout analysis allowed greater insight into the strength of the overall response to each survey item. Also, French and mathematics students' responses were kept separate. French students' responses were colour-coded blue and mathematics students' responses were coloured green. This allowed French and mathematics students' responses to remain separated throughout the findings, allowing easier comparison with their French and mathematics teachers' responses and between subject areas. This also helped develop key findings for the quantitative data, and allowed cross-data analysis with the qualitative data. The darkest blue and green colours represent SA responses, with the lightest blue and green colours representing SD responses. Figure 3.1 below provides an example of the student survey data presented in the findings.

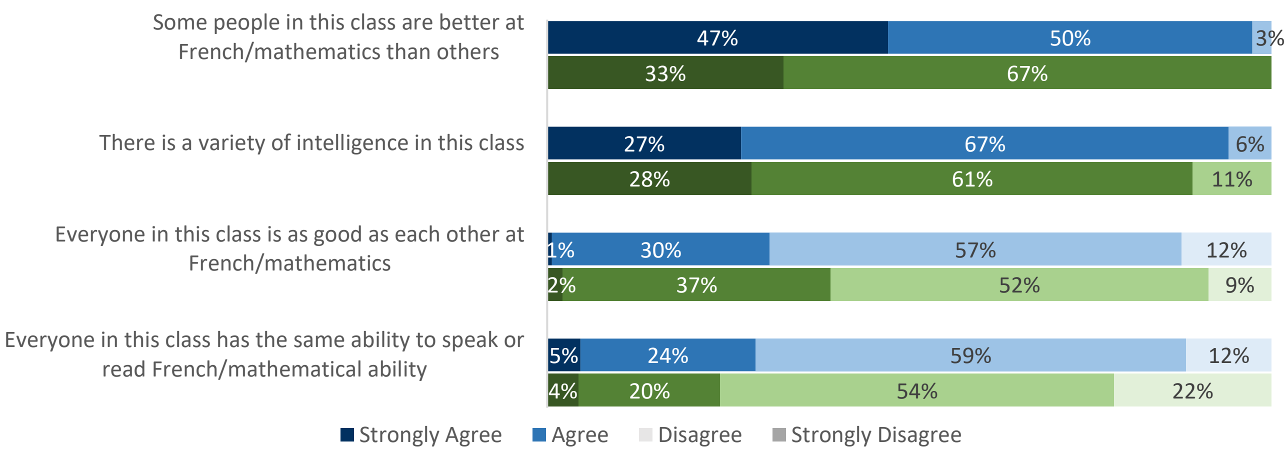

Figure 3.1: Example of student survey data

3.6 Qualitative data collection and analysis

Semi-structured interviews were conducted first with the mathematics teachers during December of 2018 and then with the French teachers and principal during July of 2019. All data was de-identified, with pseudonyms attributed to the teachers. The secondary school was referred to as the case study school.

3.6.1 Semi-structured interviews

The semi-structured interviews were split into two major categories, academic diversity and ICT programmes (such as Education Perfect and Mathspace). Each major category had overarching questions following on from each other, each with follow-up questions. Most of these overarching questions were aligned with the student survey questions. They included: the range of academic diversity within the teacher's class; how teachers cater for academic diversity; the barriers to catering for academic diversity; the motivational, functional and educational impact of Education Perfect and Mathspace; and the barriers involved with accessing and using such software (see appendix 3).

The semi-structured interviews ran for 60 minutes. They were audio-recorded and later transcribed. They provided a guided conversation regarding the primary research questions with the flexibility to discuss closely related ideas and questions that emerged as the interview progressed. All interviews were conducted and recorded on the school campus, and transcribed to Word documents by transcribing service Scribie (scribie.com). These transcripts were quality-assurance checked by the researcher.

The overarching questions posed to the principal and teachers helped guide the inductive analysis of the qualitative data; a method to establish clear links between the research objectives and key findings (Thomas, 2006). Cohen (2017, p. 645) summarises the inductive process outlined by Thomas (2006) with the following steps: 'understanding the research objectives, preparation of the raw data, reading and re-reading the raw data, and reflecting on the raw data and their meanings, category generation, revision and refinement'. These steps are not always sequential, and can include coding and recoding (Cohen, 2017). In this study, interviewed participants were given coded names for anonymity, such as FT1 and MT1 to represent French teacher 1 and mathematics teacher 1 respectively. The transcript from each respondent was also colour-coded. This allowed the qualitative data to be organised, analysed and presented according to group (French vs mathematics) and individual responses.

Interview responses were coded via the following method. First, responses were grouped according to the pre-determined, semi-structured questions which are also referred to as subtopics throughout the qualitative data. This is known as selective coding (Fraenkel et al., 2018). For example, all responses relating to the subtopic, the range of student's academic diversity, were grouped together. Then responses were grouped within the semi-structured questions/subtopics as emergent ideas in a method known as inductive coding (Fraenkel et al., 2018). For example, all responses regarding the range of students' academic diversity being a result of students having different backgrounds were grouped together. Lastly, responses were continually rearranged and refined until no more emergent ideas were identified. If any emergent ideas/themes fell outside of the semi-structured interview questions, they were attributed to a new subtopic. Figure 3.2 illustrates this process of qualitative data collection and analysis. These emergent ideas helped form the key findings for the qualitative data. Advanced organisers are used throughout Chapters 5 and 6 to summarise the overarching topic, subtopics and emergent ideas. See Figure 3.3 for an example.

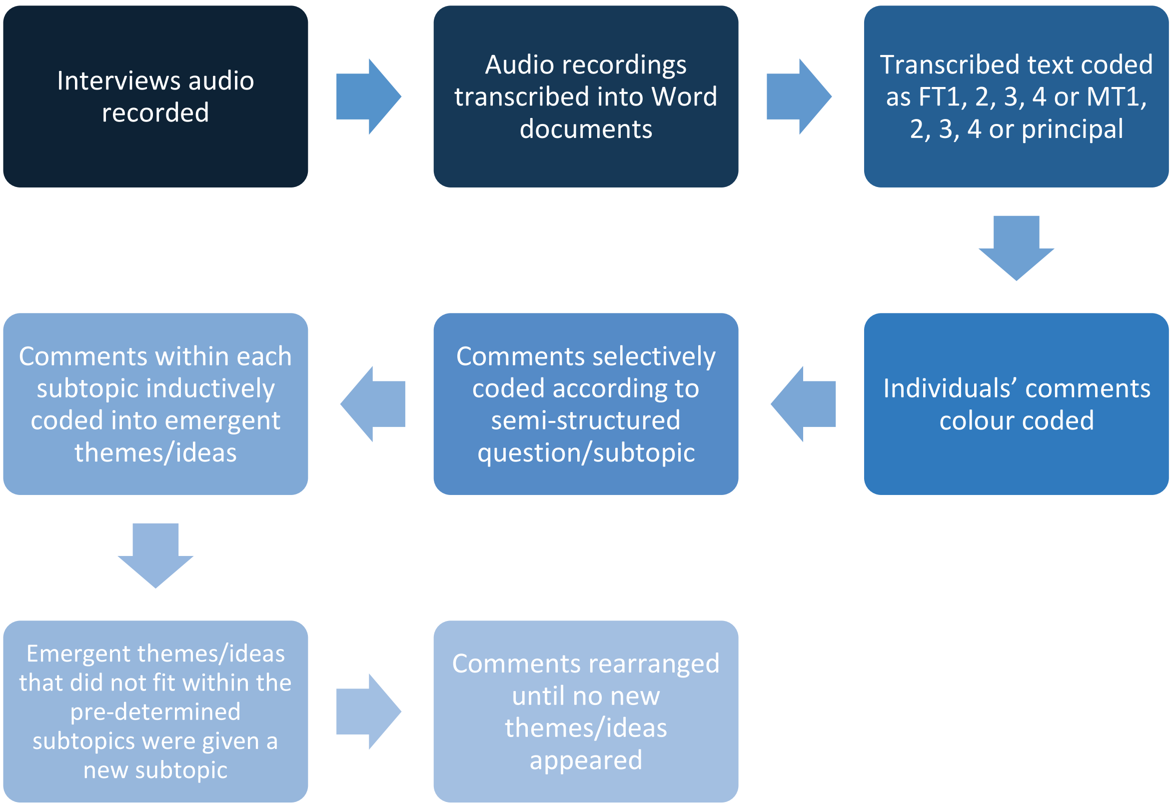

Figure 3.2: Qualitative data collection and analysis process

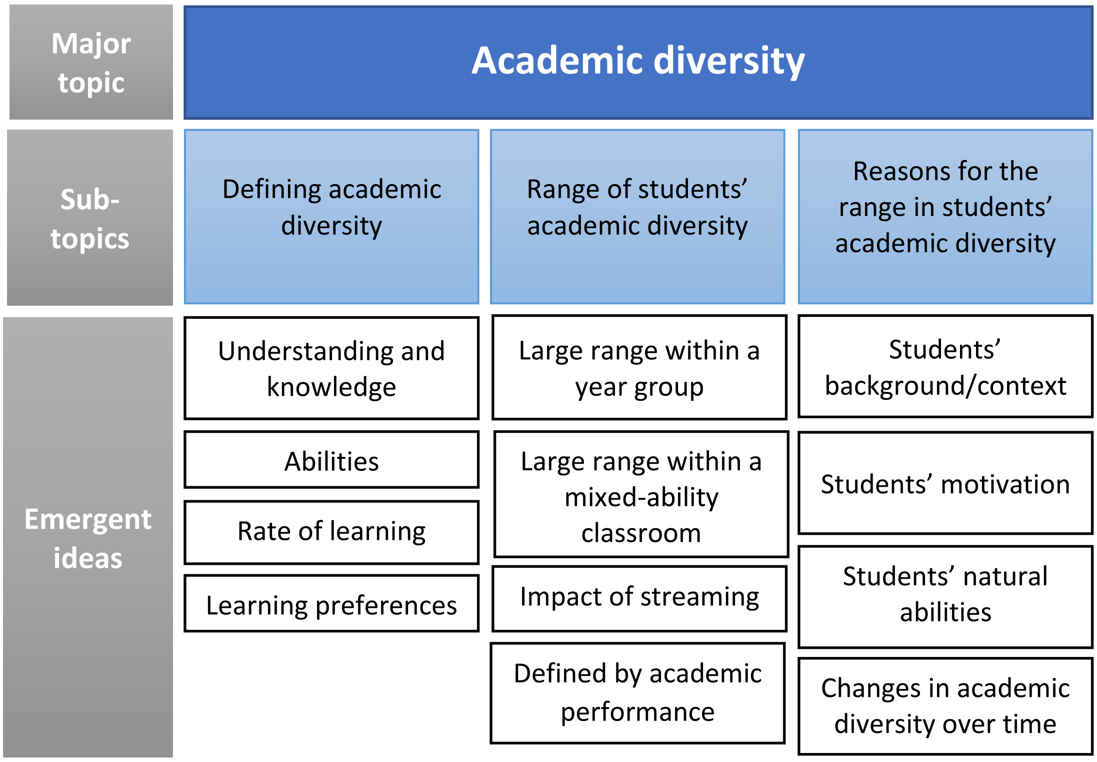

Figure 3.3: Example of the advanced planners used in Chapter 5 and 6

3.7 Measures of research quality

As research depends on the collection and interpretation of data by the researcher, researcher bias posed a risk to the study's findings (Fraenkel et al., 2012). A variety of techniques were used to combat researcher bias, including triangulation: a common method for validating qualitative research (Fraenkel et al., 2012). One example included the principal and teachers being asked for their definition of academic diversity. These definitions were compared to one and other to ensure participants were discussing the same topic. Additionally, student survey data provided insight into students' beliefs about their teachers catering to the academic diversity within their class, allowing cross-analysis with teachers' responses. To avoid social desirability bias, a phenomenon whereby participants respond in a manner considered socially acceptable as opposed to truthfully (Lee & Sargeant, 2011), the anonymity of participants' responses was emphasized during the semi-structured interviews and trustworthy relationships developed.

In order to understand French and mathematics teachers' perceptions of academic diversity and ICT software, all teachers in each subject area were invited to participate to increase the number of responses and identify emergent ideas consistent between teachers. With eight teachers from two subject areas and one principal participating in 60-minute, semi-structured interviews, a significant amount of qualitative data was collected, providing rich cross-analysis between and within the French and mathematics departments and administration.

Cronbach's alpha was calculated with Wessa.net (Wessa, 2017) within each of the six subtopics of the quantitative data. Cronbach's alpha is a 'measure of the internal consistency of a test or scale' and allows greater insight into the strength/internal consistency of the items/questions; a Cronbach's alpha range of 0.7 to 0.9 is considered acceptable (Tavakol & Dennick, 2011, p. 53). Any survey item within the subtopics that decreased the Cronbach's alpha value was removed, moved to a different subtopic or left unchanged. There was a small amount of movement between subtopics, however, almost all subtopics provided a Cronbach's alpha value between 0.73 and 0.89, which suggested internal consistency was achieved (Tavakol & Dennick, 2011). Also mentioned earlier was the use of negatively worded questions to help reduce acquiescence bias.

3.8 Ethics

Both Curtin University and the WA Department of Education (DoE) approved the conduct of this research. There was no significant risk in participating for the principal, teachers or students as no sensitive information had been collected and all information that was collected had been de-identified, including the school name. Anonymity was provided for interviewed participants by using code names such as MT1 to represent mathematics teacher 1. Students' online survey responses didn't require students' names so were anonymous upon submission. The 'code sheet' for the coded names was stored securely and separately from the collected data. The only identifying factor for the principal and teachers were their roles within the school.

All participants were given a detailed information and consent form to ensure everyone was well informed before agreeing to voluntarily participate. The principal, four mathematics and four French teachers returned a signed and completed consent form, and all semi-structured interviews were conducted in private, away from other staff and students. All students who commenced the online survey selected a check box confirming their consent. Students' parents were given information and consent forms clearly expressing that providing their child with the online survey URL link and password to access the survey constituted consent for their child to participate.

3.9 Limitations

The most significant limitations faced came from the WA DoE, with student data being the most impacted. Despite being approved by the Curtin University Research and Ethics Committee, the WA DoE disallowed students to undertake the anonymous online survey during class time. This dramatically affected the number of student responses received. Additionally, a seven-month delay (substantial in a master's degree by research schedule) in ethics approval by the WA DoE resulted in significant delays to the collection of data; negatively impacting mathematics students' and teachers' responses with regards to the software programmes they had been using as most of them had stopped using the software approximately six months before their data was collected. This was telling, as most teachers mentioned their inability to remember the software mechanics during the semi-structured interviews. This setback led to a compounding of further delays due to WA school holidays and lack of participant availability.

Another limitation beyond those imposed by the WA DoE included the trustworthiness of students', teachers' and the principal's responses. This is addressed above with reference to cross-analysis, triangulation, anonymity and negatively worded survey questions.

3.10 Chapter summary

This chapter has outlined the mixed-method approach to this study as well as the context of the research and the participants involved. Data-collection and analysis techniques were described. Online surveys which formed the quantitative data were completed by students in Years 7 to 10. Semi-structured interviews were conducted with the school principal, four French teachers and four mathematics teachers, forming the qualitative data. The following three chapters outline the results from students, teachers and the principal regarding the overarching research questions.

4. Results—student responses

4.1 Introduction

This chapter presents students' online survey responses. Responses from both French and mathematics contexts have been presented on the same graph for each set of questions. French students' responses are coloured blue; mathematics students' responses are coloured green. This enabled a clear presentation of the overall data and a comparison between the two subject areas (see section 3.5.1 for elaboration). Sections 4.3 and 4.4 present students' responses regarding academic diversity and Education Perfect respectively.

4.1.1 Student survey responses overview

A voluntary online survey was made available to lower-school French and mathematics students from the participating school. A Likert scale survey was used to gather students' responses, which are cross-analysed with teachers' responses in Chapters 5 and 6. The following research questions informed the development of student survey items:

RQ 1: How do principals and secondary French and mathematics teachers perceive and cater for students' academic diversity?

RQ 3: What are students' attitudes towards Education Perfect?

Survey invitations were sent to the parents of 513 students across Years 7 to 10. A total of 199 students commenced the survey and 146 (73%) of these students answered all 45 questions. A significant drop in student responses (182 to 151) occurred when questions about Education Perfect were introduced. All 31 students that didn't answer questions regarding Education Perfect were mathematics students. Only 12 mathematics students completed all survey questions regarding Education Perfect, representing just 8% of all responses to these particular survey items. There was almost a 50/50 split of male and female responses; 77% of responses were from a French context (N=153) and Year 7 students provided more than half of the responses (N=133). Figure 4.1 illustrates the background information for all students who commenced the survey. This information is updated in section 4.3, which includes students' responses to Education Perfect.

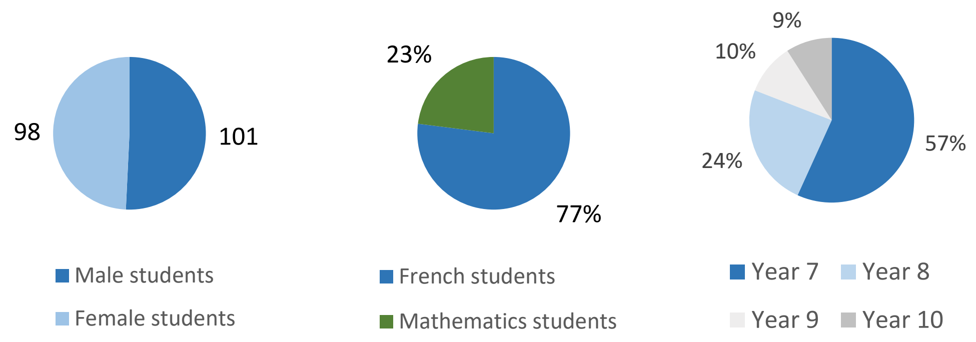

Figure 4.1: Students participating in all survey questions apart from Education Perfect questions

Student survey questions were grouped into two major topics: academic diversity and Education Perfect. They were divided further into six subtopics. Table 1 displays the major topics, subtopics, and number of questions for each subtopic. These subtopics are investigated below.

4.2 Student survey responses regarding academic diversity

4.2.1 Students' perceptions of the academic diversity within their class

Students were asked about the academic diversity of the students within their class. Did they believe students in their class had different abilities/knowledge of the topic at hand? Four survey items were grouped together for analysis (see Figure 4.2). All questions asked students to compare their peers' abilities/knowledge within their class by using phrases such as 'better at French/mathematics', 'variety of intelligence', 'as good' and 'same ability'. The four questions had face validity, that is, they appeared relevant to the concept of academic diversity within the classroom; a 'minimum requirement of acceptance of a scale' (Bannigan & Watson, 2009, p. 3240).

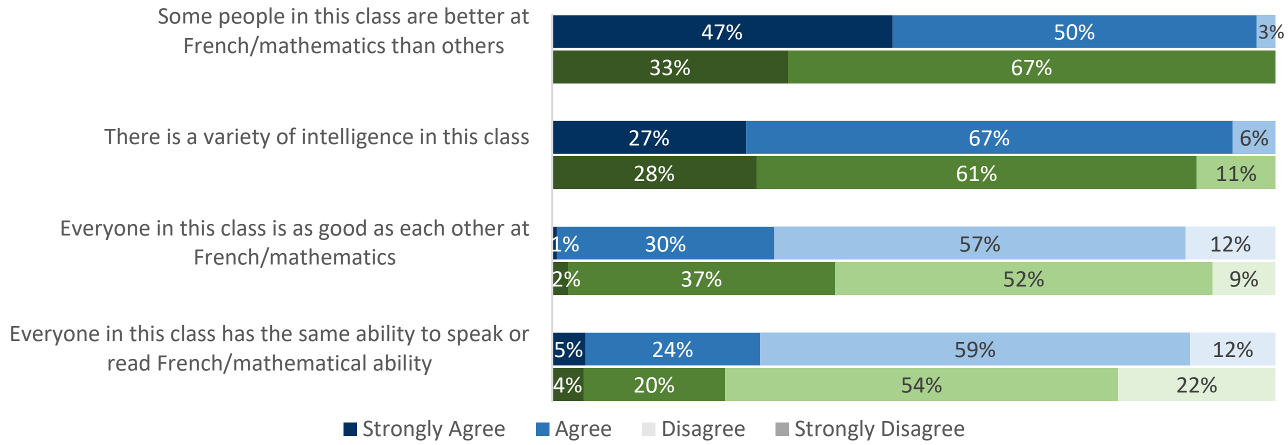

Figure 4.2: Student responses to survey items regarding the academic diversity within their class (N French students (blue) = 153, N mathematics students (green) = 46)

French and mathematics students overwhelmingly agreed that some people in their class were better than others at French/mathematics; as expected, this first survey item returned one of the highest SA responses out of the 43 survey questions for both French and mathematics students. This strong response was supported by the vast majority of students believing there was a variety of intelligence in their class.

Approximately one-third of all students agreed peers in their class were as good at French/mathematics as each other. About a quarter of all students believed everyone had the same mathematical ability/ability to speak or read French. Responses to the negatively worded questions were not as strong as the responses to the positively worded questions. It is noted in the literature that negatively worded questions can be more difficult for participants to interpret and respond to appropriately (Chyung et al., 2018). Despite this, students clearly indicated they believed there was academic diversity between students within their class.

There was little difference between the responses given by students from different year levels and between males and females, apart from one item. The most significant difference was 40% of all female students agreeing with the survey item ‘Everyone in this class is as good as each other at French/mathematics’ as opposed to only 26% of males. Given the three other survey items differ by no more than 4% to 8%, males and females, as collectives, strongly believed there was academic diversity within their classrooms.

Key finding 4-1: The majority of students believed there was a range of academic ability in their class.

4.2.2 Students' perceptions of their teacher identifying and catering for academic diversity

Figure 4.3 illustrates students' opinions of their teacher identifying and catering for the range of academic ability they feel was present within their class. Some students didn't complete all of these (and subsequent) questions. This meant the number of responses to these questions ranged from 153 to 146 for French students and 45 to 43 for mathematics students. For the following two survey items, 'If I find this class too easy, the teacher gives me more challenging material' and 'In this class, the teacher gives me extra examples if I don't understand what we we're learning,' a fifth response option was provided: 'This question doesn't apply to me'. This option was made available as some students may not have sought extra work/support to warrant a valid response.

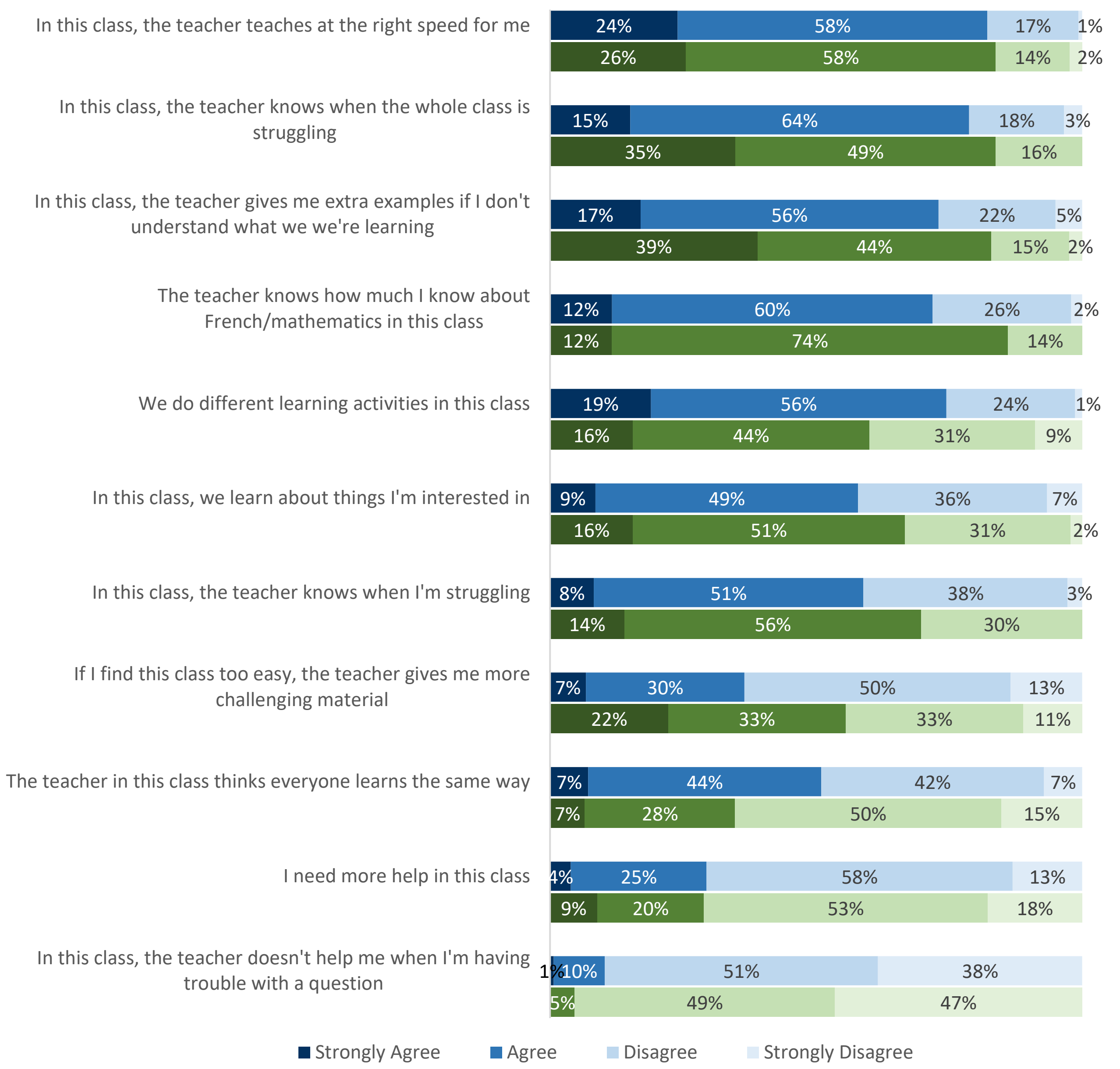

Figure 4.3: Student responses to questions regarding their perception of their teacher catering for academic diversity within their class (N French students (blue) = 153, N mathematics students (green) = 45)

As a collective, the majority of students agreed with the first four survey items from Figure 4.3, with more than 75% of students agreeing with each item. These responses indicated students believed their teacher was ‘in tune’ with the class by teaching at the right speed, identifying when the class as a whole was struggling, providing more examples if individuals were struggling and having an understanding of what each student knew. A larger percentage of mathematics students than French students agreed with these four survey items. These responses were supported by some of the responses to the negatively worded questions; 91% of all students believed their teacher helped them when they needed it and two-thirds of all students believed their teacher didn't assume all students learned the same way. Two-thirds of all students also believed they undertook different learning activities within their class; French students agreed with this survey item more than mathematics students by 15%.

Approximately 40% (the minority) of all students were not interested in what they were learning, believed their teacher wasn't aware of when they were struggling and agreed they were given more challenging material if they were finding the class work too easy. These survey items were less conclusive than the first four; pointing further in the direction of a lack of catering for academic diversity. A larger percentage of mathematics students agreed with these three survey items than French students. The majority of French students agreed with the survey item asking if 'The teacher in this class thinks everyone learns the same way'. The majority of mathematics students disagreed with this survey item. Although students were unlikely to know exactly what their teacher was thinking when answering this question, it attempted to provide a sense of how students felt their teacher addressed their class.

The final two survey items listed in Figure 4.3, which were negatively worded, strongly supported the notion that teachers were responsive to the range of academic needs in their class. Overall, it appeared the majority of students were confident their teachers did identify and address the academic diversity they believed existed within their French/mathematics class.

Key finding 4-2: Overall, students believed their teachers were both aware of and addressing the academic diversity students believed existed within their class.

The only significant difference between male and female responses were males agreeing 16% and 14% more than females to the survey items 'If I want to move ahead of the class, I know how to' and 'If I find what we are doing in French too easy, the teacher gives me more challenging material' respectively. All other differences ranged from 2% to 9%. Consistent trends were found between Years 7 and 8 students for most survey items. Year 8 students believed teachers were catering for academic diversity more so than Year 7 students, with the exception of 14% more Year 7 students believing their teacher was teaching at the right speed for them.

4.2.3 Assessment and learning progress

Figure 4.4 displays the survey items asking students about their beliefs regarding tests and academic progress. The first survey item, which asked about being tested in the same way, was one of the most agreed-with survey items; 99% of French students and 93% of mathematics students agreed everyone undertook the same tests. The homogeneity of testing is investigated further in the teacher interviews below.

Key finding 4-3: Students believed they were all tested in the same way.

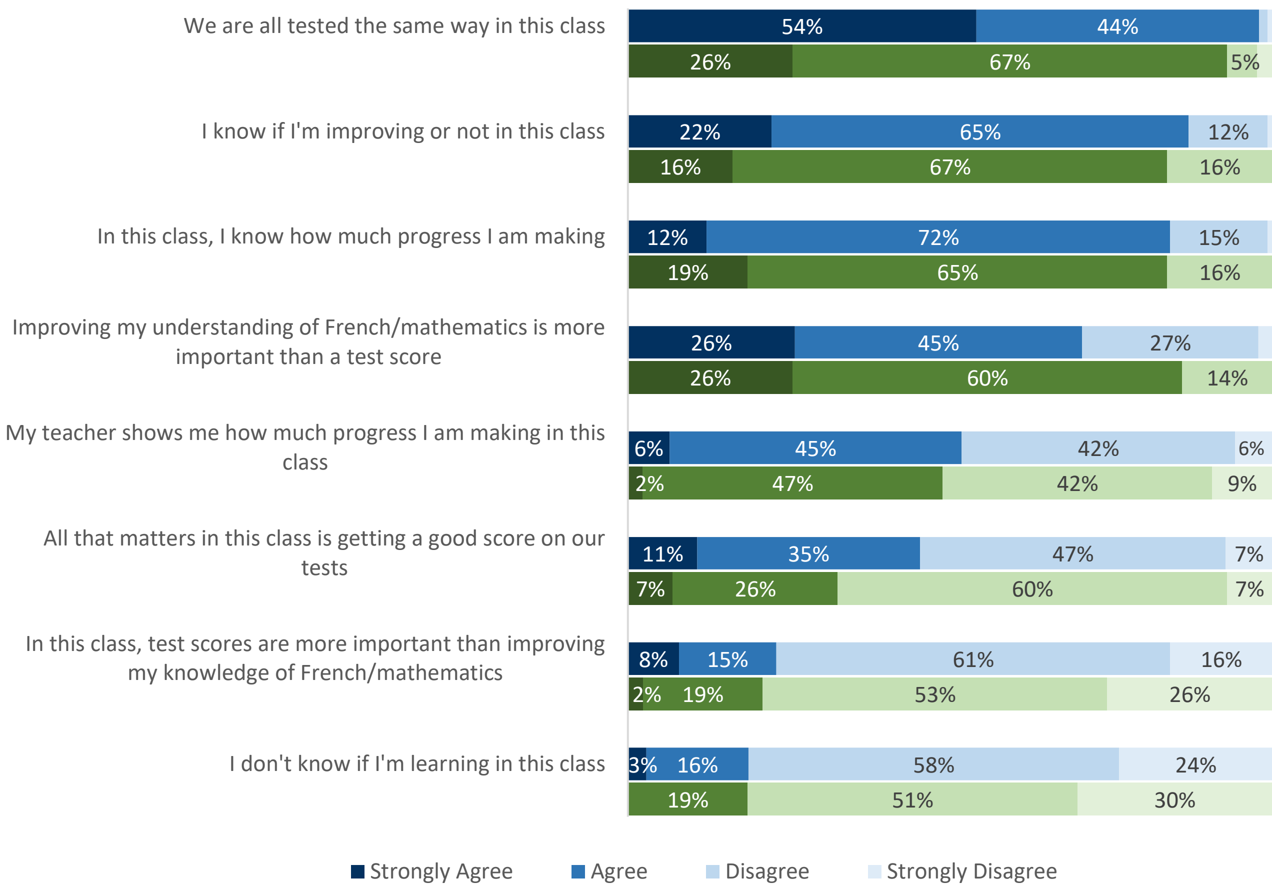

Figure 4.4: Student responses to questions regarding assessment and learning within their class (N French students (blue) = 139, N mathematics students (green) = 43)

Although the majority of all students believed they were learning and were aware of the progress they were making, this awareness was only partly attributed to their teachers; approximately 50% of all students agreed that their teacher would show them how much progress they were making. When asked about the importance of test scores, 58% of students responded that they believed test scores were all that mattered in their class, while 77% of all students disagreed with the negatively worded survey item asking if test scores were more important than improving their knowledge of the topic. The response to this negatively worded survey item supported the response to the positively worded survey item. Seen in Figure 4.4, 16% more mathematics students agreed then French students with the positively worded survey item 'Improving my understanding of French/mathematics is more important than a test score'; this was the biggest difference in responses between French and mathematics students for this set of questions.

Key finding 4-4: Some students saw test scores as the only thing that mattered in class.

Of the two sex demographics, females believed test scores were more important/significant than males, providing 12% and 14% higher agree responses to the survey items 'All that matters in my French class is getting a good score on my tests' and, 'In my French class, test scores are more important than improving my knowledge of French' respectively. There was no discernible difference in responses between year levels to all of the Figure 4.4 survey items. This suggested students' thoughts regarding the importance of test scores, knowledge acquisition and test homogeneity were consistent across time.

Key finding 4-5: Female students placed more importance on test scores than male students.

4.3 Students' survey responses regarding Education Perfect

4.3.1 Changes in students' responses to Education Perfect

After answering questions regarding the academic diversity of students within their class and how they believed their teacher addressed this diversity, students were asked about the software programme Education Perfect. Unfortunately, the number of mathematics students' responses to these questions dropped off markedly; only 12 of the 46 mathematics students who commenced the online survey responded to the 20 questions about Education Perfect. This was unexpected and is addressed further in Chapter 6. The low response rate meant any findings about students' attitudes towards Education Perfect almost entirely (92%) reflected the French students' perspectives. Despite this, French and mathematics students' responses in Figures 4.6 to 4.8 remain separate for consistency and to highlight any significant differences, despite being statistically insignificant.

The representation of males and females remained essentially unchanged, with a greater representation of Year 8 students (30% instead of 24%) after a number of Years 9 and 10 students stopped completing the survey questions (see Figure 4.5).

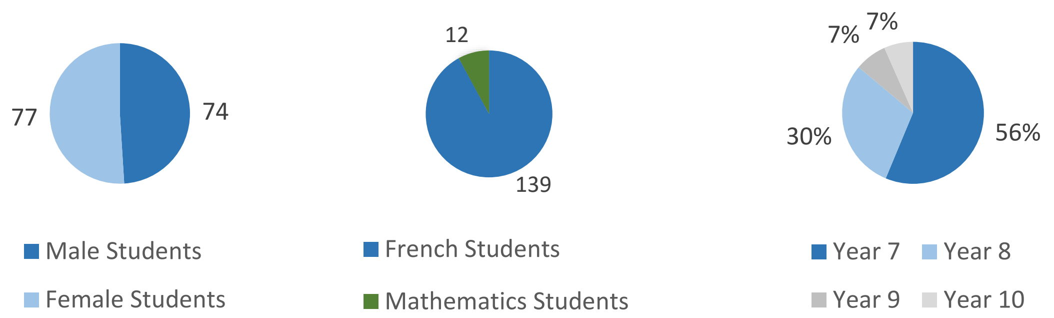

Figure 4.5: Student survey participants for survey questions regarding Education Perfect.

There were 3 subtopics within which the Education Perfect survey items fell: Education Perfect as a motivational tool, Education Perfect's functionality and Education Perfect's impact on learning. It must be noted that French students completed questions that asked about Language Perfect and mathematics students completed questions asking about Education Perfect. Although these are different names, they were designed by the same software company and shared the same website at the time of these survey responses. The website titled Language Perfect had been replaced with the title Education Perfect by the time the student and teacher data were collected. For the sake of simplicity and continuity, only the term Education Perfect was used by the researcher in the following student data findings.

4.3.2 Education Perfect as a motivational tool

Students were asked about Education Perfect as a motivational tool for learning. Questions focused on students' interest and engagement with the software programme (see Figure 4.6).

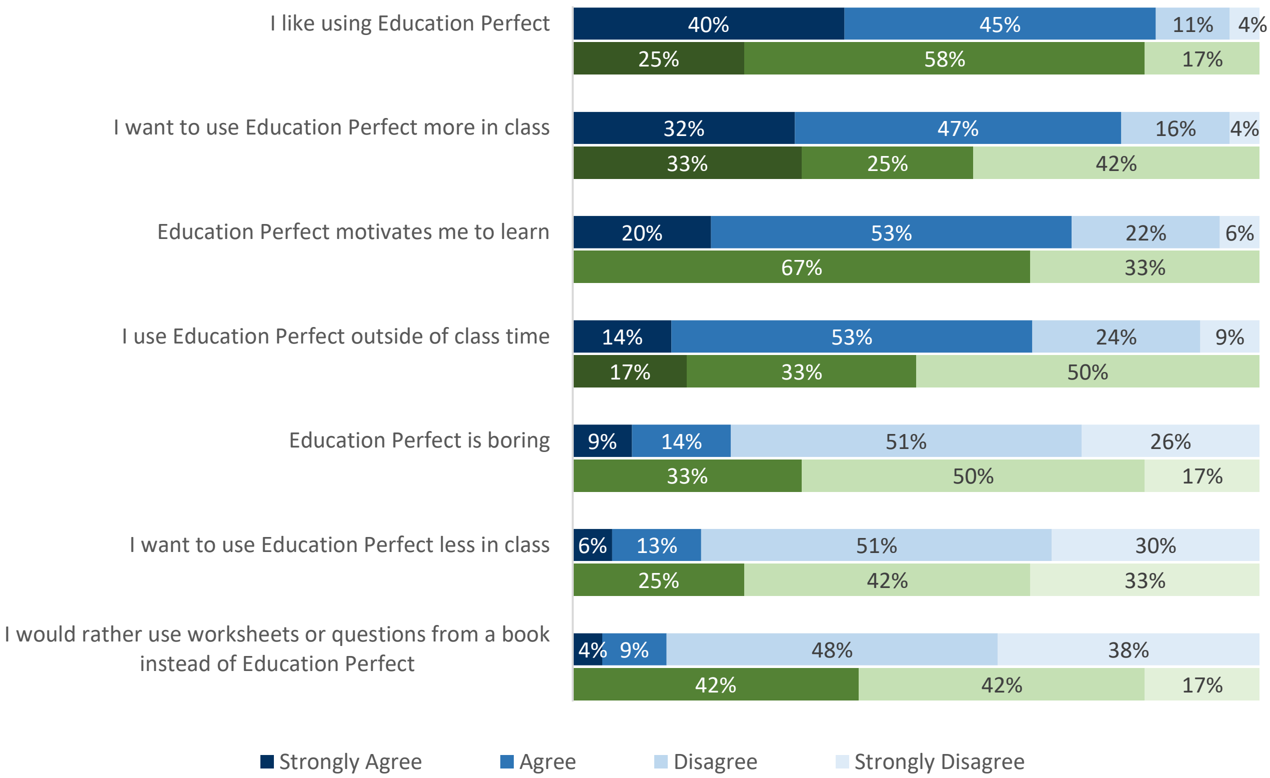

Figure 4.6: Student responses to questions regarding Education Perfect as a motivational tool (N French students (blue) = 131, N mathematics students (green) = 12)

As a collective, 84% of students liked using Education Perfect and 78% wanted to use it more in class. Three-quarters of all students believed Education Perfect motivated them to learn. These positively worded survey items clearly indicated students' positive attitudes towards using Education Perfect. Even though Education Perfect questions were not always set as compulsory homework, 66% of all students indicated they used the computer programme outside of class time. Students' responses to the positively worded questions were supported by their responses to the negatively worded questions. A quarter of all students believed Education Perfect to be boring, with 19% wanting to use it less in class time and 16% preferring to use a worksheet or work from a book.

Key finding 4-6: A majority of students liked using Education Perfect and wanted to use it more in class.

Despite there being a low number of responses by mathematics students, the pattern of responses was similar to the French students. The most significant difference in responses between French and mathematics students was to the last survey item in Figure 4.6, stating ‘I would rather use worksheets or questions from a book instead of Education Perfect’. Despite the low response numbers, almost half of the mathematics students preferred worksheets or bookwork over Education Perfect. Year 8 students indicated they were more motivated/engaged with Education Perfect than Year 7 students by agreeing anywhere from 7% to 12% more with the Figure 4.6 survey items. The only exception was the response to the survey item labelled ‘I use Education Perfect outside of class time’; 68% of Year 7 students indicated they did use Education Perfect outside of class time as opposed to 58% of Year 8 students. The difference in responses between males and females was marginal for most questions, ranging from a 1% to 6% difference for each survey item. There was a significant outlier for the survey item labelled ‘I would rather use worksheets or questions from a book instead of Language Perfect’. Only 7% of males agreed with this statement as opposed to 25% of females. This meant almost all students who preferred to work from a book or use a worksheet rather than using Education Perfect were female.

Key finding *4-7: More male students preferred using Education Perfect over worksheets and bookwork compared to female students.*

4.3.3 Education Perfect’s functionality

Figure 4.7 displays students’ responses to survey items that asked about Education Perfect’s functionality, such as its ease of use and capacity to adapt to students’ abilities/pace of learning. Students found Education Perfect to be user friendly; almost all students agreed that Education Perfect was easy to use and disagreed with the negatively worded question that asked if Education Perfect was difficult to use. Another largely agreed-to survey item was about students’ ability to monitor and compare their progress with each other within Education Perfect.

Key finding 4-8: Students found Education Perfect user friendly.

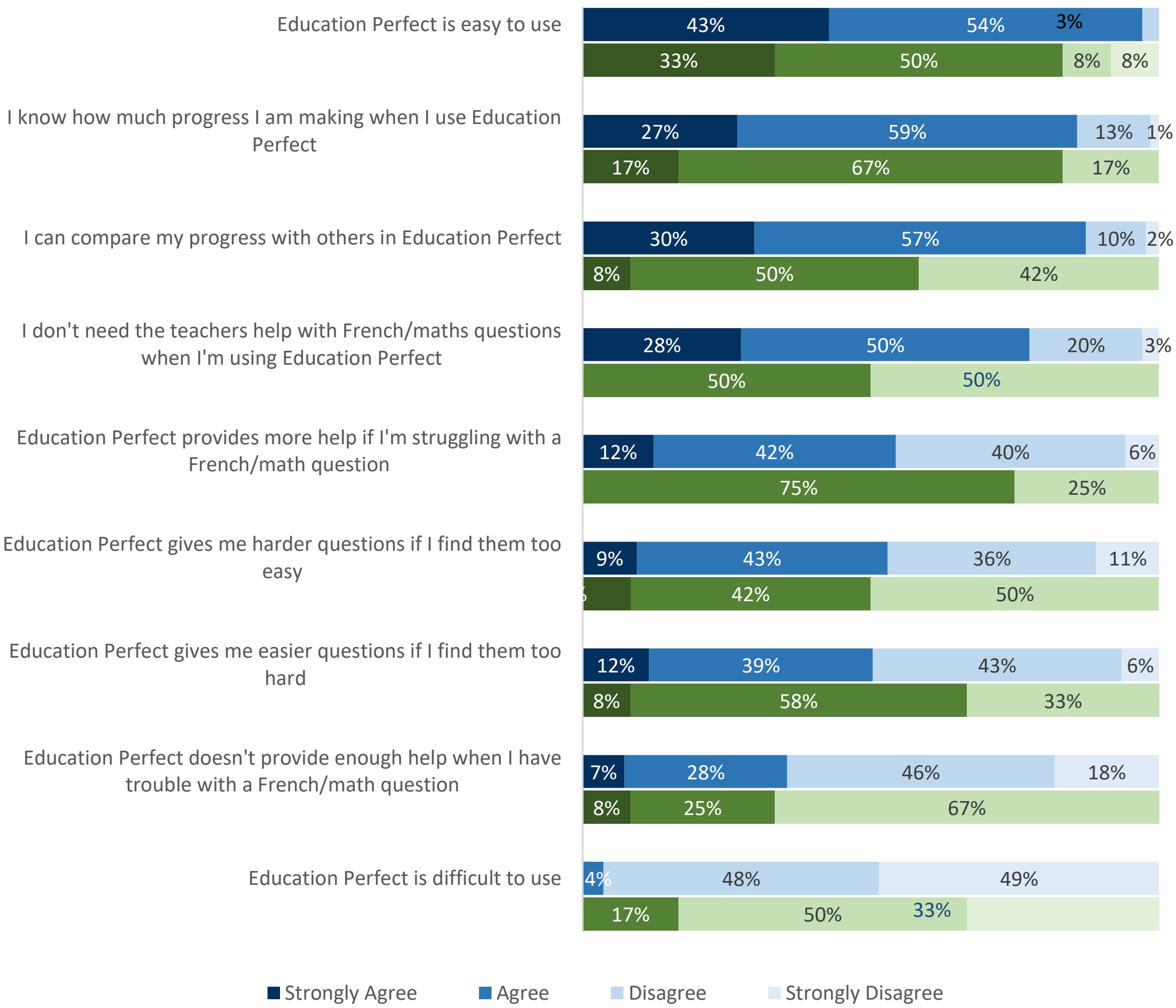

Figure 4.7: Student responses to questions regarding Education Perfect's functionality (N French students (blue) = 139, N mathematics students (green) = 12)

The majority of French students (86%) and mathematics students (84%) agreed to the survey item regarding their ability to monitor their own progress when using Education Perfect. A larger majority of French students (87%) believed they were able to compare their progress with others using Education Perfect. The majority of French students (78%) believed they did not need the teacher's help when answering questions provided by Education Perfect. This response was supported by the fact that only 35% of French students agreed with the negatively worded survey item asking whether students believed Education Perfect didn't provide enough help with the questions they faced.

Key finding 4-9: Students believed they could monitor and compare their own progress with others and were independent learners when using Education Perfect.

French students' responses were neutral regarding Education Perfect's capacity to 'meet' students where they were by providing questions at the appropriate level. Approximately 50% of students agreed that Education Perfect would provide harder questions if students found them too easy, or easier questions if students were finding them too hard.

The greatest difference in responses between males and females came from the survey item titled 'Language Perfect gives me harder questions if I find them too easy'; only 44% of males agreed with this statement compared to 61% of females. The next most significant difference was 71% of males agreeing with the statement 'I don't need the teacher's help with French questions when I'm using Language Perfect'; 8% lower than females at 79%. There were no other significant differences in the responses between sexes.

Key finding 4-10: Only half of all students believed Language Perfect was consistently providing questions suitable for their level of understanding and readiness.

Three survey items revealed a significant difference in responses between Year 7 and Year 8 students. An extra 16% of Year 7 students agreed that Education Perfect would provide easier questions if they found them too hard, with 14% more Year 7 students also agreeing they didn't need the teacher's help with questions when using Education Perfect. Having spent more time with the programme, 91% of Year 8 students believed they could compare their progress with others within Education Perfect, as opposed to 80% of Year 7 students.

4.3.4 Education Perfect's impact on learning

The last subset of questions focused on students' beliefs regarding Education Perfect's impact on their learning (see Figure 4.8). Approximately 80% of French students agreed they made more progress with Education Perfect than without, learnt faster when using Education Perfect and learnt more when using Education Perfect. When asked 'I learn more with Education Perfect than I do without Education Perfect' as opposed to simply 'I learn more when I'm using Education Perfect', the response rate dropped slightly from 78% agree to 72% agree for French students. Mathematics students' responses didn't vary much across the four survey items, with only four of the 12 students agreeing with each survey item. These survey items provided the largest, most consistent difference between French and mathematics students.

Key finding 4-11: French students believed Education Perfect enabled them to learn faster. Mathematics students disagreed.

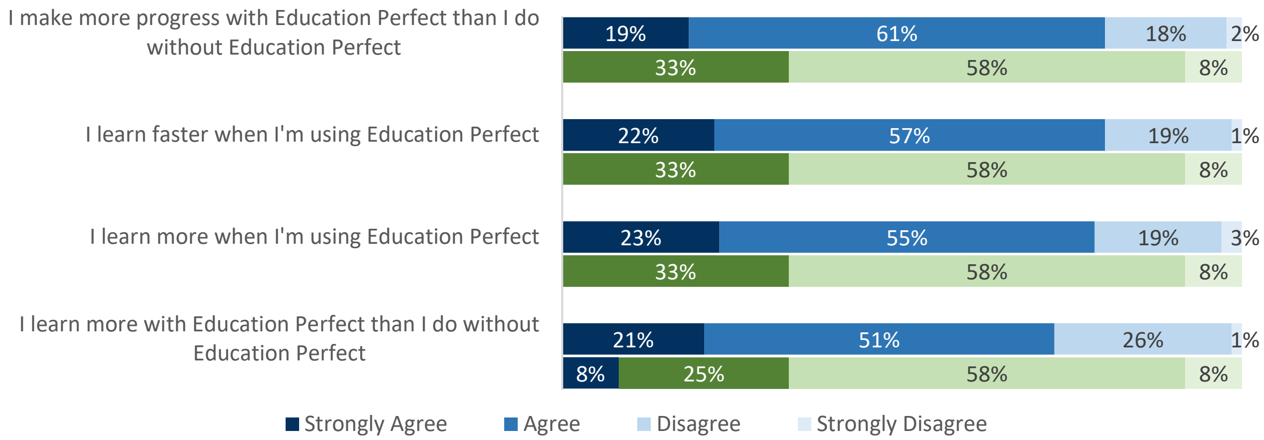

Figure 4.8: Student responses to questions regarding Education Perfect's impact on learning (N French students (blue) = 139, N mathematics students (green) = 12)

Another finding between the two survey items mentioned above was revealed when male and female responses were compared. Females (81%) agreed 13% more than males (68%) to the survey item titled 'I learn more when I'm using Education Perfect' but males and females provided the same agree response rate of 69% when faced with the survey item labelled 'I learn more with Language Perfect than I do without Language Perfect'. This means the females' responses differed by 12% for these two similarly worded questions, whereas the males' responses differed by only

1%. The difference in responses was only 3% and 5% for the other two survey items. It is unclear why these responses varied this way between males and females.

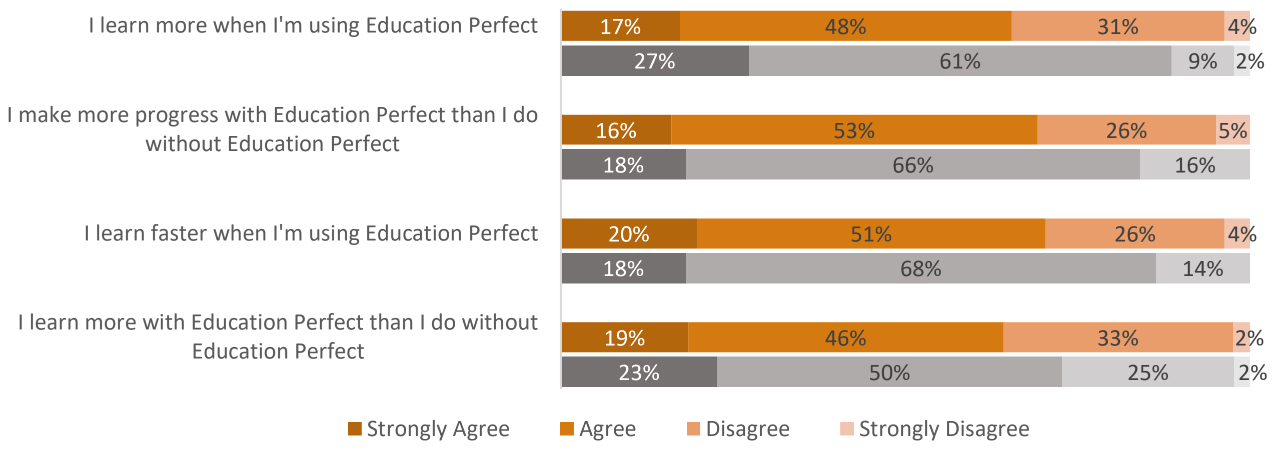

Figure 4.9: Student responses to questions regarding Education Perfect's impact on learning (N Year 7 students (orange) = 81, N Year 8 students (grey) = 44)

Figure 4.9 illustrates the difference between Year 7 (orange) responses and those of the Year 8 (grey) students. These colours were used instead of blue and green to make clear that data in Figure 4.9 did not represent a difference between French and mathematics students. Year 8 students indicated they were more convinced than Year 7 students that Education Perfect enabled them to learn faster and make more progress. This set of questions provided the most consistently significant difference in responses between Years 7 and 8. Year 9 students continued the trend, with an overall higher agree response rate than Year 8 students. Year 10 students broke this trend, with an overall response similar to the Year 7 cohort. It is important to note that there were only 11 Year 9 and 10 Year 10 responses to the Figure 4.9 survey items.

Key finding 4-12: More Year 8 than Year 7 students believed Education Perfect had a major impact on their learning.

4.4 Chapter summary

This chapter summarises all quantitative results from the case study school, being students' survey responses. The responses were judged as a collective, with comparisons made between French and mathematics students, sexes and year groups.

Overall, students were fairly convinced their teachers were aware of and addressed the academic diversity within their class, and that teachers were aware of their academic progress. They clearly indicated the opinion that they were assessed in the same way, with a significant minority of students suggesting test scores were all that mattered in their class.

With an over-representation of French students, most found Education Perfect motivational and wanted to use it more in class, with males in particular showing significant preference for it over paper-based work. Although only 12 responses were submitted, mathematics students appeared to show less interest in Education Perfect than French students. Although responses indicated Education Perfect was easy to use and enabled students to be relatively independent learners, there was almost a 50/50 split regarding Education Perfect's capacity to supply questions appropriately targeted to students' level of understanding and readiness. French students were convinced Education Perfect improved their learning; mathematics students were less convinced.

5. Findings—Teacher and principal responses to academic diversity

5.1 Introduction

All mathematics and French teachers, as well as the school's principal, were asked a subset of questions regarding the overarching research question.

RQ 1: How do principals and secondary French and mathematics teachers perceive and cater for students' academic diversity?

This chapter focuses on the principal's and teachers' responses to one of the two major topics in this study: academic diversity. More specifically, section 5.2 looks at these overarching questions: How do they perceive the term academic diversity? What does the range of academic diversity look like within a given year level and classroom? And what are the factors influencing the range in students' academic diversity? Section 5.3 investigates how the principal and teachers perceive academic diversity is being addressed at the cohort and classroom level, the importance of doing so and the barriers faced. Some students' responses were compared against these semi-structured interview responses. Mathematics and French teachers' responses have been cross-analysed throughout this chapter to identify common or opposing ideas from each department.

5.2 Principal and teachers' perceptions of students' academic diversity

The first part of the semi-structured interviews saw teachers and the school principal discuss their perspectives on academic diversity; what the term refers to, if it exists and to what extent (how large is the spread of academic diversity at the cohort and classroom level), the factors responsible for academic diversity and how it has changed over time. The following emergent ideas and subsequent key findings were identified from the interview data

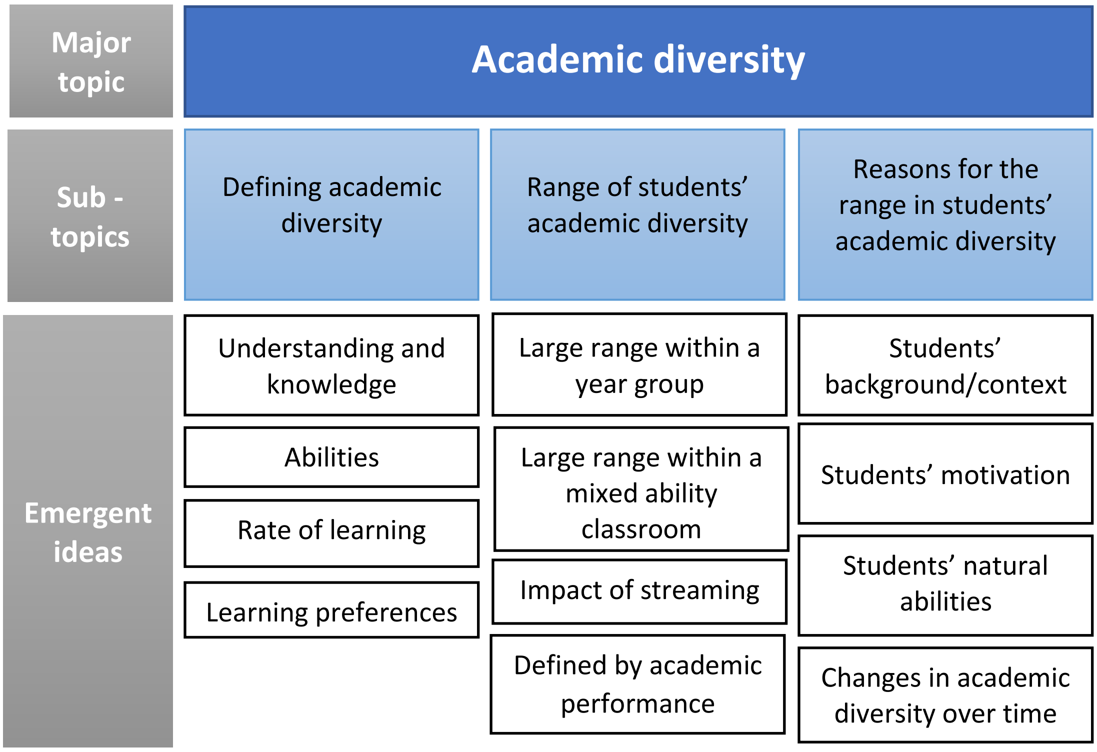

Figure 5.1: Advanced organiser of the emergent ideas from the principal and teachers' responses about academic diversity

5.2.1 Defining academic diversity

The teachers and principal referred to students' content knowledge and understanding when discussing students' academic diversity. For example, FT1 and MT1 said, 'I'm talking about understanding, having language concepts' and 'Well, firstly are they understanding the mathematical concepts?' respectively. Students' content knowledge and understanding was mentioned alongside the terms 'ability', 'different abilities' (FT2) and 'I guess high ability, low ability' (MT3). They also referred to the rate at which students learn, stating some students learn faster than others. The principal differentiated these concepts by saying, 'Are you talking about where a kid is at, [or] are you talking about a kid's capacity to develop more knowledge and understanding? So let's talk about those two separately for a minute.' One French teacher further elaborated that depth and accuracy in learning were also indicators of students' academic diversity.

Key finding 5-1: Content knowledge, ability and rate of learning were the most commonly referred-to terms by teachers and the principal when asked to define academic diversity.

The principal and MT2 briefly referred to students' learning preferences as a part of academic diversity, agreeing that students' learning preferences included different types of content delivery and topic interest: 'Some kids are really visual learners and they need to see diagrams and things to have things explained, whereas others can follow the algebra and the mathematical working and they don't need more visual aids to help them grasp concepts.' (MT2)

5.2.2 The range of students' academic abilities

When asked to describe the range of academic diversity across an entire year group and within a single classroom, staff focused on measures of students' content knowledge and academic performance (such as test scores), and the students' ability to cope with content. Staff compared students' abilities to year level expectations. For example, MT4 said: 'I think we ranged from like 5% right up to 100% [in our assessments].' MT1 added: 'Effectively [there's students] in Year 7 that are going to have abilities going right back to Year 1, 2, or 3.' This meant staff shared a more refined concept of academic diversity when considering range. This came as no surprise given test scores were the primary tool used for comparing and ranking students academically at this case study school. Students' survey responses supported the staff's focus on the importance of test scores as a measure of academic diversity.

Key finding 5-2: When describing the range of students' academic diversity, interviewees referred to test scores and year level expectations.

The teachers, as a collective, presented a sense of being overwhelmed when trying to describe the range of academic diversity across a given cohort, with one teacher describing the range as 'enormous' (MT2). Test scores were again referred to most frequently to indicate the wide range in academic diversity; for example, test scores ranged from '5% right up to 100%' (MT4) within a given year level. Some teachers referred to students being in an unsuitable year level, suggesting that students can have abilities up to six years below or two years beyond their current year level, with a range in ability of eight years within one cohort. MT1 clearly articulated this idea by saying there would be students in Year 7 with abilities at the 'Year 1, 2 or 3 [level]' versus some Year 7 students 'that might actually be a year or two ahead'. Three teachers compared the range of students' understanding of content to demonstrate the range of academic diversity within a given cohort. FT2 stated, 'high ability [students] would understand 99% of the [French] words, the lowest ability [students] may understand five [%]'.

The term 'bell curve' was used by one teacher to describe the academic diversity across a given cohort. The school principal believed if a bell curve was to illustrate the range in academic diversity, it would have a 'significant range' as students commenced Year 7 but that the lower-ability students would 'push up and narrow the width of the gap' as the year group progressed through school.

Key finding 5-3: Interviewees believed there was a large range in students' academic ability within a given year level.

The significant range of students' academic ability and performance within a given cohort was believed to be reflected in most Years 7 and 8 classes by all French teachers: 'All Year 7 and Year 8 classes that are not the academic extension classes [are] very much mixed ability. I've got students who are not in academic extension Year 7 and they're [academically ranked] second, third, fourth in the whole cohort' (FT3). The unanimous belief of a large range in academic diversity existing in almost all French classes may have been due to the lack of streaming. The French department had two extension classes in Year 7 and one in Year 8; the rest were mixed-ability classes. Years 9 and 10 French classes were electives (not mandatory), which appeared to stream students as only those motivated to continue learning French chose the elective class, reducing the range of academic diversity within the class. This was highlighted by FT3 saying, 'Once they've chosen to do it then they often … there's still a range of ability, but it's not as wide.' French teachers noted the large spread of academic ability across a cohort as being reflected within their classes more often than in mathematics classes.

All mathematics teachers believed streaming reduced the range of students' academic diversity within a given class. One teacher described a high-performing streamed class as having 'taken that range from the cohort and you've reduced it and slid it up the scale, (MT4), but said they believed there was still a range of prior knowledge and academic ability within the class. Despite the mathematics department streaming classes more than the French department, two of the four mathematics teachers were confident there was a significant range of academic ability within some classes. MT1 illustrated a significant difference between students in their mixed-ability Year 7 mathematics class as follows: 'I've got students in one of my Year 7 classes that can barely count on fingers and add up on fingers, to another student that really is pushing the extension classes.' The principal was also aware of the impact, or its lack, of streaming on the range of academic diversity within a given class, stating: 'There's no doubt that teachers will have a range of ability in a class, particularly if it's not streamed. They could have a student who is demonstrating in some aspects four, five, six years below their age group.' Streaming is discussed further in section 5.3.4.1.

Key finding 5-4: The principal and teachers believed the large range in students' academic ability within a year group was reflected in most of their classrooms, especially those not streamed.

5.2.3 Factors responsible for academic diversity and changes over time

The principal and teachers were asked about the factors responsible for the range in students' academic ability. Students' background and context was commonly mentioned as a significant contributor to the differences in academic diversity. This was further broken down into students' primary schooling, parenting, family life, interests, concept of the world, time spent on French or mathematics subjects, culture and residential suburb.

The students' backgrounds and prior knowledge was highlighted by three teachers as contributing to the diversity in their classrooms. For example, 'There's a whole background thing as well, so diversity is the ability level but it's also the surroundings as well, where they've grown up' (MT3), and 'different experience of learning the language' (FT3). A student's primary school experience was mentioned by two teachers and the principal as directly correlating to that student's development and preparedness leading into high school. The principal said, 'The way that Year 6 is taught and dealt with in terms of the curriculum can be quite different amongst not only just teachers but schools, so there is a significant diversity there.'

Parenting was also considered a significant factor in the wide range of students' academic diversity; specifically, parents' attitudes towards the subject at hand. For example, MT1 stated, 'There's also a lot of research, especially in mathematics, that show that a parent's beliefs on mathematics impact greatly on what a student believes.'

Although a large gap in test scores was commonly noted as a metric of academic diversity, some teachers believed students' academic performance was contingent on motivation. FT4 said, 'The lowest-ability students don't necessarily lack the ability to achieve; it is more that they choose to not listen, not concentrate, not try and not study.' The impact of students' motivation was further highlighted when FT2 discussed French students moving from the mandatory Year 8 classes into the elective Year 9 classes by saying, 'Year 9 is better because you've got kids who want to be there and they'll learn more than … that's when they start learning.' This was supported by FT2 claiming, 'They've chosen to go on, so you get those who are more willing to learn.' MT3 agreed that some Years 7 and 8 students did not place much importance/value on 'buckling down' and studying hard until they reached Year 9 or 10.

The last significant factor believed to impact the spectrum of students' academic diversity was their natural ability/intelligence. Although they didn't go into depth about this topic, it was mentioned by five of the teachers: 'It's just in their makeup' (MT2), 'Some just seem to be able to grasp it very easily, others seem to struggle' (FT3), 'Some kids can and some kids can't' (FT2) and 'Some of them are just naturally smart' (MT3). One teacher referred specifically to natural IQ as a reason for the range in students' academic abilities.

Key finding 5-5: Primary school, parents' attitudes, students' motivation and natural ability were believed to be contributing factors impacting the observed range in students' academic abilities.

Some teachers believed there had been changes to childrearing and students' lifestyles over the recent decades, leading to a decrease in motivation, independence and learning standards, and increasing polarisation of performance: 'Standards of independent learning or logic has dropped dramatically,' FT1 said. FT4 believed this had led to an inversion of what had traditionally been a bell curve of academic performance into a U shape, stating, 'Now I would say we are getting more of a U-shape, with a smallish group of students, maybe 25%, achieving an A while the majority of the rest of the class are Cs and even Ds.' The disparity between higher and lower academically performing students was considered by two mathematics teachers to be widening as a result of larger and larger cohorts; a result of school popularity. 'Year groups are also getting bigger … parents are trying to get the students into the [school catchment] area', MT1 said. MT1 also referred to the change in parenting whereby, more commonly now, both parents were working; increasing the time students spent in before- and after-school care. Similar to primary schools, day care could vary in the quality of educational activities and philosophy, impacting on a student's experience of education from a young age.

In addition to the apparent inversion of the bell-shaped curve, achievement was considered to be slipping by most French teachers who had been in the profession for multiple decades. Achievement levels, and the standards of independent learning and logic, were perceived to have dropped significantly across subject areas and schools, both public and private, in general. FT1 gave a specific example of the changes in expectations for learning French, saying, 'There's no grammar in [Years] 7 and 8 [anymore] 'cause the kids won't learn it. It's too hard.' These changes in expectations were not believed to be the students' fault; more so it was thought that students were considered 'victims of the generation in which they live' (FT4). Technology was perceived as a generational factor, considered damaging to students' motivation and self-discipline. Instead of being required to think carefully about a particular question or to go to lengths to find an answer, it could be easily 'googled'. 'Today's students were not required to think as much as those who were born without a mobile device, whether it be interpreting a map directory, sending mail, using a table of contents, or simply being acclimatized to instant access of any kind of information or media.' (FT4). FT2 said, 'There's been a revolution in how kids learn or don't learn. Well, they don't need to learn anymore, because of technology; they just look everything up. So you don't need to remember anything. If you forget, google it.'

FT2 spoke at length about the 'dumbing down' of content and curriculum. This was considered to have taken place during the last 10 years or so, stemming from a philosophy that no child should fail; instead, everyone is equal and it could hurt students' self-esteem if they were to fail an assessment. FT2 said, 'When I used to work in the Education Department, and worked part time, it was that philosophy that kids can't fail. It'll hurt their self-esteem.' Instead of dropping expectations, FT2 believed they should be raised over time. FT2 believed students were not being prepared for life beyond high school, unless they were headed to university, a place they believed reflected the same low expectations as high schools: 'It's an economic thing, because it's money, bums on seats.' FT2 also mentioned alternative entry pathways to university, a concept that had become more pervasive in high schools: 'So again, it's dumbing down. Everybody is equal. We all have a right to go to university. No, we don't. If you're not academically capable, you don't have a right to go to university.'

Key finding 5-6: Teachers believed students' academic performance, expectations and motivation were decreasing.

5.3 Addressing academic diversity

Once the teachers and school principal had elaborated their perspectives of what academic diversity meant to them and how broad it ranged within a given cohort/classroom, they were asked about the importance of addressing this diversity at the department and classroom levels. Section 5.3 presents the data for these subtopics, including the barriers to addressing academic diversity. An advanced organiser illustrating the emergent ideas for each subtopic can be seen below in Figure 5.2.

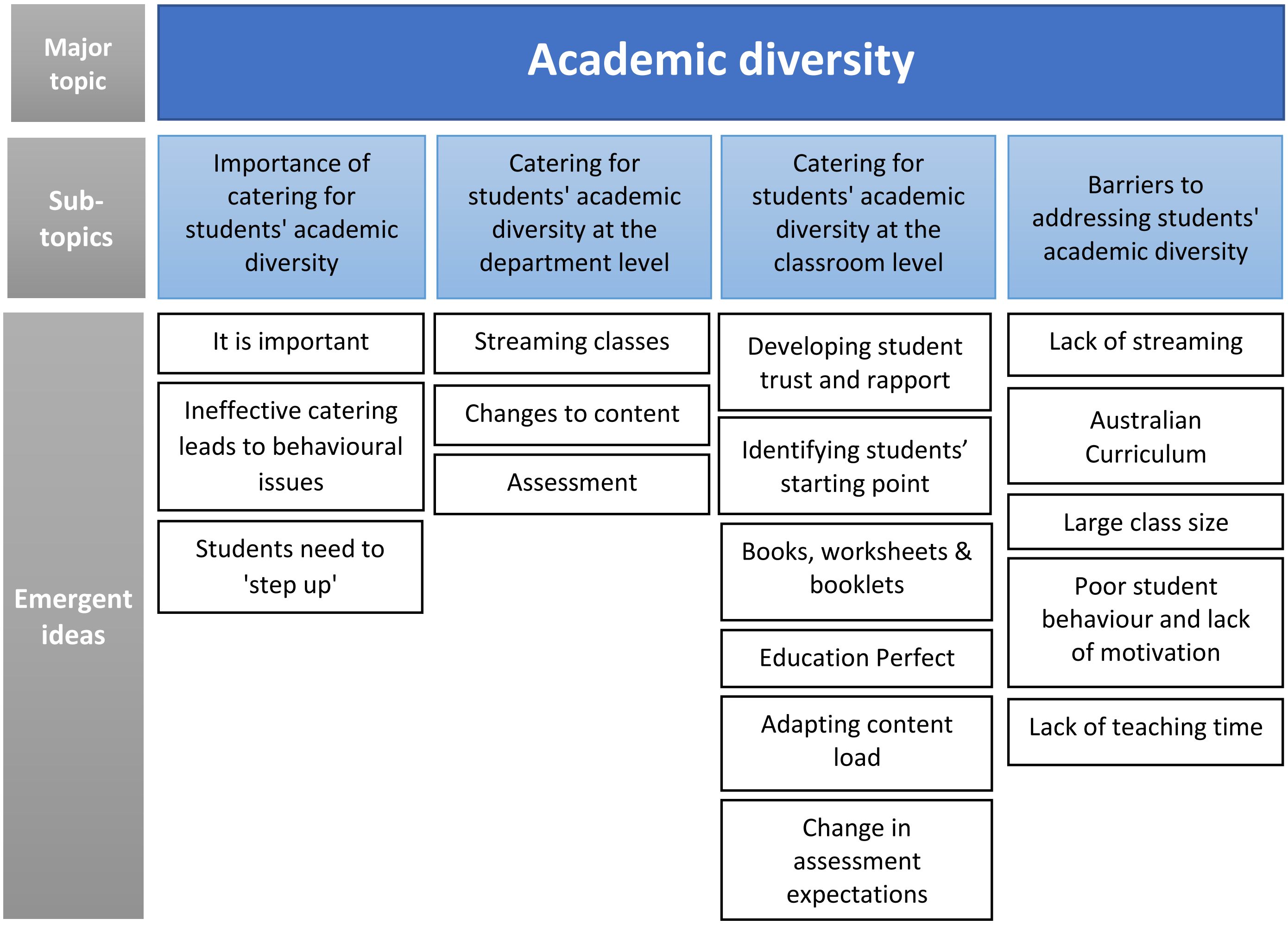

Figure 5.2: Advanced organiser of the subtopics regarding how academic diversity is addressed and their emergent ideas

5.3.1 The importance of catering for academic diversity

The principal and school teachers had defined the term academic diversity by referring to students' academic ability, content/prior knowledge, pace of learning and test performance (see section 2.2.1). When asked if catering for the academic diversity in their classroom was important, a definitive 'yes' response was given by all participants. The principal and teachers presented two broad themes in response to being asked *why* catering was important: because every student needed the chance to show what they're capable of ('Every kid has to be given the chance to show what they can do.' FT2); and it would increase the likelihood that everybody was learning ('To be able to make sure that every student leaves your class having learned something.' FT1). If students were not being presented with information aimed at their level of current understanding, teachers believed boredom would grow within both high- and low-achieving students. MT1 said, ‘If the kid finishes early, [there’s] more possibility they'll become a disruption, will get bored and get off task’. This view was supported by FT3, who added: ‘If you pitch it too high, they'll just switch off. If it's too low, they'll switch off.’ Teachers’ experiences had shown them that if the content was too easy, high-performing students would begin to socialise and distract others; if the content was too hard, lower-performing students would begin to create distractions. Behavioural issues appeared to be a by-product of providing information at an inappropriate level of difficulty.

Students’ learning preferences and interests were mentioned earlier as a part of the diversity found within the classroom. One teacher commented on the need to provide a variety of activities to suit different ‘learning styles’ (FT4) while another teacher suggested students needed to change their study ‘habits’ (MT3) and raise their standards of independent learning instead of being individually catered for. MT3’s sentiment supported earlier comments made by other teachers that suggested educational standards and expectations of student performance had slipped in recent decades.

Key finding 5-7: The principal and teachers believed it was important to cater for the academic diversity found within a classroom so as to maximise students’ learning and minimise behavioural disruptions.

The principal outlined some of their expectations and goals when discussing students with varying academic performance. They believed students’ grades were an appropriate measure for student success: ‘We typically, as educators, put a C against that; they're learning enough, that's average, that's an average result … So in terms of with the differentiation, really what we should be aiming for is that all students should be getting Cs or higher … So if there are no significant factors affecting the student, such as significant illness, time off school or a mental health plan, but the kid is simply getting a D, I would say that the differentiation needs to improve.’ They acknowledged not all students achieved the same grade or level of understanding, but that there should be an understanding of what students should be achieving as a base level.

Key finding 5-8: The principal had clear expectations about the minimum standard of achievement for students.

5.3.2 Catering for academic diversity at the department level

When asked about addressing academic diversity at the department level, the primary focus was on streaming classes; grouping students into classes based primarily on their academic results from previous or current years. In the Years 7 to 9 mathematics cohorts there were three streamed, classes: extension, advanced and core. Any students not in these classes were in 'general' mathematics classes; classes with a greater mix of ability. Extension classes were for the academically top-performing students. Advanced classes allowed students who only just missed selection for the extension class to undertake 'additional work' at a 'faster pace' (MT1). The difference between these classes was that advanced students did not undertake any interschool mathematics competitions whereas extension students did.

The additional learning that the extension and advanced mathematics students undertook was above and beyond the AC content expected for their given year level. MT4 said, 'We extend them [Year 8 students], then we might start doing some Year 9 work, so we might accelerate them or just [provide] enrichment at this level, so problem-solving, investigation'. Because these higher-performing students completed content above and beyond the AC expectations, they were given additional assessments. According to MT4, this 'didn't count towards their grade because we can't assess them on anything other than the Australian Curriculum, but it goes toward their [cohort] ranking', which does influence their ability to remain in the extension or advanced class. Four high-performing classes were going to be created for the Year 7 students due to the high number of student enrolments in 2019. According to MT1, 'We were having a significant portion of kids that really were extension quality, and so we decided to try and push all of those to give them as many opportunities as possible.'

Extension, advanced and mixed-ability classes ranged in size, with 32 students being the upper limit. Core classes were deliberately kept small to allow for a better 'teacher to student ratio' (MT1). Students who were academically low-performing in mathematics were given the choice to join the core class. According to MT1, giving students the choice to join the core class meant 'kids that will actually want the support and are willing to engage' are within the same class. It was hoped that this would minimise behavioural issues. The pre-essentials mathematics class available in Year 10 (the Year 10 core class equivalent) takes a step further in catering to students' academic diversity by 'doing everyday kind of maths that they're going to find useful when they finish school', claimed MT3. This content replaced AC content that all Year 10 students were expected to complete. Parental permission was required for students to enter this class, which was seen as a positive direction for lower-performing students to take because at times it would be 'a big issue' (MT3) when students saw content as irrelevant as it would lead to disinterest, a lack of focus and poor behaviour.

The principal believed streaming was 'appropriate if you've got a significant diversity amongst students in terms of their capacity … expecting a teacher to be able to differentiate from a student who's at, say, a Year 4 level to a student that's at a Year 10 level, all in the same class, is a bigger ask than all the students being at Year 10 level. That's just common sense.' As well as facilitating the streaming of classes, they saw part of their role in addressing academic diversity as being responsible for choosing 'outstanding educators to work in the school, with an open mind, and an understanding and the right attitude.'

Key finding 5-9: Streaming classes based on performance in mathematics helped teachers to address students' academic diversity in their own classrooms.

Before Year 6 students entered high school, they were pretested with mathematics assessments. This allowed insight into students' academic performance, meaning they could be streamed as soon as they entered high school in Year 7. A newly trialled pretesting strategy also ran for the higher performing classes in Years 7 and 8. Students were assessed on the mathematical content expected for their year level before teaching began. Having students undertake the school-designed pre-test helped identify where students were regarding the topic to be commenced. This was believed to reduce the risk of losing higher-performing students' interest because they may not have been challenged early enough; 'I didn't waste really precious class time teaching them stuff that they've already done and risk losing their interest because they're not being challenged,' MT4 said. All lower school mathematics students also completed a common assessment twice a term that focused on what was expected for their year level according to the AC. There was some differentiation within these assessments, with questions arranged in an A-B and C-D grade level.

This was to allow lower-ability students to concentrate on questions better suited to their level of prior knowledge and readiness.

Students were able to move in or out of the higher or lower-academically streamed classes based on their ongoing academic performance. The most significant movement of students between classes occurred at half-yearly intervals.

Key finding 5-10: Pretesting provided mathematics teachers with insight into students' prior knowledge, resulting in more appropriately targeted content.

French extension classes were implemented into Year 7 in 2017. Year 8 had extension classes for many years before this change to Year 7 took place. There were two extension classes in Year 7 and one in Year 8. There were no streamed classes in Years 9 and 10 as French was an elective class for these year levels (the class wasn't mandatory in Years 9 and 10). As mentioned earlier by one of the French teachers, this acted as a streaming mechanism; only students interested in putting in the effort chose to pursue French. This decreased the spread of academic diversity within Years 9 and 10 French classes: 'There's still a range of ability, but it's not as wide.' FT3 said. A key difference when compared to the mathematics department was the French department's greater emphasis on students' attitudes towards the topic when streaming Year 7 classes. There was more emphasis on student interest and primary school experience with the French, as opposed to purely looking at academic performance. FT3 said, 'Extension was based on expression of interest when they came into high school; students who'd done French in primary school and who'd experienced sort of success with it, perhaps they've got some French relatives or just generally an interest in learning languages.' Years 7 and 8 French students could be moved in and out of extension classes with the other mainstream classes, based on academic performance. These movements also occurred at half-yearly intervals. Another difference was the absence of a core French class for low-achieving students. This is partly because students who achieved below their given year level expectations for English undertook extra English literacy classes instead of French classes. FT1 explained, 'There are already some students in Year[s] 7 and 8 who do extra literacy rather than French because I think their NAPLAN results are so low.'

A similarity between the mathematics and French departments was the testing of all students with the same assessments. Students' responses to the survey item asking about being assessed in the same way strongly support this finding. FT1 said their department would discuss the assessments year to year and communicate any proposed adjustments: ‘We discuss it among ourselves, yes. And from one year to the next we say, "Alright, well, did that work?” And [if so] we'll reuse it. Or, "That didn't work." Or, "We need to adapt this one, because ... ”’ (FT1). These discussions indicated an attempt to improve and adapt questions to appropriately assess all students. FT2 expressed concern that they were failing to achieve a bell curve spread of results despite making assessments more difficult each year because the higher-performing students would step up to the challenge but the lower-performing students would simply end up with lower results: ‘We're always saying to ourselves, "How do we get the bell curve? What do you do? How much more difficult can you make it?” Every year we make the test more and more difficult. But the good kids, they'll accept that challenge. They'll learn it … They step up, yeah. But then the kids who really should try harder don't, and they end up down the bottom,’ FT2 said. This echoed the concern of the inverted bell curve in achievement mentioned earlier.

Key finding 5-11: French teachers found it difficult to design assessments that produced the bell curve of results they sought.

5.3.3 Catering for academic diversity at the classroom level

How teachers addressed academic diversity at the classroom level was identified as what they had independent control over and could vary from class to class; for example, how they presented content in class. Developing trust and rapport with students was considered an important first step by most teachers; one that should be addressed before attempting to identify and cater for students’ varying academic abilities. MT1 said, ‘Being able to get a relationship, a rapport, with the students so they're willing to actually talk to you, [to] seek help, and [to] give them an opportunity for success … building trust is one of the biggest things with the class you have to do. And then from there, identify what they do know and then adjust the course from there.’

Most mathematics teachers commenced new topics in a similar way. There would be some form of informal assessment to help gauge students’ prior knowledge and motivation, both individually and as a class. This would include pretesting, assessing questions provided on the board or on a worksheet, gauging the discussion students were having with each other about the questions, checking students’ mathematical working as a sign of proficiency and providing easy questions for all students to start with. Another method for assessing mathematical students' understanding throughout a topic included formal and informal written tests.

Key finding 5-12: Mathematics teachers started each new topic in a similar way, with formal and informal questioning and assessments.

When mathematics teachers discussed which resources were used in class it was mostly AC-orientated textbooks and worksheets. These materials were also used as a means of extending or supporting students where required. Students who were learning at a pace beyond the rest of the class would be provided with the mathematics textbook for the following year level or more demanding worksheets.

Key finding 5-13: High- and low-performing mathematics students were extended or supported with online digital resources, worksheets and textbooks aimed at the appropriate level of difficulty.

MT4 discussed how they would 'think out loud' in front of the class if students were struggling with the questions, providing step-by-step solutions on the board with the students. MT1 also mentioned Khan Academy, YouTube, Education Perfect and Mathspace as other resources used by the mathematics department. Khan Academy and YouTube videos would be recommended for academically weaker students to watch either the night before (a 'flipped classroom-style' approach) or after new content was presented. Education Perfect and Mathspace are discussed further in Chapter 6.

One mathematics teacher used peer learning as a technique for students to appreciate the importance of setting out their working when completing mathematical formulas. A class of high-performing students were tasked with teaching lower-performing students how to set out their work to help with understanding and processing of information. MT4 said, 'They worked with the person, and how they did it, how they taught it to them. So they loved it, absolutely loved it.' This process of learning from teaching others enabled students to work at their own pace and interact with each other in new ways which saw positive results in the higher-performing students working out abilities in following tests. Another teacher explored concepts with their lower-performing mathematics students by using physical aids. When explaining volume and cubic centimetres, wooden blocks were used to both enable students to better visualise what was being discussed and increase interest. When explaining a different topic, props better suited to those concepts were used. MT3 explained, ‘With my algebra stuff, I had my ... I brought in a little see-saw thing.’ Another maths teacher explained how there was assistance offered to students who wanted extra help before or after school and during lunch breaks.

Key finding 5-14: Mathematics teachers used a range of strategies to help target their teaching at the appropriate level of students’ understanding and ability.

One French teacher mentioned recapping content to check for understanding, but this was more of an ongoing strategy and dissimilar to pretesting. The lack of discussion around pretesting in French classes may have been due to the perceived absence of students’ background knowledge. FT4 stated, ‘Remember that we are dealing with a foreign language, so every topic is a blank canvas which students mostly know nothing about. There is usually no prior knowledge.’

Key finding 5-15: French teachers undertook little or no questioning/assessment at the beginning of each new topic due to a perceived lack of students’ background knowledge.

Instead of a textbook, French teachers would give students a booklet to progress through. The booklet generally took a term to complete and gave students the opportunity to progress at any rate by simply moving on to the next pages of the booklet if they finished the assigned work for the day. It was suggested that the open-ended nature of most French questions enabled students to display a range of abilities. Students could provide extra information, more sentences or more technical responses for some of the open-ended tasks. FT4 said this provision was ‘mainly through open-ended tasks in speaking and writing, allowing both more capable students to showcase a range and diversity of language learnt and the less able to at least demonstrate that they could communicate some basic structures in a more limited fashion.’ This suggested the nature of the

French subject allowed teachers to cater to the academic diversity within their class by differentiating some assessment items.

Key finding 5-16: Some French assessments were differentiated by allowing students to display a range of responses to open-ended questions.

Another resource all French teachers reported using to address academic diversity was an online computer programme they referred to as Language Perfect (now known as Education Perfect). Three French teachers described the programme as 'fantastic' (FT2), 'an absolutely superb tool' (FT3) and 'a godsend. It has been a lifesaver. I did not think that it would be this effective,' (FT4). This praise is investigated further in Chapter 6. Other resources, used less commonly in French classes than Language Perfect, included word sleuths and crossword puzzles.

Key finding 5-17: French teachers highly praised Language Perfect as a means of addressing academic diversity.

There was variation in the French teachers' learning activities and pedagogy. FT2 spoke about splitting students into pairs to undertake dialogue, conversation and reading with each other. The French teachers also spoke about not overwhelming lower-performing students by asking them to focus on less content at any given time; for example, focusing on five French sentences instead of trying to master 10. This was differentiating content expectations between students and was believed to help the lower performing students succeed. Additionally, students who were really struggling with an assessment would be given another chance to achieve a better score. These students would be given more explicit instruction about what content to focus on before the assessment. As discussed earlier, FT2 believed there was an overarching push for all students to pass; something that was absent in previous years: 'We never did that in the past. The test is on Monday, do the test. And it was pass or fail.' Higher-ability French students were encouraged to extend themselves with speaking- and writing-based assessments. They weren't penalised for not going above and beyond what was expected, but were pushed simply because they had the capacity to do so.

Key finding 5-18: French teachers adjusted their expectations of academic performance for lower- and higher-achieving students.

5.3.4 Barriers to catering to students' academic diversity

When asked explicitly if there were any barriers to catering for the academic diversity within a classroom, teachers most commonly responded with lack of streaming, lack of teaching time, class size being too large, poor student behaviour and lack of student motivation. An emergent theme throughout these perceived barriers was the Australian Curriculum; it appeared to play a significant role in the inability of teachers to stream content and classes, and was considered to be responsible for teachers being time poor more generally speaking. Not streaming content to better target students' prior knowledge also resulted in poorly targeted assessments, leaving lower-performing students with a negative self-efficacy and Year 10 students feeling immense pressure to not miss the pre-requisite scores for their Year 11 subjects.

The principal said catering for the range of academic diversity found within some classes was a difficult task, but believed the majority of staff had the ability to do so: 'I do think it's difficult, and I think teaching is difficult … I would say that the majority of people that have been appointed to teaching roles [at this school] are those that can do it, can do that difficult task. Teaching isn't easy. Teaching is actually a real skill.' One of the possible barriers to teachers effectively differentiating, the principal highlighted, was their training and experience, or lack thereof. However, they believed this could be overcome by giving teachers 'the opportunity to develop'. The principal was asked about the idea of teaching at the individual level, to which they responded, 'If we are going to talk about teachers specifically narrowing down exactly what each individual kid needs and then delivering something to them, how are they going to do that? You can't. You can only do that if you're one on one.'

Key finding 5-19: The principal believed effectively addressing academic diversity in some classes to be a difficult task, but also that teachers could be supported to improve their ability to do so.

5.3.4.1 Streaming

The French department had lobbied for an extension class in Year 7 prior to 2017. FT4 explained part of the reason for the lobbying: 'This mixture of rank beginners and those with some knowledge of the language is not easy for the teachers to handle. This has long frustrated students as well as parents, when their child who had completed some [French] language at primary school was placed with those who knew nothing at all.' Some French teachers expressed interest in streaming students further than only providing two extension classes in Year 7 and one extension class in Year 8. FT1 described the 'ideal scenario' for streamed classes as including 'different assessment, different expectations, [and a] different set of vocabulary' within each year level. FT1 went on to describe another perspective, stating, 'Those [lower ability] students are not only academically challenged; they're also, behaviour-wise, an issue. So if you were to put them together [by streaming], you would have the class of … if I may say, nightmare.' The principal suggested that the streaming of students based on academic performance could result in students with negative attitudes towards a particular topic being placed in the same class and being able to 'feed off each other'. As well as concerns for the grouping of poorly behaved students, logistical issues were considered a barrier to streaming classes by FT4, who said: 'Over the years [pre-2017], it was just too hard for the deputies to organize due to the complexities of the high school timetabling structure. We thus have no focus classes and there is no streaming [beyond the extension classes in Year[s] 7 and 8].' The high school timetabling structure refers to the class configurations, of which there were a limited number.

Key finding 5-20: French teachers wanted more streamed classes with different expectations for learning and assessment.

The mathematics department had tried streaming every class within every year level in the past. One of the most significant problems faced was that students in the lower-performing classes developed a fixed mindset of being in the 'dumb group'. Parents also raised issues with streaming all classes by claiming it was the teachers' fault that the lower-performing classes were consistently achieving low test scores. MT1 said, 'We've actually gone back to doing heterogeneous classes for the mainstream, so we're mixing kids around. So hopefully we can remove that stigma of being in a 'dumb class' as such; getting some support from the other kids, giving opportunities as part of it, and to also remove any potential misunderstandings about teacher quality and all that sort of thing.' The reduction of streamed classes was being trialled for the year. If it was found lower-performing students were struggling in the mixed-ability mainstream classes, the mathematics department would be pushing for another core class, allowing more students to elect for further targeted academic assistance.

Key finding 5-21: The total number of streamed mathematics classes was reduced due to students' developing fixed mindsets and parental concerns about teachers' abilities.

5.3.4.2 The impact of the Australian Curriculum

The principal, who was relatively new to this high school, discussed streaming at length, partly because they had completed a research project on streaming during one of their post-graduate degrees. When considering a classroom with students ranging in academic ability from a Year 4 to Year 10 level, the principal believed it would be common sense to attempt to reduce this academic diversity by streaming to lower the demand of differentiation on the teacher. More significantly, the principal stated, 'We have got it wrong as a state, and as an Australian Curriculum, and as a nation, in the way that maths is delivered.' The principal went on to explain what may have been the most significant idea found in this research: 'So, when they [students] get to senior school, we actually stream the complexity of the maths courses that are on offer. So if you do the lowest-level maths in senior school you have the capacity to get a grade A, B, C, D, according to a grade-related descriptor, in that if you do math specialist, you get an A there. But the math specialist A is nothing compared to the A in the lower-stream maths in senior school. Yet in lower school, we don't do that; we expect everybody to be the same. So what does that do in terms of teachers' capacity to offer what you're calling academic diversity in their teaching, and what does it do to the attitude of those kids with maths? What does it do to the parents who get feedback, assessment after assessment after assessment, that their child has got a D but they're trying really, really hard? What does it do in terms of streaming in lower school, where you put all of these students together so that the teacher can offer the best support for these kids? And it means in that class the average grade is a D. In the next class the average grade is a C. So in terms of streaming, I think streaming's extremely important in some subject areas. In maths it is, and the maths curriculum in lower school should be streamed, with an opportunity for kids to progress from one stream to the other so they're not pigeonholed. But at the moment, we're getting it wrong. And we're getting cohorts of kids that have failed maths in Year[s] 7, 8, 9, 10, who go to senior school so they can get a C.'

Another issue concerned the lower-school mathematics classes being more streamed in the past and the difficulty in students moving from one stream to the other. MT1 said, 'Once you start down that path, that's it. It's really very difficult to come out of it because they're missing other work.' (MT1) Despite this, the principal's sentiment was mirrored by MT1, who believed Years 7 through 10 increased in difficulty to allow students to undertake Year 11 methods and specialist level classes (the highest-level upper school mathematics classes); this meant the majority of students who weren't moving on to Year 11 methods/specialist classes would be dropping back to content at a Year 8/9 level. MT1 said, 'So kids have gone like this massive big hump, struggled all the way through to try and keep on the Australian Curriculum, and then back to an easy run.' MT1 agreed the mathematics courses had not been designed well as too many students were pushed in order to undertake common assessments. Having all students complete the same curriculum in lower school was seen as having a negative impact on lower-performing students' self-efficacy. MT2 described it as 'a bit soul-destroying for them'. MT3 also mentioned the lack of interest from students in the content presented, saying, 'The Australian Curriculum, especially for Year 10s, is so dry and so ... Just "here's some numbers, do this thing". And they just can't see any use for it. It's really quite sad.'

In order to choose the Year 11 methods class, students must have achieved an appropriate score in the Year 10 pre-methods class. The AC was believed to negatively impact higher-performing students' capacity to learn effectively as there was too much content to cover in the Year 10 pre-methods class. MT3 said, 'It's just if you miss one lesson, you've lost it. It's really hard. It's jam-packed.' Almost a quarter of the Year 10 pre-methods students had moved down to a lower-difficulty class by the end of the first semester. The principal mentioned some concern amongst other principals about there being too many assessments. They said, 'I was in a meeting with six other principals of high-performance schools where we were talking about this, about assessment, and the fact that we feel that, a number of us, that kids are over-assessed in the curriculum, and that teachers are over-assessing and burning themselves out.' It is important to note that the reasons for students changing class could be varied and may not have simply been because the class they are moving out of is set at an inappropriate level.

When the principal was asked if they would like to offer classes with streamed content to lower-school mathematics students, as was done in Years 11 and 12, they responded with, ‘Absolutely’, however, they also said it was not possible ‘because we’re guided by the Australian Curriculum, and we grade students according to that.’ When all mathematics classes were streamed in the past, there was an attempt to work around the grading requirements by giving students two different grades: one grade (A through E) was based on the streamed class the student was in; the other grade (A through E) was aligned with the Australian Curriculum. The principal provided the following example: ‘So if you were streamed in the bottom class in maths, your learning-area grade might be a D, but your streamed class grade might be an A.’ Despite this attempt to provide students with a grade to reflect their performance within the streamed class they were in, the principal said it confused a lot of students and parents. This two-tiered grading system was in place when the principal arrived and had left some parents frustrated. The principal gave an example of what these parents would say: ‘My kid’s got an A in maths in Years 8 and 9, and, now they're in Year 10, I want them to do ATAR Maths and I'm being told they can't.’ This was another example of the parents’ voices playing a role in changes to how classes were streamed.

Key finding 5-22: The principal and mathematics teachers believed the Australian Curriculum didn’t allow for the delivery of content and assessment appropriate for all lower-school students.

Despite the AC not having been implemented into the French subject area at the time of their interviews, the French teachers were aware of the implications of the AC for their department, as well as a potential rationale for why the AC was being rolled out. FT1 spoke about the need to compare students across schools as part of the justification for there being an AC for all teachers and students to follow. This comparability was believed to allow a student to more easily transfer from one school to another without much disruption to their learning; ‘And a B in one school is meant to be the same as another, and the thing is ... on some level, one student should be able to transfer from one school to the other, having the same backgrounds, knowledge of each subject ...

in theory,' FT1 said. However, due to the requirement for all students to be assessed the same way, FT1 added that 'because of the system that we're in, it's not possible to differentiate.'

FT2 believed that when the AC was to be implemented it would be 'a total farce' because the expectations of what students needed to learn were 'a joke': 'It can't be true. Kids in Year 7 learning all the verb tenses in French? There's six of them. Kids in Year 12 know maybe two. How are the kids going to learn? Do them once a week in a primary school? How are they going to get to that level? And they talk about the environment and all that, for goodness sake. They can't talk about that [the environment] in English,' FT2 said. There was some negativity felt for the people responsible for writing the AC, as though they were too detached from the classroom to understand what students were capable of learning. This sentiment was made explicit by FT2, who exclaimed: 'This is the stupidity of these people who know nothing, who sit behind desks in the Education Department; these curriculum writers.'

Key finding 5-23: Some French teachers were sceptical/critical about introducing the Australian Curriculum due to what they believed to be inappropriate learning expectations and the impact on their ability to differentiate content.

5.3.4.3 Class time and size

French teachers believed one of the most significant barriers to catering for academic diversity within the classroom was a lack of teaching time. French teachers only gave two lessons a week with their lower-school classes, meaning two contact hours per week with 32 students. This was half the amount of time most other subjects have to teach each week. With class size having increased over the years, the time you could spend with each student had decreased, which was seen as problematic for giving individual assistance. FT2 said, 'In the old days, we had 25, 26 in a class. Now it's 32. You cannot give individual attention to each student, like less than a minute per student. If kids need help, how are you supposed to help them?' With little individual teaching time for each student, the range in students' academic diversity was highlighted by FT1 as problematic for appropriately differentiating: 'When you have a massive spread of ability across the class and you've got 32 of them and you're completely on your own … you can't cater adequately; you can't, I would say, differentiate the same way as you would with a class of 20.' FT3 agreed that it would take more time to cater for the academic diversity within their classroom due to class size, but they didn't believe it was necessarily difficult to do; more so, time consuming. When presented with the idea of catering to all students' academic needs at the individual level, the French teachers responses were strongly aligned, claiming it be an absurd concept. For example, FT4 said, 'With such huge classes it is difficult to give the students the individual time they need, no matter how able they are or not. This is not realistic.'

Key finding 5-24: French teachers found a lack of teaching time and large class sizes to be significant barriers to appropriately addressing the academic diversity within their classes.

Despite having twice the amount of time to teach their lower-school classes each week, the mathematics teachers also raised the issue of being time poor due to what was believed to be an overcrowded and demanding AC that had to be adhered to. 'Yeah, our curriculum is so full. It would be nice to go back over stuff; it's just a hectic pace. I feel very restricted by that. We've got a curriculum. We've got to get through it. There's no time to do any fancy-free stuff, no real problem solving,' said MT4. MT2 believed the AC was mostly responsible for the school having moved away from streaming all mathematics classes. They believed this meant that the mathematics teachers were no longer catering for the students' academic diversity as well as they used to.

Key finding 5-25: Mathematics teachers believed the demands of the Australian Curriculum had left them time poor and led them away from appropriately addressing students' academic diversity.

5.3.4.4 Student behaviour and motivation

All teachers reported that student behaviour presented a barrier to effectively catering for the academic diversity within their classroom. Poor behaviour, described by most teachers as students being off-task and distracting others, was said to come primarily from lower-performing students who misunderstand the content or did not keep up with the pace of work. Difficulty understanding the schoolwork at hand was considered the catalyst for misbehaviour as a student's attention would move away from their work and towards others around them. MT3 reported that students who did not understand a concept being taught would begin to misbehave, leading to further misunderstandings, hence more behavioural problems. They said, ‘The lower-ability kids, you spend 70% of the lesson just trying to control them, 30% teaching. So, it's constantly resetting passwords, getting them to sit where they're supposed to sit, not calling out’. The teachers reported that poor behaviour of individual students in class instigated similar behaviour from their peers, and this impacted on students’ learning. Tending to students who were completing work at a slower rate inhibited the teacher’s capacity to continue forward with the rest of the planned lesson. Although there was a general belief some students were poorly behaved, this did not apply to all students or classes. Teachers with extension classes experienced less behavioural concerns.

Key finding 5-26: Teachers believed students who struggled with the classroom work caused disruptions to their class, making it more difficult to adequately tend to other students and progress their lesson.

All teachers repeatedly mentioned students’ lack of motivation and poor attitude towards the classroom work as a significant influence on classroom behaviour. Despite some teachers’ efforts to motivate and engage students, there was a sense of struggle because of the variables that were out of the teachers’ control. MT3 said, ‘You can make all these changes, try to make it more engaging, exciting, but some of them just, they'll just fall asleep and say, “It's maths and I don't wanna do it.”’ The variables teachers believed to impact on students’ motivation and attitude towards learning included students’ priorities, technology, parents’ attitudes, the AC and the nature of the topic. Some teachers commented that students were more interested in socialising with friends than learning the curriculum at hand. As mentioned above, teachers did not perceive student disengagement to result from their lack of capacity to learn; rather, it was attributed to their work ethic. It is important to note teachers were referring to a subset of students here, not students in general. Part of this lack of effort was considered to stem from students not continuing the subject into the following year. Students in Year 8 didn’t need to continue French into Year 9; students in Year 10 didn’t need to continue mathematics into Year 11. MT3 said students would say, ‘I’m not doing maths next year; why do I care?’ FT1 agreed, saying, ‘If students know that they’re not going to carry on with it [French], why bother?’

Most teachers commented on the impact parents' attitudes were believed to have on students' attitudes and motivation. If the students' parents made negative comments regarding the topic, such as, 'Oh, I was never good at mathematics' (MT1), the student was believed to mirror this attitude; potentially leading to a belief they too are not 'good' at mathematics.

Key finding 5-27: Some students' lack of motivation to complete work was seen as a barrier to teaching effectively and contributed to behavioural problems.

Because French is a foreign language for most students undertaking the topic in Australia, the teachers assumed students were not capable of working independently on the subject. The teachers reported that students would find it difficult to progress and/or stay on task because they were not learning in their native language. It was believed that in another subject, such as English or science, students could independently progress because they could comprehend most of the information given to them, as they already understood the language. Students' inability to be independent, self-disciplined learners was also identified as a consequence of age and maturity: 'They're children', FT1 pointed out.

Key finding 5-28: French teachers believed most students lacked the ability to progress independently and/or stay on task.

Most teachers described some students as being too lazy to do the work, partly because they may not have seen much value in learning the topic at hand. While there will always be a variety in students' motivation to learn, two of the French teachers who had been teaching for more than 85 years combined believed there had been a decline in students' motivation, as well as their ability to concentrate, over the past 20 years. FT2 was quoted earlier, saying, 'There's been a revolution in how kids learn, or don't learn', supporting FT4's comment that 'If they can't do it straight away, or if it involves effort, then many can't be bothered. It is not their fault: it is the period in which they live.' As presented in section 5.3.4, one of the most significant factors believed to be responsible for this change was technology, which leads students to grow up experiencing and expecting instant gratification and instant access to myriad information and easily accessible answers. This is discussed further in section 6.1.1.

5.4 Chapter summary

The school principal and teachers were fairly unanimous when describing the term academic diversity, both directly and indirectly. It was described as the range in students' prior knowledge, pace of learning and learning ability, and measured by academic performance such as test scores or expected year-level performance. The range of academic diversity was considered very large across a whole cohort of students, with this range also being reflected in some mixed-ability classes. A reduction in the spread of academic diversity was observed in both lower- and higher-performing streamed classes. Reasons for the range of academic diversity within a secondary cohort or classroom included students' background/context (such as the quality of their primary school, parental attitude towards the subject area and family life), natural academic ability/IQ and intrinsic desire to learn.

Streaming was one of the primary mechanisms the French and mathematics departments used to reduce the range of academic diversity in their classes. Academic diversity was addressed at the classroom level via pretesting, enabling more targeted teaching sooner, although this only applied to high-performing Years 7 and 8 mathematics classes. Also, different learning activities were undertaken that involved a range in content delivery and interaction such as props, student-student mentoring, bookwork, worksheets, whole-class and individual questioning, and ICT-based learning such as Education Perfect, although this was used more often in French classes.

French teachers would sometimes adjust the workload for lower-performing students so they experienced more success. This lower performance was seen as partly due to the lack of streamed French classes; a perceived barrier to catering for academic diversity. The principal and teachers' comments regarding the lower-school AC were all negative. Criticisms included unrealistic learning expectations, too much material, untargeted and uninteresting content, and one-size-fits-all assessment requirements, resulting in difficulty providing appropriately targeted assessments. These barriers to catering for the academic diversity within a classroom was summarised by MT3, who said, 'The school system's not good to teach individuals, but it's the best way to teach a group of individuals.

6. Findings—Principal and teacher responses to educational software

6.1 Introduction

Chapter 6 continues discussing principal and teacher comments, with a focus on ICT; Education Perfect and Mathspace in particular. Although few students responded to questions regarding Mathspace, some mathematics teachers provided insight into the use, or lack thereof, of this software. The chapter begins with more generalized comments about ICT. Following this, Education Perfect and, at times, Mathspace, are discussed in five separate sections. These include: the implementation of said programmes; their functionality; their impact on pedagogy and students; and the barriers and cons faced. The emergent ideas within each of these subtopics can been seen in the advanced organiser of key findings below (Figure 6.1).

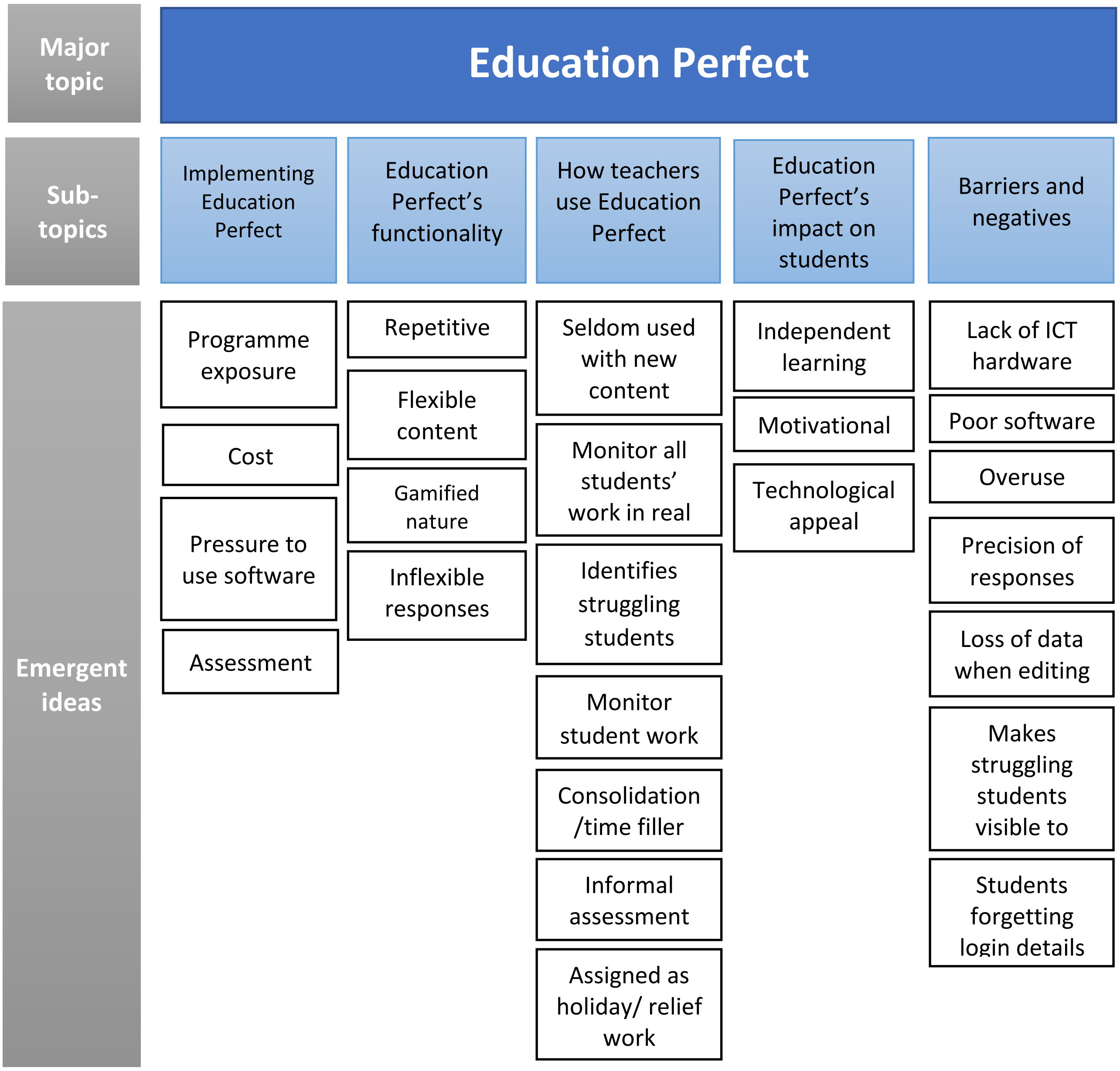

Figure 6.1: Advanced organiser of the key findings from principal and teacher interviews regarding Education Perfect

6.1.1 The general impact of ICT on students

Without being asked explicitly, the French teachers discussed the impact ICT has had on students and the content being taught over time. Although there were some positives described, such as ICT bringing French 'to life' with the interactive and interesting content made available online, the overall impact of ICT use on students, more broadly, was believed to be negative; leading to students being less motivated and less disciplined. FT4 described the immediate gratification provided by the Internet and social media as the 'New World' in which students are now growing up. FT2 believed students' common knowledge was 'non-existent'. The capacity for students to 'just google it' was believed to result in students reducing the amount they read or remembered because information was on demand and easily accessible: 'If you forget, google it. And that's the way ... the kids are today. They've gone brain-dead', said FT2. FT1 had a firmer stance against technology, saying, 'There is no replacement, especially in terms of learning how to read and write, [or] anything better. Or even in maths for that matter: the concept of writing it down, looking at it, and the connection between the hand, the movement and the brain, and vice versa. The thing is that technology will never do the thinking for you.'

Another problem, briefly mentioned by FT4, was that students spent too much time on ICT such as laptops and mobile phones; contributing, according to FT4, to a decrease in students' fitness and negatively impacting their sleep.

Another negative aspect that the teachers identified as resulting from the introduction of ICT into the classroom was students spending too much time on irrelevant websites when undertaking computer-based tasks. This was considered to be the result of students being swamped with too much information on a basic search, making it difficult to 'zero in on useful information' (FT4), and accessing irrelevant websites. Students were said to copy and paste information found on the Internet into assigned work without reading or understanding the content. FT4 questioned the information presented to students on the Internet, asking, 'Is the information presented of any value?'.

The French teachers said students were not at fault for the changes to the ICT they have grown up with. FT4 believed the students were 'victims of the generation in which they live … the current student of the technological era is less willing and able to do so.'. When the principal was asked about their view of ICT in education, they said it was another learning tool to 'enhance the teaching of our teachers, but that we shouldn't have to rely on it.'

Key finding 6-1: ICT was believed to be negatively impacting students' general knowledge, motivation and self-discipline to learn.

FT2 believed there was little that teachers could do to resist this generational change because there was a perceived requirement to keep up with these ongoing technological developments. The French department sought to adapt to new technology by changing the curriculum and pedagogy. For example, instead of teaching students how to understand the giving and receiving of directions to navigate a city, time was spent teaching the names of locations as the French teachers believed students would use their phones for directions in foreign landscapes instead of asking someone for directions. Additionally, paper-based dictionaries were replaced with app-based dictionaries that could be downloaded onto any smartphone. This saved money for the French department and meant students had 24/7 access to the dictionary. Mathematics teachers didn't speak about the impact of technology on students and content in the broader sense. It is unclear why not.

Key finding 6-2: New ICT technology, such as Google maps, led French teachers to adapt both the curriculum and pedagogy.

6.1.2 Implementing Education Perfect

As in its original form the online software only offered content for learning languages, the French department was the first to begin using Education Perfect (when it was called Language Perfect). As Education Perfect developed to include more subjects, the company website changed its name from Language Perfect to Education Perfect; the date of this name change could not be located.

Education Perfect initially had two points of contact with the school's French department. The software company approached the French HOLA to discuss the use of Education Perfect within their department. At first there was hesitation from the HOLA, as they were not convinced of the educational value it provided when considering the cost; it was considered expensive, but a free trial was offered.

Around the same time, a beginner teacher who was being supervised by FT3 mentioned the programme. FT3 said the programme appeared to start 'popping up out of nowhere.' FT3 decided to let their students undertake an annual competition held by Education Perfect. This spanned two weeks and was a part of the free trial mentioned earlier. FT3 said their students enjoyed using Education Perfect during this competition, which influenced the department's decision to purchase the programme for all French students the following year. Despite being unfamiliar with Education Perfect, and starting work at this case study school after the software programme had been introduced, the principal supported the continued funding for this programme, saying, 'I felt that the rationale that was provided to me was sound and therefore I supported it.'

The English department was later introduced to Education Perfect as a free trial was offered to other departments after the French department had made their purchase of the software licence. This happened from about 2014 onwards. From here the software was adopted by a number of other departments, including mathematics and science (FT4). Not having to pay for the software initially was a significant factor in the uptake of the software (MT1). Education Perfect had been used within the maths department since 2017. In addition to Education Perfect, other programmes being used within the mathematics department included Mathspace and MangaHigh. Mathspace was offered at no cost for one term in 2017. This offer was extended to cover three out of the four school terms. Kahoot was also briefly mentioned as an online platform that helped to engage students on various mathematics topics.

Key finding 6-3: Free trials encouraged departments to try out Education Perfect and other ICT software.

One teacher had a negative experience when some of these novel online technologies were being introduced. They felt there was pressure from staff above them to use the new software as the school was adopting a technology-orientated plan. Despite it not being their preferred method or tool for teaching, they tried it with their students. This experience led the teacher to develop a negative attitude towards ICT programmes more generally: 'I don't think it went well at all [for me].' (MT2).

Teachers agreed that when setting up Education Perfect with students for the first time, it took just half a lesson to log them in, setup their accounts and start using the programme. The only issue regarding the introduction of the programme with the class was having students appropriately record their username and password so they could sign in to their accounts during following classes. Some teachers printed off all of the students' account information for quick access in future classes. The swiftness with which the programme was introduced to students was mostly dictated by the school's ICT hardware, software and Internet speeds. To give the researcher an idea of the school's focus on ICT, the principal said over $1,000,000 was spent on ICT equipment, licenses and staff per annum. With this level of ICT expenditure, it may be unsurprising teachers faced little difficulty setting up Education Perfect with their students for the first time. There were, however, some comments regarding issues faced with ICT hardware and software, which are discussed in section 6.1.6.

Key finding 6-4: Teachers found setting up Education Perfect with students to be relatively easy and swift due to the user-friendly nature of the software.

6.1.3 Education Perfect's functionality

When referring to the French component of Education Perfect, the French teachers described the programme as a tool whereby students would be presented with a word, sentence or picture in English and be required to type an answer in French, or vice versa. If students typed the correct answer into Education Perfect, with the correct spelling, they would be presented with a new question; if they spelt the word incorrectly, they were immediately shown the correct spelling. The word, or words, they failed to spell correctly would be 'remembered' by the programme and presented to students to try again at a higher frequency than the words they spelt correctly. The French teachers referred to this feature of Education Perfect positively: 'It lends itself to languages really well.' (FT3) Another positive feature was the precision of spelling required from students, which 'reinforced accuracy' (FT1) when attempting to spell.

One of the French teachers had put a large amount of time into creating their own tasks within Education Perfect, such as grammar and vocabulary exercises. This meant they were aware of the programme's capacity to enable teachers to further tailor the content and delivery method provided by Education Perfect. French teachers would also use the content and delivery methods Education Perfect provided as they tended to be 'more sophisticated and may have cartoons, graphics and videos et cetera.' (FT4) The gamified nature of Education Perfect was also noted. FT2 believed the creators of Education Perfect had designed the programme with 'kids in mind. [They] knew that kids played games, and knew how they played games, and … they know how to encourage kids to keep coming back; a bit like the old casino where you win a little bit.' A couple of the French teachers mentioned that students could 'cheer' their friends on via an 'applause' response, also referred to as an electronic 'shout out'.

FT4 briefly described the competitive feature of Education Perfect: 'It is competitive in a non-threatening way. Scores scroll across the top of the screen, so they know where their total is compared to the class.' Students would also challenge their friends to Dash, a type of race where students would try to beat their friends by typing all of the correct answers first. One mathematics teacher briefly mentioned the points system utilized by Mathspace, which they used to award prizes for students who had achieved the most number of points within a certain time frame. Only one of the four mathematics teachers commented on Education Perfect's functionality as only they had implemented and used Education Perfect with their mathematics students enough to confidently comment on the programme's workings. The comments made regarding Education Perfect were sparse and were usually made in comparison to other mathematics software. For example, it was referred to by MT1 as a 'skills and drill practice, rote learning sort of thing', with less structured guidance than Mathspace.

Two mathematics teachers described the finer-grained nature of Mathspace, saying that students were required to provide all of their mathematical working in order to progress through Mathspace questions. Instead of being asked a question and simply typing in the final answer, as in Education Perfect, they would need to type in the next line of working, which was marked by Mathspace as either correct, incorrect or almost correct. The mixed feelings about this scaffolded process are discussed further in section 6.1.6.

The feedback/student data provided by Education Perfect and Mathspace was also identified as a function of these programmes by one mathematics teacher and two French teachers. These teachers were referring to the programme's capacity to pre-test, monitor students' progress through their assigned work, check for homework completion, and display the time students spent working on their assigned work and the frequency with which a student logs into the programme.

Key finding 6-5: Education Perfect was seen as a tool that provided questions, required very accurate answers, had a gamified nature, and provided information about students' use and progress.

6.1.4 Education Perfect's impact on pedagogy

When the teachers were asked about how and when they used programmes such as Education Perfect or Mathspace in the classroom, there was a range of responses. These included: the online software being used before, during or after a new topic had been introduced; how the electronic data and feedback was used, if at all; and if the programmes were used in class or only assigned as homework.

Only one of the French teachers discussed how they used Education Perfect at the introductory stage of a new topic. FT3 believed the programme was very useful as a vocabulary acquisition tool at the beginning of a topic, explaining, ‘The students need to actually know some basic vocabulary before they can do anything with the language. In that introductory state, it’s very, very helpful’. Once students had grasped enough of the French vocabulary relating to the new topic, FT3 would set Education Perfect only as non-compulsory homework for students to complete. FT1 was opposed to using Education Perfect at the introduction of a new topic, responding with, ‘No, never’, when asked if they had done so.

MT1 believed programmes such as Mathspace and Education Perfect weren’t suitable to introduce content as they weren’t capable of inquiry-based learning, a style of learning they said was the focus of the Australian mathematics curriculum: ‘Generally it’s been seen more as a drill and practice or a pretesting/revision programme more than a teaching tool per se’ (MT1). Out of the eight teachers interviewed, only MT1 spoke about using Education Perfect or Mathspace as a pretesting tool. They seldom used these programmes for this purpose.

FT3 spoke about their ability to monitor students if they were going off task in Education Perfect. FT3 liked this function, saying, ‘That works wonderfully, yeah. Well, it does because you know they’re actually doing the right thing’. The tool that would monitor students’ progress within Education Perfect was referred to as the live tracking tool by FT3. When first using Education Perfect with their French classes, FT3 projected the live tracking tool onto the projector screen for everyone to see, which FT3 believed acted as ‘a bit of peer pressure’ and competition, with students seeing in real time who was progressing the fastest and achieving the most points within the Education Perfect points system. Over time, FT3 noticed it wasn’t necessarily the French students’ understanding of the topic that was allowing them to progress faster and achieve more points; their IT skills enabled them to type faster, hence they answered more questions in a shorter time. Following this observation, FT3 stopped displaying the live tracking tool for the class to see and instead focused on students’ individual progress/points within the programme.

Key finding 6-6: Students' progression through Education Perfect and Mathspace questions was partly dependent on their ICT skills such as keyboard typing and website navigation.

MT2 also mentioned using the progress tracking tool in Mathspace during class time. They would monitor students from their computer screen at the front of the class, as well as walking around the classroom. The progress tracking tool was sometimes used weekly by MT2: 'So at the end of the week I could see exactly who was progressing well and who wasn't progressing well. So that side of thing, it was good, I could see quite easily.' MT2 would sometimes use the information about students' progress to assist those who weren't progressing as fast as others by helping them with a few questions or by providing some motivation. MT1 described how Mathspace's live progress tracking tool could be used to make their time spent with students more efficient by checking the programme and quickly identifying which students needed more support and which were well ahead, as opposed to walking around the classroom and constantly checking for students' understanding. They explained if you were trying to monitor every student's progress without a programme like Mathspace, you would only have 1 to 2 minutes to spend with each student within an hour-long lesson. MT3 said it was much easier to quickly identify where students were struggling when using Mathspace, something that was only usually achieved after having marked a test: 'The computer programme makes it a billion times easier to detect [students struggling with a particular question]. If I'm having to mark a test, I'm actually physically having to look at every single kid's answer. Then when I'm handing out the test I'll go, "Okay, everyone stuffed this question up. I'm going to actually explain it properly." But by that time it's too late because then you're moving onto the next thing anyway', MT3 explained. Live progress tracking was seen as one of the most significant advantages of a programme like Mathspace.

Key finding 6-7: Mathspace's live tracking tool was used to monitor students' progress during class time and identify those who were struggling more quickly than if students were completing paper-based work.

FT1 had thought of using Education Perfect's live tracking tool from home if they were away for the day due to illness or to look after a family member: 'I can see who's on it, who isn't on it, who's doing what, how much has somebody done and I can send a message at the same time', FT1 explained. The data provided by Education Perfect, such as the number of times a student had logged in to complete their assigned work, the number of questions completed and the amount of time spent working on Education Perfect was used by FT1 to provide feedback to parents. FT4 discussed how they had sometimes accessed Education Perfect late at night on a weekend and found some students practicing by their own volition. FT1 would send them an electronic *shout-out* as the students responded positively if they felt their extra work had been noticed. FT3 mentioned that while they checked Education Perfect every now and then for homework completion and students' understanding, 'it's probably just data that confirms what you already know'. FT4 agreed, they didn't feel the data provided by Education Perfect necessitated alterations to their lesson planning.

FT4 suggested the progress tracking data provided by Education Perfect was primarily used for keeping note of who had completed their homework: 'Most teachers use it to inform us as to who was doing the homework.' FT4 saw it as a very informal process that each teacher used at their own discretion to emphasize or recap certain material with students, but that they didn't rely on Education Perfect data to direct their lesson planning. FT4 briefly mentioned the teachers' lack of time to formally process and utilise this information. MT1 echoed this idea by comparing it to paper-based work; instead of going through the students' working out on paper to find the mathematical error, you would need to access the information through Mathspace. 'It's just a matter of would you only pull that data up when you needed to pull the data up?'. MT3 also used the data provided by Mathspace as a quick check for student understanding: 'Are these kids getting what I'm trying to teach them in class or are they not? That's the easiest way for me to see what they're up to.'

Key finding 6-8: The academic progress data presented by Education Perfect and Mathspace was mostly used to quickly check if students had completed their homework or classwork, or understood recent content.

Another major use of programmes such as Mathspace and Education Perfect by mathematics and French teachers was as a consolidation tool towards the end of a topic, and near the end of individual lessons if students had finished all of their assigned work for that lesson. FT2 spoke about how students having very short attention spans, something they had noticed change over their teaching career, meant they needed to use programmes like Education Perfect to 'keep students on the boil'. If one of their students finished their work early, FT2 would tell them, 'We've got 10 minutes to go. Go on Language Perfect.' They claimed it was a good way to fill in time when students were done with all of the assigned work. FT1 and two of the mathematics teachers spoke to this idea. MT2 said, 'I would just use it after they finished their bookwork. Bookwork first, half an hour maths and then go onto the computer.' MT3 said the programme worked well in lessons that were towards the end of the day, when students had come in from lunch tired and unmotivated. FT1 said they never used it as a lesson tool; only as a revision tool once students had finished their assigned work, at the end of the lesson.

Key finding 6-9: Most teachers had their students use Education Perfect or Mathspace towards the end of their class or topic as a consolidating and/or time-filling tool.

FT1 said that if parents were concerned with their child's performance, they directed the parents towards Education Perfect's vocabulary lists as another means of practice. MT1 and MT3 did the same thing with Mathspace and Education Perfect, having it as 'extra ammo' (MT3) for students who were struggling and needed more help. MT4 said the programmes were 'very handy' when students were going on holiday for an extended period of time and their parents would ask for extra work for their child to complete. This was because students could access the work online as long as they had Internet access; extra work was easily assigned to the individual student.

FT1 said the programme was a really useful tool for relief teachers. If FT1 was absent from teaching for the day, they would assign Education Perfect work for the majority of the lesson: 'If you're absent and you don't know who's going to take your class … it's an easy tool to use to set up work for.' Despite the fact that the relief teacher would seldom be a French specialist teacher, having them use Education Perfect was feasible because the students understood how to access and use the programme. This ensured students were able to complete their work relatively independently of the relief teacher, lessening the burden of relief preparation and stress that students wouldn't use the lesson productively. This was of particular importance in lower school, where French classes only ran twice a week.

Key finding 6-10: Education Perfect enabled teachers to quickly and confidently provide relief and/or holiday work they felt students could work on independently, as well as administer extra work upon parental request.

6.1.5 Education Perfect's impact on students

After discussing how they used software like Education Perfect and Mathspace, the teachers spoke about the impact these programmes had on their students and how students interacted with them. This included students' independence with the software, the motivational effect the software had on students and the actual impact it had on their learning.

6.1.5.1 Independent learning

Although the mathematics teachers mentioned the capacity for students to progress through programmes like Mathspace and Education Perfect at their own pace, the French teachers were much more vocal on this idea. One of the reasons French students were considered independent while using Education Perfect was the help provided by the online programme. If students got an answer wrong, they would be shown the correct answer, given time to correct themselves and then move on. The French teachers believed that students of all abilities could use the programme independently and effectively. FT2 said, 'They don't need a teacher for Language Perfect.' Education Perfect was also said to have *smart lessons*, which were essentially PowerPoint slides the students could progress through at their own pace; they had colour-coded text to highlight important pieces of information, and videos, illustrations and quiz-type questions. FT4 said, 'Education Perfect allows students to practice in a more fun way, at their own pace and without the teacher having to correct the work as the programme automatically corrects their errors.' It was recognized that students could independently advance through the content in Education Perfect quickly, but FT1 was sceptical, saying: 'Whether they do it is a different matter.' FT1 was referring to a student's ability to quickly skip over the slides and complete the assigned questions by clicking on the help/hint button.

MT2 said that similarly to Education Perfect, Mathspace enabled students to click on help icons when they were stuck on a particular concept or question. An animation with audio would explain the concept the student was struggling with. 'It was good because it allowed the kids to get an explanation when they wanted it. It's not like they had to ask me,' MT2 explained.

Key finding 6-11: Teachers believed students could work independently with Education Perfect and Mathspace because of the assistance the programmes provided.

6.1.5.2 Motivational

The teachers believed Education Perfect and Mathspace were liked by all students across the academic spectrum. FT4 mentioned that students were technologically orientated, saying, 'Students enjoy their own space and, being of the current generation, they prefer to focus on a screen rather than a teacher!'

Lower-performing students were believed to enjoy interacting with the programmes because they were fun and because the programmes could adapt to provide content at their level of readiness: 'So I guess it caters individually because the lower-ability kids would keep getting those easier questions until they start getting it right', MT3 said. FT4 said, 'We were all quite flabbergasted to see some very disengaged students take to it like a duck to water.' Instead of asking students to learn their French vocabulary via the 'dry or boring traditional *look, cover, write, check* method', FT4 said. FT2 would sometimes say, 'Don't do that, it's boring. Go to Language Perfect.' FT2 reflected on how they had been taught French when they were a student, saying: 'Their way of learning has changed and it's become more fun. I wish I had Language Perfect when I was at school.' FT4 commented, '[Language Perfect] has a broad appeal to suit the academic and attitudinal diversity of the class.'

Higher-performing students were said to be just as engaged with these programmes as the lower-performing students, although for different reasons. They were seen to enjoy getting the answers correct all the time, which was a feature that occurred frequently in Mathspace and Education Perfect. Every question was marked the moment they submitted their answer. These programmes effectively provided an endless supply of content, meaning higher-performing students who would finish their work much faster than others were able to continue working at their high work rate as opposed to relying on the teacher to provide more worksheets or bookwork, which they weren't as motivated to undertake. Education Perfect had a World Championship quiz that created 'quite some fervour' among higher-performing and motivated students, according to FT4. Some of these students would spend significant amounts of time practicing on Education Perfect to beat their last year's score or to place highly in the competition. FT2 said students would sit at home all day working on Education Perfect so they could come to school and announce, 'I got 10 thousand points on the weekend,'. This was seen as significant by FT2 as they believed students wouldn't go home to open up their French books and worksheets at their discretion. 'They're not going to read a book. But they will go on a computer programme and have fun with it, Said FT2. Additionally, scores would pan across the top of their Education Perfect screen so they could compare their scores with others. This motivated higher-performing students to overtake the classroom or cohort 'leaders'.

MT1 agreed that Education Perfect and Mathspace could work well for all students but that some programmes were better suited to lower- and higher-performing students. MT1 said the 'drill and practice' orientated programmes, with their game-like elements, were better suited to lower-performing students, but that programmes with the capacity to be open-ended and allow students 'to go off on tangents' were better suited to higher-performing students.

When asked about students' general attitudes towards Education Perfect being negative, FT2 said, 'Oh no, no, no. Never, never.' FT2 believed Education Perfect to be the best motivational tool in their arsenal, explaining that if students had the choice they would choose Education Perfect over any other learning resource/tool. Part of the engagement displayed by students was believed to be due to Education Perfect and Mathspace being so different from paper-based work. As mentioned earlier, an example of the motivational effect Mathspace had was students' willingness to use the programme at the end of their final lesson on Fridays, which was considered a difficult time to engage students with their work: 'We've always struggled to get much out of them after lunch on a Friday,' MT2 said. The teachers' beliefs about students' attitudes towards Education Perfect was supported by the student survey items (see Figure 4.6). Most students liked using Education Perfect, would like to use it more in class and preferred using the programme instead of paper-based work. A smaller majority (73% of French students and 67% of mathematics students) agreed Education Perfect motivated them to learn. Despite some teachers suggesting their French students were beginning to lose interest in Education Perfect, students had a positive attitude towards the programme.

Key finding 6-12: French teachers considered Education Perfect to be highly motivational for all students.

Some comments made by FT1 and FT3 touched on a recently emerging phenomenon among students. The teachers had observed a number of students beginning to lack the level of motivation to use Education Perfect that they displayed when the programme was introduced to the school. FT1 said, ‘If you use it too much, after a while they get bored.’ This was supported by FT3, who commented, ‘At first it was such a novelty. To be able to go into a classroom and have a laptop, and type away on a laptop five years ago, was hugely motivating for students. Whereas now, I think it’s fairly commonplace and they’re using Education Perfect in quite a lot of subjects now.’ This drawback to Education Perfect is discussed more in section 6.1.6.

Without being explicitly asked, FT2 mentioned the motivational impact Education Perfect had on male students in their French class. They said, ‘Kids who normally wouldn’t do much in class, they’ll do Language Perfect. The boys especially, normally just sit there and you can’t get anything out of them. When you say Language Perfect, they’ll dash over to the computer.’ Although six of the seven survey items asking students about their attitudes towards Education Perfect showed little difference between male and female student responses, when asked to respond to the question titled ‘I would rather use worksheets or questions from a book instead of Language Perfect’, only 7% of male students agreed with this statement compared to 25% of female students. This also supported FT3’s comments about female students being less interested than male students in Education Perfect: ‘The girls that find language learning a bit more difficult or aren’t as interested, … that technology doesn’t even appeal to them.’ FT2 believed it was the competitive nature of Education Perfect that enticed boys more so than girls. They added: ‘It’s the only thing I can think of in education where kids say “Can we do it at home?”.’

Key finding 6-13: Some French teachers identified male students as showing greater interest in using Education Perfect than paper-based work.

The principal was confident that computer programmes such as Education Perfect would never replace classroom teachers, regardless of the programmes’ level of sophistication and capacity to teach students; partly because 'we're social beings', they said. MT1 touched on the social component of online learning programmes. They believed programmes such as Mathspace and Education Perfect were beginning to increase the communication capacity of students within the software so students could work alongside each other, even though they may not be in the same room. MT1 said these software companies recognized the social element they had been lacking, stating: 'A lot of programmes at the moment, it's just you sitting at a computer by yourself. You're not learning by talking it through with other people, so they're adding that in.'

Key finding 6-14: The capacity for students to interact socially in programmes like Education Perfect and Mathspace was considered important and something that had been lacking.

6.1.5.3 Impact on learning

Teachers were asked about the impact Education Perfect and Mathspace had on their students' learning. Did they believe students were learning their content faster or at a deeper level? FT1 considered Education Perfect to be a game that didn't teach students anything. The other French teachers didn't state explicitly that the programme taught students better, but they indicated that students were seen to be improving their reading, writing, listening and spelling skills more generally. Most of the French teachers believed that the academic improvements they saw were a result of Education Perfect. These improvements were mostly attributed to the game-like/fun nature of the programme, which motivated students to complete more work than they otherwise would through more traditional methods. Although Education Perfect was able to provide the same amount of repetition as any book, worksheet or flashcards, the key difference was the students' engagement with the programme. FT4 said, 'The more reluctant students are usually more focused on the work than they would be with a paper worksheet.' FT3 agreed, saying, '[Education Perfect is] motivational and just the repetition … It's something that they probably wouldn't apply themselves to normally.' As noted earlier, most students had a positive attitude towards Education Perfect, with the majority believing it was motivating to use.

Two of the mathematics teachers agreed with this sentiment of technological appeal. They believed students were benefiting from using Mathspace and Education Perfect, but no more so than if they spent the same amount of time and effort with paper-based work. MT3 said, 'It's their persistence in trying to learn it. Whether it's computer or on paper, it's the same thing. It's easier for me to detect on computer, but they can get it just as easy on paper if they're persistent.' Beyond the motivational aspect, MT2 believed students benefited from having Mathspace present the mathematical content in different ways to how they had taught it. They believed it reinforced students' understanding of the concept.

Key finding 6-15: Teachers believed Education Perfect and Mathspace had a positive impact on students' learning due to the motivational and engaging nature of the programmes.

6.1.6 Issues with Education Perfect and Mathspace

When asked if there were any negatives regarding Education Perfect, FT2 said, 'The biggest con when we started was the kids just wanted to do Language Perfect all the time.' When asked the follow-up question of why this was a negative, FT2 responded: 'Well, we're here to teach them.' Another French teacher agreed, saying there were no cons regarding the programme itself and adding that the assistance offered by Education Perfect staff was swift and helpful. FT3 said the biggest issue with Education Perfect sometimes was the precision required when answering questions: 'When I devise a task and I've put something like "The door is red" in French, and it's just a silly example, but then I'll put "The door's red." D-O-O-R apostrophe S. And then the student types in "The door is red." It would tell them they've got it wrong and they get so frustrated with that.' This resulted in the teacher having to change the correct answer within the programme for students' future attempts. This ended up scrapping existing data from students' previous attempts on the particular set of questions; sometimes completely resetting the task they had completed/were completing.

Similarly to FT3's comment above, the mathematics teachers' opinions were strongly aligned when speaking about one of the issues presented by Mathspace: the lack of flexibility when providing answers in Mathspace led to a lot of frustration among students and teachers. MT4 provided the strongest remark, saying, 'It was just so particular that it was unusable.' MT3 provided an example of the problem commonly faced: 'They kind of have to be trained into how to enter their answers. So instead of typing 40 cm as their final answer, they have to type x = 40 cm.' Despite there being no real difference in the answer provided, Mathspace didn't allow minor differences like this to be accepted. This was said to lead to a significant number of students making no progress for as long as 40 minutes because they hadn't rounded their answer quite right, for example. 'Like for them it's frustrating, and for you it's frustrating because you've got 10 kids doing the same thing,' MT3 said.

Key finding 6-16: The frustration felt by students and teachers over the high level of precision in answers required by Education Perfect and Mathspace was significant; some teachers stopped using Mathspace because of it.

Although it was noted earlier by one mathematics teacher that Mathspace provided a sense of safety for the students because their personal scores weren't displayed to other students, another mathematics teacher claimed students would say to others, 'Oh, you're still stuck on that one. I finished that ages ago.' MT3 was asked if this also occurred for paper-based work. They believed it was less obvious that students were struggling because they would simply claim they hadn't been doing their work. MT3 suggested that students believed everyone was able to move through something like Mathspace without many distractions. If students were using Mathspace most weren't talking, so for those not completing Mathspace questions it was solely due to their inability to complete the work instead of the typical excuses that would be made.

Mentioned earlier, setting up the software programmes for the first time was considered relatively quick and easy. Contrary to this, an ongoing and significant barrier to accessing and using programmes like Education Perfect and Mathspace was the ICT availability and capabilities. Most of the French and mathematics teachers said it could take anywhere from 10 to 40 minutes to have all students logged on and undertaking work within these programmes: 'It was not uncommon for a student to wait 20, 30 or 40 minutes for the computer to finally log on', FT4 said. MT4 said they would rarely use a programme like Mathspace in class time because they 'don't want to waste 5 to 10 minutes setting it up and [students saying] "I forgot my password", "I'm locked out of my computer", "The keys are missing on my keyboard". So very rarely we will do stuff like that.' As the school's infrastructure was considered quite old, it was believed it could not handle the demand for electricity and Internet required by all of the newly installed computers. FT4 said that before the electrical transformer had been updated, the school's electrical circuit was often tripped. This was more commonplace in earlier years but was noted as having improved in recent times. In addition to slow-loading computers, a lack of access to computers was also noted. The uptake of software such as Education Perfect and Mathspace increased the demand for desktop and laptop computers that were already relatively scarce. This was seen as problematic by FT4, who said the French content couldn't be taught out of order: 'Three or four classes are often on at the same time and we are all doing the same thing at the same time. Things can't really be taught out of order as there is a sequence to language acquisition.' The principal acknowledged the ICT difficulties faced, saying the school was 'looking to achieve a one-to-one programme where the computers actually work and they don't take 15 minutes to log on.' They were aware of the increasing expectations for higher-quality ICT, responding with changes such as increasing the school's Internet bandwidth for greater speed and capacity.

Some teachers used Education Perfect or Mathspace for a particular part of the learning programme, for example, at the end of a 2-week topic. If there was no access to computers during these lessons, the software may not be used until the class progressed to the end of the next topic. Another issue regarding computer access was students constantly forgetting their login details. MT3 eventually projected their students' login details on the board every time they went to login as they had been worn down from 'constantly running around' to ensure everyone was able to log in successfully. FT1 believed students usually forget their login details because they hadn't used the software as much as required: 'Even then [when they have used the software regularly], sometimes, [they say] "Miss, I don't remember my login details." Because some of them will rarely go on it, and it's the same students who will not do the revision', FT1 said.

Key finding 6-17: A lack of computer access and reliability during class time and students forgetting their login details were barriers to using programmes like Education Perfect and Mathspace.

The most recent barrier identified by French teachers had been, ironically, the uptake of Education Perfect by other departments. Education Perfect was described as a reward when it was first introduced to French students. The French teachers believed that after Education Perfect was implemented by other departments, students' enthusiasm towards it slumped. FT3 described students' attitudes as having moved towards, 'oh, another thing we have to do now.' FT2 said, 'For us, doing Language Perfect was something like a reward for the kids. But now everybody's doing it.' FT1 said they discussed this overuse with some of their French teacher colleagues and all agreed it was problematic for students' motivation towards using Education Perfect.

Key finding 6-18: French teachers believed the overuse of Education Perfect was negatively impacting students' motivation to use the online programme.

FT4 also mentioned the cost of the programme being 'very expensive'. This may have been because they were responsible for budgeting the programme into their department's costs, or because only recently had the departments been required to pay for their programmes after a year or so of free trials. The issue of cost was mentioned earlier.

6.2 Chapter summary

French teachers discussed the general impact of ICT and social media on students. They believed students were victims of the generation in which they had grown up, with less: motivation to learn, discipline and common sense. Despite this, French teachers were very positive about Education Perfect, more so than the mathematics teachers. The French department was the first to use Education Perfect throughout their lower-school classes and found it easy to introduce and set up with their students.

Education Perfect was used by French teachers before, during and/or after a new French topic was introduced, mostly as a repetitive tool for content consolidation or as homework. This was similar to the few mathematics teachers who used Mathspace. During class time, the live-tracking function in Education Perfect and Mathspace enabled teachers to quickly identify students struggling with particular questions/content, both individually and as a class. Despite being described as very useful, it was not used very often. Teachers were also aware of the large amount of student data provided by these programmes but it was hardly used, mostly because it was believed to provide information or insight the teachers already had. One of the most helpful attributes of Education Perfect, for French teachers in particular, was the ability to set Education

Perfect work for relief lessons or holiday work as they were confident students could independently complete this assigned work.

French teachers believed their students were very independent when using Education Perfect, so much so that some felt they were not needed when students used the software. Most French students were also seen as highly motivated by Education Perfect, especially when it had been newly introduced to the school. Mathematics students were also considered independent when using Mathspace, although students faced more difficulties when submitting their answers as Mathspace required more precision, such as typing in x=20 as opposed to simply typing 20 in the answer box. Mathematics students were not often described as motivated by Mathspace; in fact, they were usually described as frustrated due to the high level of precision Mathspace required when students input their answers.

There was consensus among teachers regarding the educational impact of the software. Paper-based work was believed to provide the same learning outcomes as the software, except the programmes provided significantly more motivation to complete work, leading to more learning. This motivation was seen to drop over time as students were overexposed to the software, thereby wearing off the novelty. Access to reliable computers was another barrier to using the educational software.

7. Discussion

This chapter discusses the key findings of the three research questions in this study. The two major topics of this research, academic diversity and ITSs, specifically Education Perfect and Mathspace, are presented in section 7.1 and 7.2 respectively. This discussion combines the data from the principal, teachers and students with the key findings. Recommendations for further research are made towards the end of this chapter.

7.1 Academic diversity

In order to answer research question one (RQ 1), How do principals and secondary French and mathematics teachers perceive and cater for students' academic diversity?, the case study principal, teachers and students were asked about academic diversity in a number of questions. This included questions asking participants to explicitly define the term academic diversity, describe the range of academic diversity at their school and explain why such diversity existed. This enabled the researcher to understand what participants were referring to when they were asked about catering for academic diversity and the challenges faced by teachers.

7.1.1 Understanding academic diversity

The principal and teachers held a consistent and comparable idea of academic diversity. They mostly used the term to refer to the range in students' content knowledge/prior learning, rate of learning and learning abilities (Key finding 5-1). They also described students' academic diversity by referring to the range of academic performance as indicated by test percentages and year-level expectations (Key finding 5-2). This use and understanding is consistent with other studies (Tomlinson et al., 1997; Woodward & Ono, 2004).

Teachers and the principal reported that academic diversity was significant within a single cohort, with estimates of student assessments ranging from 0% through to 100% and 6 to 7 years difference in year level expectations (Key finding 5-3). That is to say, for example, that one student in Year 8 may be performing academically at a Year 10 level while another may be performing at Year 3 level. This range was reflected in some teachers' classes, and those with this level of academic diversity were called mixed-ability, or general, classes (Key finding 4-1, Key finding 5-4). This range of academic diversity has been found in other Australian school cohorts and classrooms, meaning this school is not atypical (Goss et al., 2015; Goss et al., 2016; Masters, 2013; OECD, 2016; Siemon, 2001; Thomson et al., 2016).

The principal and teachers reported there were many factors that influenced the range in students' academic diversity. These included students' primary school experience, attitudes and motivation towards school/the subject, parents' attitudes towards education/the subject, natural-born intelligence, health issues, time off school, and general background context (Key finding 5-5). These factors are consistent with studies of academic diversity (Berger & Archer, 2016; Carroll et al., 2008; Gibbs et al., 2019; Goss et al., 2016; Sirin, 2005; Smith et al., 2018; Teese et al., 2007).

Three teachers who had been in the profession for more than 20 years discussed the change in academic diversity they perceived over their careers, describing students' results as increasingly polarised and U-shaped as opposed to the bell curve distribution they had been used to previously (Key finding 5-6). They suggest there had been a downward trend in academic performance, learning expectations and student motivation both locally and within the broader community. These downward trends were believed to result in fewer B grades and more C and D grades. Masters (2016, para. 8) has described Australian students' academic performance as a 'long tail of underachievement' when referring to the Program for International Student Assessment data, which has shown a consistent decline in the reading, mathematics and science achievements of 15-year-old Australian students since 2000 (Thomson et al., 2018).

Despite these perceived changes, and the significant range in academic diversity within some classes, catering for academic diversity was justified as a way to maximise students' learning and minimise behavioural disruptions (Key finding 5-7). If students, high- through to low-achieving, were not presented with content targeted at their level of prior knowledge, teachers believed they would *switch off*. Student disinterest would impact negatively on their own learning and other students' learning, an observation made by Subban (2006), and Tomlinson and Kalbfleisch (1998).

The findings presented in this section help answer the first part of RQ 1, which sought to understand how the principal and teachers perceived academic diversity. The purpose was to ensure participants were discussing the same overarching concept for subsequent questions, allowing more accurate comparisons and analysis between individuals. The principal's and teachers' concepts and understanding of academic diversity was fairly consistent among themselves and the relevant literature.

Assertion 1: There can be a significant range in students' academic diversity within a single cohort and/or mixed-ability classroom, which the principal and teachers agree is important to address.

7.1.2 Catering for academic diversity at the department level

The mathematics department streamed lower-school students into four different classes: extension, advanced, mixed-ability and core. Year 7 students entering the high school were streamed based on their Year 6 mathematics results. The extension and advanced classes had the highest-performing students, enabling teachers to undertake more difficult content and assessments with these classes. Some of these assessments were beyond AC expectations and did not count towards these students' final grade. Core classes had fewer students than other classes and usually had an education assistant in addition to the teacher. The content and pace of learning were more appropriately targeted for the students in this streamed class, leading to a better learning experience (Key findings 5-9 and 5-10). Streaming students according to their prior academic achievement in the subject was justified as a way to reduce the academic diversity within most mathematics classes, enabling teachers to better address the range of students' prior knowledge and pace of learning in their class. Although streaming can be a controversial topic, Forgasz (2010) found streaming in secondary mathematics departments to be commonplace in Victorian schools, and a practice supported by mathematics teachers. This study supports these findings and helps fill what has been identified as a deficit in educational literature regarding how and why schools stream classes, and teachers' attitudes on the matter (Johnston & Wildy, 2016; Spina, 2018).

French teachers wanted more streamed classes in Years 7 and 8 so they, too, could more appropriately target learning expectations and assessments (Key finding 5-20). A lack of streaming also frustrated teachers, parents and students. The French department only had two extension classes out of 16 in Year 7, introduced in 2017, and one in Year 8, which had been running for many years. The other 17 Year 8 classes were mixed-ability. Although there were not any lower-performing streamed classes in the French department, such as a core French class, some students would undertake extra literacy classes instead of French in lower school. One of the reasons for there being less streamed classes than the French staff would have liked was timetabling issues. When creating the timetable of class times and locations, having too many different classes would result in too many time and location clashes.

The principal recognized the difficulties of effectively catering for the academic diversity in some classes. They reported that they played a role in addressing academic diversity at the department level by: employing the most capable teachers; allowing the streaming of classes; having high expectations for all teachers; and providing professional learning opportunities for teachers to develop their ability, and resources to cater for a range of students' academic diversity (Key finding 5-19).

Assertion 2: Streaming classes is the primary method for addressing students' academic diversity at the department level. Teachers reported it allowed them to better target their content, assessment and pace of learning.

7.1.3 Catering for academic diversity at the classroom level

At the classroom level, mathematics teachers would start a new topic by providing informal verbal and written questions, thereby probing students' prior knowledge (Key finding 5-12); a key component of addressing academic diversity (Goss et al., 2015; Tomlinson, 2001, 2014). During lessons, mathematics teachers claimed to roam the classroom to continually check for students' understanding of the content. If students were struggling as a class or individually, teachers would assist the whole class or individuals by offering different explanations of the content and more worked examples. Students' survey responses supported these claims. Mathematics teachers used a few different strategies to help address the academic diversity within their class, such as group work, cross-class tutoring and props. Teachers mostly used textbooks and worksheets to support or extend students who were learning more slowly or faster than the majority of the class (Key finding 5-13, Key finding 5-14).

French teachers would begin teaching straight away as students were assumed to have no prior knowledge of the French on a new topic (Key finding 5-15); French being the second language of almost all French students. French teachers mostly used booklets, worksheets and Education Perfect. Students could progress through any of these resources at their own pace, which the teachers considered a means of addressing different paces in learning. The problem, as discussed above, was that French, being a foreign language, made it difficult for students to progress independently. This was partly why Education Perfect was considered one of the most powerful tools for catering for students' academic diversity in French classes. Education Perfect is discussed further below. A large majority of French students believed they undertook different learning activities in their class. The range of learning activities and resources that French and mathematics teachers used reaffirms the learning activities teachers have been found to commonly use in the classroom, broadly speaking (Birnie, 2015; Robinson, 2017; Tomlinson, 2014; Tomlinson et al., 1998).

French teachers also spoke about how they reduced the amount of content lower-performing students in their class were expected to learn while increasing expectations for higher-performing students, especially with regard to open-ended assessments (Key findings 5-18 and 5-16). This meant lower-performing students could focus on achieving more success with less content while higher-performing students could display a level of understanding above their year level expectations. Holding large differences in student achievement expectations within a single French class may have been partly due to the lack of streaming in the French department. Without catering for the academic diversity through streaming, the French teachers had adopted a wider range in student performance expectations than seen in other subject areas that stream, such as mathematics departments. Forgasz (2010) found streaming to be relatively commonplace among secondary school mathematics departments.

Although mathematics assessments did not provide as many open-ended questions, they did return a range of scaffolded questions in their common assessments to help address academic diversity. They also provided assessments that tested above year level expectations for students in extension and advanced classes, as judged by the AC. This, as with French assessments, was justified as enabling lower-performing students to experience some academic success while higher-performing students could display abilities beyond their year level expectations.

Students' survey responses also indicated they felt teachers taught at the right speed, were aware when students were struggling and provided supporting or extending material when needed (Key finding 4-2). One area that did not address students' academic diversity was assessments. Both students and teachers were clear that almost all assessments were the same across an entire cohort. Part of the reason for this lack of differentiated assessments was the AC and this is discussed further below.

Assertion 3: Teachers addressed academic diversity in their classroom by using different learning activities and resources. Assessments did not address academic diversity.

7.1.4 Barriers to catering for academic diversity

While mathematics classes were streamed in past years to address academic diversity, they had more recently become less streamed due to several factors. The principal and teachers reported students in lower performing classes developed poor self-efficacy; parents were confused with the different learning-grade system, and concerned with teachers' abilities to teach effectively because most students in their class were low achieving; and curriculum and assessment were restricted by the AC (Key finding 5-21).

The AC appeared to play the most significant role in preventing teachers and the school from effectively addressing academic diversity in lower school (such as by targeting content and assessment) (Key finding 5-22). This curriculum constraint on content and assessments, which can lead to standardized testing and a disregard for students' academic diversity, has been noted in the literature (Bondie, 2019; Ricketts, 2014; Robinson, 2017; Smeeton, 2016; Tomlinson et al., 1998). Having to follow the AC assessment and reporting requirements, it is unsurprising lower-school students undertook the same assessments as each other (Key finding 4-3). As teachers were required to assess students against the AC year level expectations, their homogenous testing was reflected in the same content being presented to almost all students. This is known as a one-size-fits-all classroom (Goss et al., 2015; Masters, 2013; Subban, 2006; Tomlinson, 2014). The principal and teachers reported that adhering to the AC meant some lower-school students did not experience any academic success until, in some cases, they reached Year 11; affecting their self-efficacy and attitude towards the subject area. Instead of the mathematics department having to create streamed classes, the AC allowed a greater variety of classes in Years 11 and 12. Although there were four different levels of mathematics in Year 11 and 12, the same number as in lower school, students undertook different content and assessments and were graded against different levels of expectation. The only barrier to streaming classes identified by French teachers was timetabling difficulties.

Assertion 4: The barriers to streaming lower-school classes included the AC, students' self-efficacy, timetabling clashes and parents' confusion about grading.

The Australian Government DoE released a report in 2014 that reviewed the AC. It stated, 'We must deal with the overcrowding of the curriculum as a matter of priority', (Australian Government Department of Education, 2014, p. 7). Four to five years later, the mathematics teachers in this study felt the AC left them time poor due to an overcrowded curriculum (Key finding 5-25). A French teacher also mentioned the unrealistic expectations of the AC. Curriculum writers were accused of being out of touch with students' prior knowledge, abilities and interests. The AC has been described as a one-size-fits-all curriculum (Ditchburn, 2012) and overcrowded (Orpe, 2014). Teachers have been found to be critical of the AC, with mathematics teachers in particular concerned with the rationale for the curriculum content selected (Briant & Doherty, 2012).

Yet to introduce the AC into their subject area, French staff also felt time poor. Lack of class to effectively cater for the range of academic diversity was also attributed to large class sizes. French teachers were more concerned than mathematics teachers about the lack of class time to effectively address students' academic diversity (Key finding 5-24).

Assertion 5: Large class sizes, lack of teaching time, the absence of streaming and the AC are barriers to addressing academic diversity.

7.2 ICT: Education Perfect and Mathspace

In order to answer research questions 2 and 3, participants were asked about their experience with educational software Education Perfect and Mathspace, and the capacity for these programmes to address academic diversity. These research questions are:

RQ 2: How do secondary French and mathematics teachers use and perceive Education Perfect and Mathspace for addressing students' academic diversity?

RQ 3: What are students' attitudes towards Education Perfect?

The principal, teachers and students were asked about the role this software played inside and outside the classroom, how it functioned, the impact it had on students and the barriers to these programmes. Unfortunately, student responses regarding the Mathspace software were too low (N=3) to include in this study. Mathematics students' responses regarding Education Perfect were also small (N=12) compared to the number of French students' responses (N=153). This meant there was no insight into Mathspace from the students' perspective, and discussion regarding Education Perfect was heavily weighted towards students who were using the software as a part of their French course. This section opens with a broad look at ICT and its impact on students, and finishes with recommendations for future research.

7.2.1 The Broader Impact of ICT

Broadly speaking, students were described by some French teachers as victims of the generation in which they live. They felt students had grown accustomed to the plethora of on-demand information and entertainment, which takes little effort to access and use. In general, students' motivation, discipline and general knowledge were believed to have declined over the span of most teachers' careers; a result of constant exposure to technology that does the thinking for them (Key finding 6-1). The term digital dementia is used by Moledina and Khoja (2018) to refer to the impact of instant access platforms, such as Google, on our memory and cognition. They found studies suggesting that having instant access to information has led to a shift towards shallow learning and rapid attention shifting, which 'have been linked with increased distractibility and reduced learning in the classroom', (Loh & Kanai, 2016, p. 516). There has been a gain in knowledge of where to find information but a decline in remembering the information itself (Sparrow et al., 2011). Mobile device technology has also been found to decrease students' critical thinking when compared to typed or written work (Heflin et al., 2017). Although this research did not intend to investigate the broader ramifications of ICT or platforms such as Google on students' learning, it was interesting to find a juxtaposition of thoughts and behaviour. Some teachers highlighted the negative impact of technology on students' learning and attention spans while holding positive attitudes towards the introduction and use of educational technologies such as Education Perfect.

Assertion 6: Information and communication technologies are believed to have negatively impacted students' academic achievement and effort, based on traditional testing.

7.2.2 Education Perfect's and Mathspace's function and use

Teachers found setting up students' Education Perfect and Mathspace accounts easy, taking no more than one lesson to do so (Key finding 6-4). This was partly due to the user-friendly nature of the software (Key finding 4-8, Key finding 6-11). Teachers were also confident with students using the software in circumstances when they (the teacher) were absent from class, or when students were away from school. This included relief lessons, homework, additional work requested by parents and during holidays. Teachers found this educational software to be the best resource to administer in the above-mentioned circumstances because of the students' capacity to be independent with the programme (Key finding 6-10).

Despite students' independent use of the online programmes, all teachers believed software such as Education Perfect and Mathspace were tools to assist, rather than replace, their teaching. A part of Education Perfect's short-term effectiveness was due to the repetitious and user-friendly nature of the programme. Providing repetitive content can reduce demand on working memory, which has been found to improve students' learning, especially when faced with novel information (Agodini et al., 2009; Bransford, 2000; Deans for Impact, 2015; Kirschner et al., 2006; Sweller, 1988). A downside to this feature was that Education Perfect did not target content at students' current level of understanding as often as other ICT, such as Mathspace (Key finding 4-10); all students needed to progress through the same content. This was one advantage Mathspace had over Education Perfect in regards to addressing academic diversity. Mathspace provided questions at the students' level of readiness more often and more accurately.

Another feature of Education Perfect and Mathspace that was identified as keeping students motivated and on track, at least in the short to medium term, was the gamified elements of the online software, a finding that supports existing literature (Alshammari, 2020; Beavis et al., 2014; Ge, 2018; Kyewski & Krämer, 2018; Sailer et al., 2017). The sounds, colours, score points and mini games Education Perfect and Mathspace provided were considered a part of the software's gamified nature (Key finding 6-5); this is discussed further below. It was noted by one of the French teachers that the point scoring system in Education Perfect was favourable to students with greater IT skills, such as touch typing, because the faster students could type, the faster they could complete questions and gain more points (Key finding 6-6).

Most teachers used programmes like Education Perfect and Mathspace towards the end of their topic and/or lesson as a tool to consolidate students' learning. After gaining a foundational understanding of newly presented information, concepts or skills from their teacher and related activities, students would use Education Perfect and Mathspace like a revision worksheet in which repetitive, scaffolded questions enabled students to practice newly acquired skills and knowledge (Key finding 6-9).

Assertion 7: Mathspace and Education Perfect are user-friendly, repetitive and gamified. They are commonly used as tools to reinforce learning, and are assigned for student use when their teacher is absent.

Teachers were also aware of the information these programmes provided about students' progress within the software. For example, the live-tracking tool, which tracked students' progress through questions, highlighted in real time any misunderstandings both individuals and the class as a whole were experiencing. This feature was considered by some mathematics teachers as much more efficient than gathering and analysing data with paper-based work, leading to faster feedback for student learning (Key finding 6-7). Trying to identify difficulties that students were facing when completing paper-based work, such as worksheets or questions from a book, was considered time consuming. The teacher would either need to constantly monitor students' work by walking around the classroom or ask students individually/as a class where they were up to so as to obtain *live* data on student progress. Assessing students' learning progress was often achieved by the teacher marking their work, whether as a formal or informal process, but this did not provide real-time feedback to the teacher or student.

Although some mathematics teachers considered this feature highly effective for efficiently addressing academic diversity in their classes, it was underused by most. Some teachers were not convinced the data provided by Education Perfect or Mathspace would tell them anything they did not already know. However, the live data provided teachers access to formative, summative and diagnostic data which could have been used to address academic diversity (Goss et al., 2015; Hattie, 1999; Hattie & Timperly, 2016; Tomlinson, 2001, 2014). In addition to some teachers being sceptical that the data would inform them of novel information, some other possible reasons for the underuse of this data could include: a lack of professional development in accessing and interpreting the student data; a lack of professional development in using the data to address academic diversity; poor presentation of student data by the software; lack of time to access and interpret the data; and/or information overload. These barriers to addressing academic diversity have been found in other studies (Bondie, 2019; Goss et al., 2015; Ricketts, 2014; Robinson, 2017; Smeeton, 2016; Tomlinson et al., 1998).

Assertion 8: e-Learning software provides more real-time data on student learning than paper-based work.

7.2.3 Education Perfect's and Mathspace's impact on students

Students enjoyed using Education Perfect and wanted to use it more during class time (Key finding 4-6), with the vast majority of French students, males in particular, preferring Education Perfect over paper-based work (Key finding 4-7, Key finding 6-13); an idea put forward by Newhouse

(2016). One teacher mentioned that male students may have liked Education Perfect because of the programme's point scoring system, which provides competition between other students and classes locally, nationally and internationally. This supports Beavis et al. (2014), who found some teachers referring to competitive, digital, game-based competition as particularly engaging for boys. This competitive element, coupled with the programme's other gamified elements, appeared to play a significant role in motivating most students to use Education Perfect. This finding supports studies that have found gamified educational software increases students' motivation and engagement (Kyewski & Krämer, 2018; Sailer et al., 2017).

Education Perfect's motivational impact on students was considered by most French teachers to be significant for both high- and low-performing students, although for different reasons (Key finding 6-12). Lower-performing students were said to have fun with Education Perfect, mostly because of the gamified elements of the programme. Higher-performing students were seen to be motivated by Education Perfect because of the competitive elements of the programme, and their capacity to progress quickly through content without having to wait for the rest of the class to keep up. There is no independent evidence to verify this.

Students' independence with the online software was another factor responsible for students being more engaged with online learning software than paper-based content. Students could learn independently with Education Perfect and Mathspace because of the programmes' user-friendly interface and built-in assistance (Key finding 4-8, Key finding 6-11). If students faced a question they were unfamiliar with, or answered a question incorrectly, these programmes would provide either: the correct answer; hints for the correct answer; additional written, verbal or illustrated content targeted to the question at hand; or a combination of these. There was some teacher scepticism about students not learning much because they were moving through content too quickly by gaming the assistance the software provided; a problem found by Muldner et al. (2011).

As French was a foreign language for almost all students in this study, it was considered difficult for these students to independently learn French if little or no assistance was provided in real time, assuming they had the motivation to do so (Key finding 5-28). When using Education Perfect, the real-time feedback and assistance provided by the software meant French students could independently progress through their work; this was a significant advantage over paper-based content. Education Perfect's motivational effect and its capacity for students to be independent learners with the software are why the French teachers considered the programme to be highly effective in addressing the academic diversity within their classes (Key finding 5-17).

Most French teachers in this study believed Education Perfect had a positive impact on French students' learning outcomes; a large majority of French students agreed (Key finding 4-11). The mathematics teachers who used Education Perfect or Mathspace enough to comment on the impact the software had on students' learning also assessed its impact positively. This supports findings by Alshammari (2020), who has called for more empirical evidence into the impact of gamified elements on students' learning. Alshammari (2020) found gamification to positively enhance the learning outcomes and motivation of 58 secondary students learning Arabic. Interestingly, the French and mathematics teachers who believed the online programmes positively impacted students' learning attributed this effect to the motivational component of the software (Key finding 6-15). Similarly, Ge (2018) found that awarding points to university students when they answered questions correctly on an online assessment improved their learning outcomes. Teachers in this study believed if students were as motivated and engaged with paper-based content as they were by Education Perfect or Mathspace, the same amount of work would be completed, leading to the same amount of progress and learning.

This study, at first, appears to contradict Dalby and Swan (2019), who claimed teachers are unclear of the impact that technology has on student learning. Teachers in this study were fairly certain of the impact Education Perfect and Mathspace had on their students' learning, whether it was positive, negative or non-existent. However, there was less certainty regarding the magnitude of this impact.

Assertion 9: Education Perfect addressed students' academic diversity by motivating them and allowing them to be independent learners. The impact on students' learning outcomes is unclear.

7.2.4 Barriers to Education Perfect and Mathspace

Despite both the French and mathematics departments having free trials with the e-learning software, Education Perfect was more successful than Mathspace. Although both departments faced similar challenges accessing and using the online programmes, mathematics teachers' and students' challenges were more frequent and difficult to manage.

As stated by teachers in both departments, Education Perfect and Mathspace required a high precision of accuracy when entering answers into the software. Even though students would input the correct answer, it was marked as incorrect because they hadn't entered it exactly as the software required. This was more troublesome with Mathspace than Education Perfect. Because Mathspace sometimes requires multiple steps to be completed in order to solve a problem (a design feature to simulate mathematical reasoning), students could be told they were incorrect multiple times during one question, despite answering all steps correctly. This caused significant frustration among teachers and students, leading some teachers to stop using the programme after they had just implemented it (Key finding 6-16). Paper-based questions allowed mathematics students to work free from a predetermined set of very specific steps, enabling them to skip steps. This was considered higher-order thinking. Also, different mathematical approaches could be used to answer questions, something Mathspace did not allow.

Other problems faced by both departments included students forgetting their software login details and a lack of access to reliable computers (Key finding 6-17). Students forgetting their login details was less problematic as teachers could project all students' login details onto the front screen. Teachers were less able to overcome the hardware barrier; sometimes there were not enough computers for all students to access, plus some of the computers that were accessible did not work properly or took too long to start working appropriately. This was another issue mathematics teachers had more trouble with than French teachers. They had a much larger department, which meant fewer laptops per student. The school was addressing this issue at the time of this research.

Although not initially a barrier, the cost of the computer programmes was a significant factor (Key finding 6-3). If free trials were not provided, teachers may not have tried using the software at all. The French department's success with Education Perfect led to other departments trialling the programme as they too were offered free trials following the French department's purchase of a one-year Education Perfect licence. The principal and other departments were then willing to pay for the software after students and teachers had experienced it positively.

An emerging barrier for Education Perfect, identified by French teachers, was its overuse. With multiple departments adopting Education Perfect as another teaching tool or homework option, students were engaging less with the software (Key finding 6-18). This may be one of the most significant barriers and findings from this research as the motivational component of Education Perfect in particular was considered the primary reason students were so engaged with their work. If students' motivation to complete work on Education Perfect was lost, their work ethic with the programme could suffer, leading to less work being completed both in and outside of class.

This concern was identified in a study by Beavis et al. (2014). Teachers were worried the new computer-based games would lose their novelty, resulting in less engagement with the ICT and less learning. With the high praise Education Perfect received by most French teachers, its capacity to address the academic diversity within class could be hindered with the loss of students’ motivation.

Finally, not so much a barrier but identified as a missing element, was the capacity for students to interact socially when using Education Perfect or Mathspace. Students’ social interaction with each other was considered an important factor, and something Mathspace and Education Perfect was understood to be developing. A study by Malekzadeh et al. (2015) found ITSs similar to Education Perfect and Mathspace that employ emotional regulation strategies may improve students’ emotions and learning outcomes.

Assertion 10: Barriers to students’ use of educational software Mathspace and Education Perfect included the high precision required in answers, the lack of computer access, unreliable computers, software costs and overuse.

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8. Conclusion

This research investigated how a school and its principal and teachers addressed academic diversity, and the role intelligent tutoring systems, specifically Education Perfect and Mathspace, played in this. A mixed-method approach was employed to answer the following research questions.

RQ 1: How do principals and secondary French and mathematics teachers perceive and cater for students' academic diversity?

RQ 2: How do secondary French and mathematics teachers use and perceive Education Perfect and Mathspace for addressing students' academic diversity?

RQ 3: What are students' attitudes towards Education Perfect?

Schools and teachers are expected to improve all students' educational outcomes. With the increasing recognition of the wide spectrum of students' prior knowledge, ability and pace of learning in schools and classrooms, this can be a significant challenge, especially in resource-constrained education systems. Failing to appropriately address this academic diversity can lead to frustrated, unmotivated and disengaged students, resulting in poor educational outcomes. The range of academic diversity and possible consequences of not addressing it was something the principal and teachers in this research were aware of. The case study school attempted to address academic diversity at the department level by streaming students into higher- and lower-performing classes based on academic performance. This was believed to reduce the academic diversity within each class, enabling teachers to more easily provide appropriately targeted content, pace of learning, expectations and assessment. This was the case for mathematics teachers in this study, who streamed most of their classes in Years 7 to 10. However, most of the content and assessment that had been adapted for the streamed classes fell outside the Australian Curriculum. The AC acted as a one of the most significant barriers to addressing academic diversity. Although students in streamed mathematics classes were provided with content and assessment below or above AC expectations to improve learning outcomes, their final grades were judged against AC standards. This meant some students did not experience any sense of success in mathematics until they reached Years 11 and 12, where the AC allowed streaming of content, assessment and expectations.

Other barriers to streaming included students developing poor self-efficacy, timetable clashes and parents' confusion with reported grades.

At the classroom level, teachers addressed academic diversity by providing different learning materials and activities day to day, such as scaffolded worksheets, books, e-learning software and group work. Teachers would also monitor students' progress and understanding in order to adapt content and learning pace. Teachers faced a number of common barriers including the AC, a lack of teaching time, large class size, and some students' lack of motivation and poor behaviour. It is concerning that the principal and teachers of a high-performing secondary school were convinced the AC negatively impacted lower-school students' learning, motivation and efficacy.

Teachers mostly used Education Perfect and Mathspace towards the end of the lesson and/or topic as a tool to consolidate student learning, typically due to the repetitive nature of the software, which lended itself to revision. The software was also the default resource when teachers provided relief work for students as well as in other circumstances when students needed to complete work independently. Another feature of the e-learning software was the formative, summative and diagnostic student data provided. Although some teachers found this data valuable for more efficiently addressing academic diversity in their class, others referred to it for basic insights such as homework completion, thereby using it as an accountability tool. This may have been a missed opportunity for addressing academic diversity.

Education Perfect and Mathspace were considered by the teachers as user-friendly software that provided students with on-demand assistance when they were struggling; this is why students could be independent learners with the online programmes. The help provided by Education Perfect was especially useful for French students because independently learning a second language was considered especially difficult to do. Students found Education Perfect very motivating, which was likely due to the gamified features of the software; male students, in particular, much preferred using Education Perfect to paper-based work. This motivating factor, along with students' independent use of the software, meant Education Perfect could be used to address academic diversity better than paper-based learning resources, especially in French language classes.

The precision Mathspace required when students answered questions, and a lack of flexible working out of solutions caused too much frustration for teachers and students, inhibiting their progress at times. This led to some teachers not using Mathspace. Although Education Perfect faced a similar issue, it did not impede students' learning as much as Mathspace. Another barrier to both online programmes was a lack of access to reliable computers, which influenced teachers to avoid using the software. Other barriers to the success of the software included cost and overuse. Free trials led to many departments trying Education Perfect in particular, which resulted in what appeared to be an overuse of the software. This negatively affected students' motivation to use the software, which may be the Achilles heel of such e-learning programmes. Another issue that appeared to lead to poor learning outcomes was students 'gaming' the software. Students may have been accessing the on-demand assistance provided by the software programme too often, or skipping over newly presented information, resulting in faster movement through the content but less retention of the information.

Despite this research being conducted within one school, similar positives and negatives to ITSs were found across two different departments. Unfortunately, the reliability of mathematics students' responses was impacted by a low response rate to both Education Perfect and Mathspace. Also, due to the nature of a single case study, the findings from this research cannot be generalised until supporting evidence is found from similar entities. Although it is beyond the scope of this study to conclude exactly how effective Education Perfect or Mathspace is for improving students' academic achievement, recommendations for schools, teachers and software developers can be made:

- Software companies looking to implement their e-learning products in schools can offer free trials to circumvent any initial issues regarding programme costs.
- Ongoing offers regarding programme costs and licensing can encourage more staff and departments to try new software products.
- Schools and teachers need to be careful not to overuse one particular e-learning resource as students' motivation towards the software can be negatively impacted.
- Software developers could tailor how student achievement and progress data is presented/accessed by teachers by asking teachers about their preferences and barriers faced.
- ITSs can act as a tool to help address academic diversity.
- ITSs provide an effective resource for teachers' relief lessons.

Further research and investigation is needed to help answer the following questions:

- How widespread is the belief the AC acts as a barrier to effectively addressing students' academic diversity?

- How much of a barrier is the AC to addressing academic diversity?
- What is being done to ensure the AC does not act as a barrier to providing targeted content, assessment and expectations for lower-school students?
- What does effectively using students' data provided by e-learning software look like?
- What is the impact on students' learning outcomes if teachers and students effectively use data provided by e-learning software?
- What is the long-term impact of using ITSs on students' learning, independence and initiative?

Schools and teachers can face a significant range in students' academic prior knowledge, pace of learning and performance within a given cohort or class; in particular, mixed-ability classes. With expectations of addressing this academic diversity, schools and teachers may stream classes based on ability and provide a range of learning materials, activities and pedagogy. Despite these efforts, barriers such as the AC can make it difficult to provide content and a pace of learning appropriate for all students, especially in Years 7 to 10. ITSs are one learning resource that can help meet those expectations of addressing students' academic diversity. They can motivate students and enable them to be independent learners, more so than paper-based work can. Although ICT such as ITSs can act as a novel and engaging resource for students, it is the teacher's task to ensure the technology is not doing the thinking for them.

9. References

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10. Appendix

Appendix 1: Online survey questions for French students

French students' survey questions
Thank you for considering participating in this online survey. Your participation will involve completing an online survey. The sets of questions will fall under 3 broad categories: academic diversity – your understanding of the differences in student academic ability; differentiation (giving students different opportunities for learning) – do you think your teacher helps you in the way that you need? and technology – what you think about the Language Perfect programme you use. The survey should take less than 10 minutes to complete The survey will also be anonymous; this means no one will know what you have said in the survey, including me. You will only need to select your sex and teacher name. If you decide to stop the survey part way through, simply exit the survey. Your response will not be recorded. In addition to your responses being anonymous (no one can know what responses you have made), the responses you give will not be individually published. ○ I understand and consent to participate in this research What is your sex? ○ Male ○ Female

Who is your languages teacher?

- ◯ Mrs K
- ◯ Mrs L
- ◯ Mr G

Q1 Everyone in this class is as good as each other at French

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q2 Some people in this class are better at French than others

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q3 There is a variety of intelligence in this class

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q4 Everyone in this class has the same ability to speak or read French

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q5 The teacher in this class thinks everyone learns the same way

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q6 We do different learning activities in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q7 I need more help in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q8 In this class, we learn about things I'm interested in

- Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q9 In this class, the teacher teaches at the right speed for me

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q10 We are all tested in the same way in this class

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q11 In this class, the teacher knows when I'm struggling

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q12 In this class, the teacher knows when the whole class is struggling

○ Strongly Agree

- Agree
- Disagree
- Strongly Disagree

Q13 In this class, the teacher gives me extra examples if I don't understand what we we're learning

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q14 In this class, the teacher doesn't help me when I'm having trouble with a question

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q15 The teacher knows how much I know about French in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q16 If I find this class too easy, the teacher gives me more challenging material

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

○ This question doesn't apply to me

Q17 In this class, I know how much progress I am making

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q18 My teacher shows me how much progress I am making in this class

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q19 All that matters in this class is getting a good score on our tests

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q20 In this class, test scores are more important than improving my knowledge of French

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q21 Improving my understanding of French is more important than a test score

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q22 I don’t know if I’m learning in this class

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q23 I know if I’m improving or not in this class

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q24 I like using Language Perfect

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q25 Language Perfect is boring

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q26 I want to use Language Perfect more in class

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q27 I use Language Perfect outside of class time

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q28 I want to use Language Perfect less in class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q29 Language Perfect is easy to use

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q30 Language Perfect is difficult to use

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q31 I would rather use worksheets or questions from a book instead of Language Perfect

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q32 I don't need the teachers help with French questions when I'm using Language Perfect

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q33 Language Perfect doesn't provide enough help when I have trouble with a question

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q34 I know how much progress I am making when I use Language Perfect

- Strongly Agree
- Agree
- Disagree

Strongly Disagree

Q35 I learn more when I'm using Language Perfect

Strongly Agree

Agree

Disagree

Strongly Disagree

Q36 I can compare my progress with others in Language Perfect

Strongly Agree

Agree

Disagree

Strongly Disagree

Q37 Language Perfect provides more help if I’m struggling with a French question

Strongly Agree

Agree

Disagree

Strongly Disagree

Q38 Language Perfect gives me harder questions if I find them too easy

Strongly Agree

Agree

Disagree

Strongly Disagree

Q39 I learn faster when I'm using Language Perfect

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q40 I learn more with Language Perfect than I do without Language Perfect

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q41 Language Perfect gives me easier questions if I find them too hard

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q42 Language Perfect motivates me to learn

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q43 I make more progress with Language Perfect than I do without Language Perfect

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Appendix 2: Online survey questions for mathematics students

Mathematics students' survey questions
Thank you for considering participating in this online survey. Your participation will involve completing an online survey. The sets of questions will fall under 3 broad categories: academic diversity – your understanding of the differences in student academic ability; differentiation (giving students different opportunities for learning) – do you think your teacher helps you in the way that you need? and technology – what you think about the Education Perfect programme you use. The survey should take less than 10 minutes to complete The survey will also be anonymous; this means no one will know what you have said in the survey, including me. You will only need to select your sex and teacher name. If you decide to stop the survey part way through, simply exit the survey. Your response will not be recorded. In addition to your responses being anonymous (no one can know what responses you have made), the responses you give will not be individually published. ◯ I understand and consent to participate in this research

What is your sex?

- ○ Male
- ○ Female

Who is your mathematics teacher?

- ○ Mrs W
- ○ Mr M
- ○ Mr V
- ○ Mr L

Q1 Everyone in this class is as good as each other at mathematics

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q2 Some people in this class are better at mathematics than others

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly Disagree

Q3 There is a variety of intelligence in this class

- ○ Strongly Agree

- Agree
- Disagree
- Strongly Disagree

Q4 Everyone in this class has the same mathematics ability

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q5 The teacher in this class thinks everyone learns the same way

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q6 We do different learning activities in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q7 I need more help in this class

- Strongly Agree
- Agree

- Disagree
- Strongly Disagree

Q8 In this class, we learn about things I’m interested in

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q9 In this class, the teacher teaches at the right speed for me

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q10 We are all tested in the same way in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q11 In this class, the teacher knows when I’m struggling

- Strongly Agree
- Agree

- Disagree
- Strongly Disagree

Q12 In this class, the teacher knows when the whole class is struggling

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q13 In this class, the teacher gives me extra examples if I don't understand what we we're learning

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q14 In this class, the teacher doesn't help me when I'm having trouble with a question

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q15 The teacher knows how much I know about mathematics in this class

- Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q16 If I find this class too easy, the teacher gives me more challenging material

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

○ This question doesn't apply to me

Q17 In this class, I know how much progress I am making

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q18 My teacher shows me how much progress I am making in this class

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q19 All that matters in this class is getting a good score on our tests

○ Strongly Agree

- Agree
- Disagree
- Strongly Disagree

Q20 In this class, test scores are more important than improving my knowledge of mathematics

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q21 Improving my understanding of mathematics is more important than a test score

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q22 I don’t know if I’m learning in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q23 I know if I’m improving or not in this class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q24 I like using Education Perfect

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q25 Education Perfect is boring

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q26 I want to use Education Perfect more in class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q27 I use Education Perfect outside of class time

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q28 I want to use Education Perfect less in class

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q29 Education Perfect is easy to use

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q30 Education Perfect is difficult to use

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q31 I would rather use worksheets or questions from a book instead of Education Perfect

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q32 I don't need the teachers help with mathematics questions when I'm using Education Perfect

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q33 Education Perfect doesn't provide enough help when I have trouble with a question

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q34 I know how much progress I am making when I use Education Perfect

○ Strongly Agree

○ Agree

○ Disagree

○ Strongly Disagree

Q35 I learn more when I'm using Education Perfect

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q36 I can compare my progress with others in Education Perfect

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q37 Education Perfect provides more help if I'm struggling with a mathematics question

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q38 Education Perfect gives me harder questions if I find them too easy

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Q39 I learn faster when I'm using Education Perfect

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q40 I learn more with Education Perfect than I do without Education Perfect

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q41 Education Perfect gives me easier questions if I find them too hard

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q42 Education Perfect motivates me to learn

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

Q43 I make more progress with Education Perfect than I do without Education

Perfect

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

Appendix 3: Semi-structured interview questions

Perception of academic diversity

1. What does academic diversity mean to you?

2. What do you think creates academic diversity? Why are there differences in student academic ability?

3. What does the spread of academic ability look like within a given year level (year 7, 8, 9 etc.)? What does the dispersion look like?

4. How does the school cater for academic diversity at the department level?

5. What does the spread of students' academic ability look like in your lower school class/s?

    5.1. How do you recognise these differences?

6. What are some examples of academic differences between these students?

7. In your class/s, are there students who could be placed in a higher or lower year level?

8. Is there a need to cater for these differences in academic ability?

Catering for academic diversity

1. How do you cater for the differences in academic ability in your class/s?

2. Is it difficult to cater to the academic abilities of all students in your class/s?

    2.1. Do you have some examples?

3. How do you identify students' academic abilities?

4. Do you think students should be able to advance at their own pace?

5. What influences the pace at which content is delivered?

6. Would you like more training that focuses on how to cater for the differences in academic ability?

<u>ITS technology</u>

1. What are the ICT programs you use?

2. How did the ICT program/s come to be in your school?

    2.1. Who championed them?

3. Were there any difficulties faced in setting up the program?

    3.1. How long did it take to have everything running smoothly?

4. Can you give a brief description of the program/s? How they work

5. What role does the ICT program/s play in your classroom? Who/when/how/why

6. Are there benefits to using the programs for you?

7. Are there benefits to using the programs for your students?

8. Are there cons to using the program for yourself?

9. Are there cons for the students?

10. Do the programs help to cater for differences in academic abilities?

11. Would you want the program in a mixed ability class?

    11.1. Does the program scaffold content?
    11.2. Does the program adapt to students' abilities in any way?
    11.3. What data/information do the programs provide?
    11.4. Do you use any of this data or go to it regularly?
    11.5. Does it influence your practice?
    11.6. What data/information can students see?

12. Has there been any reaction or comment by parents about the software?

13. Have you noticed any negative impacts on student learning outcomes after using the program?

14. Are there any final comments you would like to make regarding these topics?