Exploring learning and employability skills and their relationship with the Australian Curriculum, SACE and the General Capabilities

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ABSTRACT

Work performance and success in the twenty-first century is broadly dictated by an individual's learner and employability skills. These are skills that are not discipline specific, but relate to a wide range of contexts to allow an individual to be successful in contemporary society. These skills are now also becoming part of the accepted standards of performance for students. However, if students are to meet these standards of performance they must first be developed and promoted in the classroom. There is a demonstrated consensus in the literature that classroom activities and student focus will always be centered on what is assessed; if there is a disconnection between the standards for assessment and the objectives of the curriculum, then the curriculum objectives will not be represented in the tasks that students are presented. Despite this, there is limited research that explores how these twenty-first century skills are incorporated into Australian curricula and assessed in the classroom.

The Employability Skills specified in the Core Skills for Work (CSfW) Developmental Framework are echoed in the Australian Curriculum and the South Australian Certificate of Education (SACE) Curriculum with the inclusion of the General Capabilities. Each of these General Capabilities resonate the skills that are acknowledged globally as being key to developing proficient learners and successful contributors to society. This thesis explores the alignment between Employability Skills specified by the CSfW Developmental Framework, Curriculum Objectives and student assessments for SACE Stage 1 Mathematics through a qualitative analysis of the curriculum and the provided school-based assessment documents.

The initial analysis evaluated the alignment between the General Capabilities and the SACE Performance Standards for Stage 1 Mathematics. The results of the thematic analysis of the two document sets showed that the SACE Performance Standards omitted the majority of the General Capability Key Idea Elements, specifically for the ICT Capability, Personal and Social Capability, Ethical Understanding, and Intercultural Understanding. This result confirmed that the current SACE Performance Standards are only able to measure student performance against the Numeracy, Literacy, and Critical and Creative Thinking Capabilities, highlighting a disconnection between the curriculum objectives and student assessment.

In addition to the review of the SACE Performance Standards, the study also analysed examples of Stage 1 Mathematics school-based assessments to explore any intrinsic links to the General Capabilities. These assessment documents were provided by a co-educational secondary school located in Adelaide, South Australia. The results of this analysis showed a similar alignment to the General Capabilities as what was identified in the analysis of the SACE Performance Standards. Only the Numeracy, Literacy, and Critical and Creative Thinking Capabilities were challenged and measured by the school-based assessments; the remaining four capabilities were all omitted from the assessment tasks. This result highlighted that the Performance Standards stipulated by the SACE Subject Outline for Stage 1 Mathematics had an ongoing effect on the way that school-based assessments were developed and the skills that were measured.

The outcomes of this study demonstrate the need for standards of performance, curriculum objectives and student assessment to be aligned. The alignment of these three elements of education will help ensure that employability and learner skills for the twenty-first century are developed and measured in South Australian classrooms. In addition to this, the review of the SACE Subject Outline suggested that the current SACE Curriculum framework prevented schools the freedom to integrate courses and better represent the General Capabilities in classroom activities and assessments. A reform of this framework could open the potential for the implementation of a highly contextualised curriculum, allowing students to apply their knowledge to applications that they are expected to face outside of the classroom.

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Author,

Jacob Hanley

1 INTRODUCTION

Success and performance in the twenty-first century are determined by three primary factors: an individual's Core Skills, Technical Skills and Employability Skills (DIICSRTE & DEEWR 2013). However, as the contemporary workforce and society evolves there is an increasing need for people to be more reactive and have an ability to absorb, learn and process new information in unfamiliar contexts (Brady 2012). This change reduces the emphasis on core and technical skills. School graduates will be expected to periodically re-skill and participate in training throughout their career. To ensure students are prepared for this environment, they will need to be equipped with twenty-first century skills that allow them to be lifelong learners and function effectively in a global society (Reis & Durkin 2018). The model for education and curriculum development must be focused on the external standards of performance required by society and the workforce. This focus will ensure that students are equipped with the skills to be lifelong learners, in addition to promoting the foundational literacies, competencies, and character qualities to be successful in contemporary society.

This research aims to analyse the Australian Curriculum, SACE Curriculum and SACE Stage 1 Mathematics school-based assessments, to ensure that the skills required for the twenty-first century are included in not only the curriculum objectives but also the assessment tasks that students are provided by secondary schools.

1.1 THE CONNECTION BETWEEN STANDARDS OF PERFORMANCE AND CURRICULUM OBJECTIVES

Mohandas, Wei and Keeves (2003) have proposed a model for evaluating curricula as an interdependent system that places external stakeholders and standards of performance as the key influences on curriculum development. This model was adapted from the Curriculum Triangle developed by Tyler (1949), and is known as the Curriculum-Evaluation Diamond. Most notable from this model is the relationship between Standards of Performance, Curriculum Objectives and Student Assessment (See Figure 2). As previously recognised, twenty-first century skills, such as learner and employability skills, are the keys to success in a contemporary society and workforce. Therefore, these must be viewed by education institutions as a primary part of the standards of performance that curriculum objectives must be developed to meet. In the case of the Australian Curriculum and South Australian Certificate of Education (SACE), the curriculum objectives that link to these standards of performance are referred to as the General Capabilities (ACARA 2019c). The key idea elements for each of the General Capabilities aligns closely with the 21st Century Learner Skills by WEF (2016) and the Employability Skills in the CSfW Developmental Framework developed by DIICSRTE and DEEWR (2013). This alignment shows a strong link in the Australian education system between the external Standards of Performance and Curriculum Objectives. However, these Curriculum Objectives are not adequately assessed by the SACE, specifically the SACE Stage 1 Mathematics Curriculum.

1.2 FORMULATION OF THE RESEARCH QUESTIONS

Prior to pursuing a career in education, I had the opportunity to work in a variety of environments and roles, primarily engineering, aviation, project management, and finance. During this time, I made an observation regarding the skills that determined success in the workplace. Many of the older generations in my workplaces had achieved their success through being a subject matter expert, by developing a set of core and technical skills that allowed them to be leaders and influencers in their area of expertise. Their promotions and success had often been tied to their length of tenure and the industry related skills they had developed. However, this was not the case for many of the younger individuals that had quickly risen the ranks of the workforce. They had not developed the same set of industry specific skills, nor had they dedicated the same time to becoming an expert in their given area. I questioned how they could have achieved success without the technical skills and experience. Yet, as I began to work with them and build an understanding of their capabilities, it became apparent that they possessed a very different set of skills that allowed them to be successful without expert-level technical knowledge.

1.2.1 Defining this Skill Set

The aforementioned skills are what I now know to be employability and learner skills, the Core Skills for Work Developmental Framework (DIICSRTE & DEEWR 2013) providing me with the language to identify what I had observed was determining individual success. The successful individuals were able to navigate the world of work and manage their roles and responsibilities while recognising and responding to the protocols of their environment. They were also able to communicate with others using a variety of practices and protocols, while also having respect for the intercultural complexities that exist in a global business. Their respect of diverse perspectives and ability to manage conflict and challenging personalities built a sense of togetherness in their teams. Most importantly, they were able to learn quickly and had a strong grasp of problem-solving processes. This allowed them to review and reflect on the challenges they were presented, to identify solutions and implement ideas while working in a digital world. All of these skills form the Employability and Learner Skills outlined by DIICSRTE and DEEWR (2013) and WEF (2016).

1.2.2 Research Questions

The goal of this research was to explore how these skills were developed and assessed in a secondary school classroom, specifically in a senior mathematics subject. To achieve this goal, the research had to answer three questions guided by the Curriculum-Evaluation Diamond Model by Mohandas, Wei and Keeves (2003):

1. Do the Curriculum Objectives in the Australian Curriculum and SACE Curriculum align with the Employability and Learner Skills (DIICSRTE & DEEWR 2013; WEF 2016) that form the Standards of Performance for curriculum development?

2. If the Curriculum Objectives align with the Standards of Performance, is student performance measured against these objectives through the SACE Performance Standards (SACE 2019b) for Stage 1 Mathematics?
3. Do the current school-based assessments for Stage 1 Mathematics measure student performance against Employability and Learner Skills (DIICSRTE & DEEWR 2013; WEF 2016)?

1.3 Significance of the Study

The transition to a knowledge economy has begun the scrutiny on schools and their ability to produce students who are able to successfully navigate and perform within a contemporary society. Graduates are expected to be more qualified than ever before and have a broad skill set, including twenty-first century employability and learner skills. Brady (2012) states that the most notable change in stakeholder expectations is the increased focus on the results of educational assessments. Schools, government, industry and families see student assessment as a key determinant of success; however, the current assessments provided in secondary education are not focused on all the skills students require. This study aims to highlight the required skills students need to be successful in a contemporary society, and also provide a review of the current curriculum objectives and student assessments in SACE Stage 1 Mathematics to determine their ability to develop and measure the aforementioned skills.

1.4 Approach to Research – Dissertation Outline

This dissertation includes six chapters, covering Introduction, Literature Review, Methodology, Results, Discussion, and finally the Conclusion and Recommendations. The Literature Review provides an overview of the transition to a knowledge economy and discusses the growing emphasis towards employability and learner skills in the contemporary workforce. Documents corresponding to each element of the Curriculum-Evaluation Diamond by Mohandas, Wei and Keeves (2003) are analysed by this review. This analysis evaluates the documents' relationship and relevance to the goal of incorporating twenty-first century skills in mathematics curricula. The third chapter reviews the chosen methodology framework and justifies the qualitative research methods used to collect and analyse the available documents. Issues of validity and ethical considerations are incorporated in this chapter. The results of the document analysis are then shown in the Results chapter, including a colour coded thematic analysis of the General Capabilities and review of school-based assessments from the partnering school. These results are discussed in the fifth chapter to identify common themes and correlations between the documents and each element of the Curriculum-Evaluation Diamond. The final chapter goes on to summarise the conclusions and recommendations from the results of the document analysis. These recommendations provide opportunities for further research on the incorporation of learner and employability skills in the SACE, specifically in regards to the current limitations that prevent the development and assessment of the General Capabilities in the Stage 1 Mathematics Curriculum.

2 LITERATURE REVIEW

2.1 STAKEHOLDERS IN EDUCATION

The success and outcomes of the schooling process has an impact on a wide range of stakeholders that stretch far beyond the students, parents, guardians, and the school itself. Industry and businesses see education institutions, schools and then universities, as direct stakeholders in their economic activities - primarily with regard to their ability to produce students who are ready to begin their journey in entering a highly skilled workforce (Brady 2012). The modern workforce is evolving. Employees are required to be more educated, more reactive, and have an increased ability to absorb and process complex data. Not only are graduates expected to enter the workforce more highly qualified than ever before, they will be expected to periodically re-skill and participate in training throughout their career. This highlights the need for students to not only be continuous learners in their educational pathway but also their career pathway as lifelong learners (Reis & Durkin 2018). This comes as a part of what Tapscott (1996) refers to as the transition to a 'knowledge economy', where human knowledge is applied to everything we produce and the tools that we use. Brady (2012) recognizes that this transition has increased the focus on education assessment and reporting. Schools, government and industry are now able to use the results of student assessment to determine how prepared students and graduates are to meet the requirements of the current economy.

Additional to the requirements of industry and the economy, the skills that people need to thrive in their everyday life are also critical. The most important stakeholder in education is, without a doubt, the student. They are central to the education process, they are the input, the output and wear the greatest amount of risk and disadvantage if their educational journey does not allow them to be successful in the twenty-first century. Students must be equipped with the skills that they need to not only absorb knowledge while at school but to be lifelong learners, equipped with the foundational literacies, competencies and character qualities that are essential to succeeding in their personal and professional lives (Soffel 2016).

2.2 MEASURING SUCCESS AND MEETING ECONOMIC MARKET NEEDS

Student success and performance within their chosen path of employment can be attributed to multiple factors, both internal and external to the school. These can be defined by two categories: push factors within the school and pull factors from outside the school. Pull Factors may include market demands, economic climate, and geographical locality. Push factors are centric to the school: student wellbeing support, academic expectations, development of character, quality of curriculum, and standards of teaching. Additional to these two groups of factors, there are also the key attributes unique to the individual that may determine their success and performance, such as their personality, skills, and cognitive ability (Hogan, Chamorro - Premuzic & Kaiser 2013). Assuming graduates meet the required level of qualifications, and are seeking employment within an industry with suitable market demands, then the two driving factors that gauge employability and success are a person's psychological attributes: specifically, their cognitive ability, personality and socio-emotional skills. Prior to exploring this correlation further, career success and employability must first be defined.

Career success can be determined through both objective and subjective measures. While it is important to help students obtain careers that provide them with a sense of accomplishment, enjoyment and money with which to live; these types of subjective measures are inconsistent. An individual may not see professional, monetary or formalized recognition of their career success. Despite this, they may evaluate their careers favourably due to a predisposition towards positivity and contentedness (Hogan, Chamorro ‐ Premuzic & Kaiser 2013). Pavot and Diener (2011) simplistically attributed this to "happy people are happy about everything". For this reason, success cannot be easily determined by a third party through subjective means. Career success from an external objective view can be measured in terms of occupational prestige and financial attainment. These quantitative measures are also known as extrinsic success, due to their highly objective and observable nature. Intrinsic success is defined as an individual's own view of their career, commonly referred to as 'job satisfaction' (Judge et al. 1999). For the purpose of this discussion, only the objective and extrinsic career success will be considered due to its measurability. To help secondary school graduates obtain extrinsic career success, they must be equipped with the appropriate skills to allow them to meet the expectations of workplace performance. These skills can be developed during secondary education. However, curriculum objectives and school-based assessment must be aligned with the accepted standards of performance to ensure that high school graduates are successful in their career and make a positive contribution to society. The Curriculum Triangle Model by Tyler in Mohandas, Wei and Keeves (2003) can be used to help explain this link. The Curriculum Triangle displays the relationship between the standards of performance set by industry and society, curriculum objectives, and school-based assessment.

2.3 Development of the Tyler Model

Ralph W. Tyler is known as the 'Father of educational Evaluation' due to his significant role in the development of American education during the 20th Century (Nowakowski 1983). His most well-known work was what was referred to as 'the curriculum rationale', which he developed during his teaching in the 1940s and 1950s. Through this time, he developed a model that provided a rationale for teachers to shape their objectives, curriculum and also evaluation of student performance (Tyler 1949). Tyler's work challenged the current conventions for educational assessment and measurement that had been prevalent for almost 40 years. His focus was to align student evaluation with the local curriculum, as opposed to implementing and administering external standardised tests that did not take in to account the educational objectives that differed in each local situation and school. Rather than only using measurable data from standardised tests, Tyler used a range of student data, including anecdotal reports, as long as it showed a link between the student's learning and the curriculum objectives (William 2017).

Tyler's model for evaluation in education originally consisted of only three key facets, these forming an interdependent relationship that can be represented by a triangle, see Figure 1. Curriculum Objectives, Learning Experiences, and Evaluation are represented by each apex of the triangle, with connecting lines showing the two-way relationship between each node and facet of education.

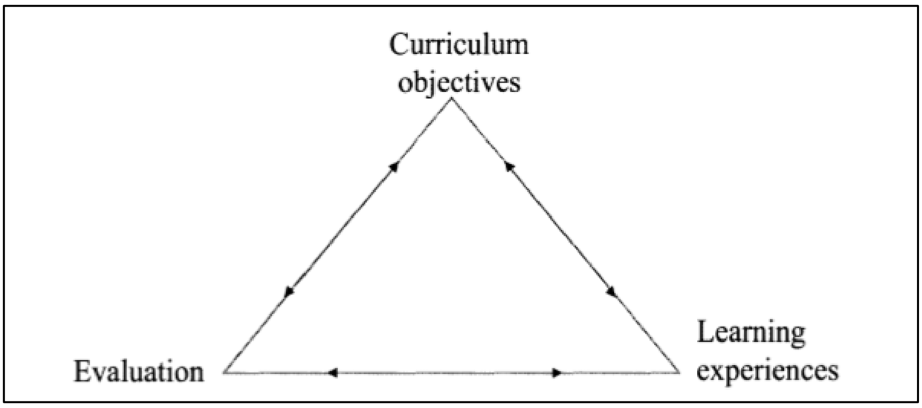


Figure 1 - The Curriculum Triangle by Tyler in Mohandas, Wei and Keeves (2003)

Tyler recognised that curriculum must be focused on the society in which the students will use what they learn. The curriculum objectives must then be developed around the demands and the opportunities of that society (Nowakowski 1983). Yet, the Curriculum Triangle model does not demonstrate that link to society, as the model only shows a school as an independent system. Schools are not isolated entities. Therefore, this model is a misrepresentation of a school's relationship with society, showing no recognised link to any external factors. The Tyler Model shows no interaction between the curriculum objectives, student evaluation, and the targets or needs demanded by external stakeholders. These external stakeholders can include industry, the local community and government bodies, all of which mold the education system and set the expectations that are placed on schools (Brady 2012). This shortcoming of the Tyler Model is addressed by Mohandas, Wei and Keeves (2003). They proposed that there are several other primary constituents that should be considered when creating a model that represents the process of education and curriculum development.

Mohandas, Wei and Keeves (2003) added two other nodes to the Tyler Model: Student Assessment and Standards of Performance. This formed what is known as the Curriculum-Evaluation Diamond (see Figure 2). They argued that the Curriculum Objectives must be linked and driven by the relevant Standards of Performance. This relates closely to the work of Brady (2012), who identified that one of the major drivers of education and development of curricula are external stakeholders such as industry and government. The role of secondary education in Australia is to nurture students, promote equity and wellbeing, and educate next generations to ensure future economic prosperity (Diplomatic Academy 2017). If we consider the Curriculum Triangle (Mohandas, Wei & Keeves 2003) from this perspective, then this Curriculum Diamond Model should strongly influence the evaluation and development of curriculum structure and assessment as an interdependent system between the school, society and external stakeholders.

The purpose of this research is to explore the alignment between the needs of society, development of curriculum, and student assessment against the required standards of performance. Therefore, the most notable element of the Curriculum-Evaluation Diamond (Mohandas, Wei & Keeves 2003) that should be reviewed is the relationship between the Standards of Performance, Curriculum Objectives and Student Assessment. These three elements have been highlighted to show their relationship in the Curriculum-Evaluation Diamond, shown in Figure 2. The relationship between these elements, and their impact on preparing students to be successful in society and their future employment, is explored further in the following sections.

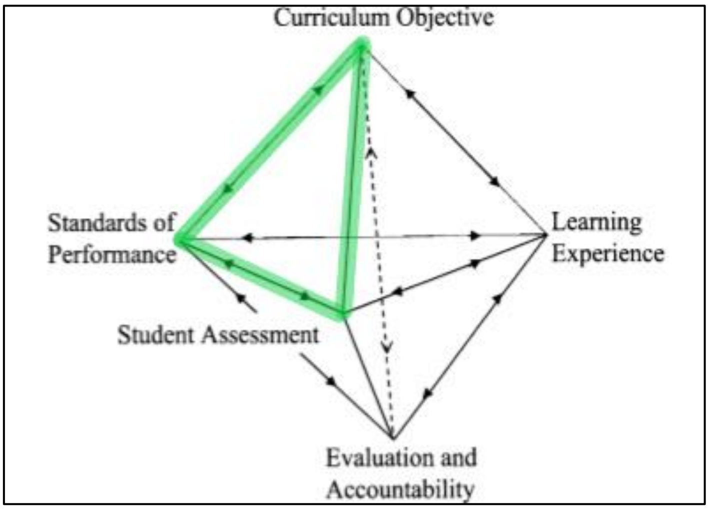


Figure 2 - The Curriculum-Evaluation Diamond (Mohandas, Wei & Keeves 2003)

2.4 STANDARDS OF PERFORMANCE

If promoting future economic success is a primary focus of education, then some of the standards of performance that will guide curriculum to meet this outcome must be taken from both government and industry as a representation of market needs. The standards of performance must contain documented benchmarks from industry and government bodies. This is required to dictate the needs of the workforce and highlight the skills that students will need to prosper and thrive in their social and interpersonal interactions in the twenty-first century. This must be examined from not only a national perspective but also international. This is to ensure that students are prepared to be global citizens, recognising the global interconnectedness between countries, organisations and individual people in the contemporary society.

From an Australian and also work based perspective, the Core Skills for Work Developmental Framework (CSfW) outlines the non-technical skills, knowledge and understandings that underpin successful participation in work within the Australian context. These are referred to as Employability Skills (DIICSRTE & DEEWR 2013). This group of skills are the Standards of Performance for successful participation in work as an employee or volunteer.

Additional to the work-related standards of performance, there are skills outlined by the World Economic Forum (2016) that are crucial for students to develop so they can prosper and thrive in their social and interpersonal interactions. This extends further than just their workplace interactions, but captures their ability to become lifelong learners and be successful, positive contributors to a global society. Employability Skills from the CSfW and 21st Century Skills developed by WEF (2016) can be considered as the two critical standards of performance to be used in the development of curriculum objectives for secondary education. Both components of the standards of performance are explored further in the following sections.

2.4.1 Employability Skills

Work Performance is broadly dictated by three generalised factors: a student's Employability Skills, Technical or Discipline Specific Skills, and Core Language, Literacy and Numeracy Skills (LLN Skills) (DEEWR 2012) (see Figure 3). However, it is difficult to prepare secondary students for the wide range of career choices and environments in which they may work when they graduate. This is due to the need for employees to reskill and change career focus to maintain employment and career progression (Reis & Durkin 2018). Not all fields share specific skill or knowledge requirements, but there are generic skills that can be applied across many professional and vocational pathways. These general skills are often referred to as 'soft skills', 'general capabilities', 'professional skills' or 'essential skills' (Bunney, Sharplin & Howitt 2014). The Department of Education, Employment, and Workplace Relations (DEEWR) referred to this group of skills as 'employability skills' (DEEWR 2012)

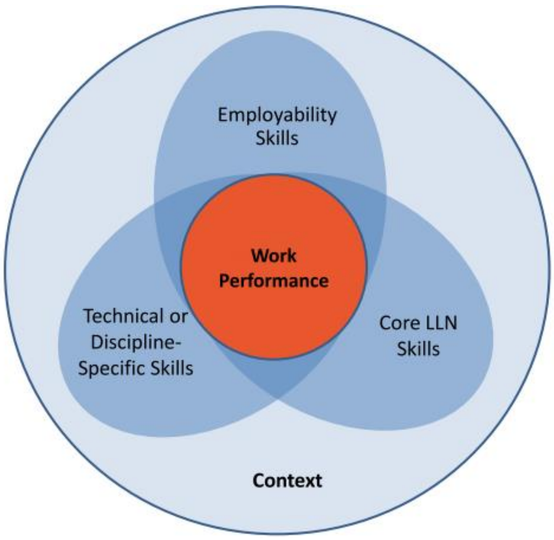


Figure 3 - Employability Skills in Context (DEEWR 2012)

Employability Skills are skills required not only to gain employment, but also to progress within an enterprise as to achieve one's potential and contribute successfully to enterprise strategic directions. Employability skills are also sometimes referred to as generic skills, capabilities or competencies. (Department of Education Science and Training 2006)

The DEEWR (2012) Employability Skills Framework Stage 1 Final Report identified employability skills as one of three inter-related skills that contribute to work performance (see Figure 3). Concerns were expressed by DEEWR that education and training institutions were not explicitly teaching and assessing employability skills due to the lack of clarification for each skill set. The framework provided in the report added clarity by identifying non-technical skills and knowledge that allowed employees to be successful. This included: being adaptable in applying their technical skills into new contexts, negotiating and resolving conflict, contributing and collaborating, and managing their own responsibilities when faced with challenges and competing priorities. DEEWR's intention in the framework was to create a link between the needs of the workforce and the learning products that are to be delivered in both secondary and tertiary education (DEEWR 2012), see Figure 4.

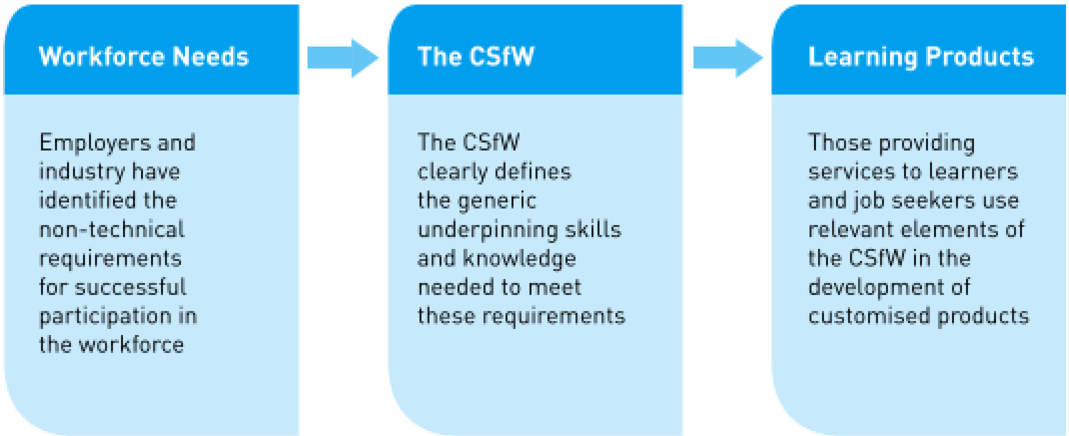


Figure 4 - The Link between Workforce Needs and Learning Products (DIICSRTE & DEEWR 2013)

The Employability Skills Framework Report (DEEWR 2012) has since helped develop the Core Skills for Work (CSfW) Developmental Framework. This framework aids educators and trainers who develop standards, curriculum, programs, and learning and assessment resources to clearly identify and emphasise the core skills that are required in the workforce. The information that underpins the framework was developed in consultation with employers to understand what skills and characteristics they valued and viewed as important in their employees (Hutchison 2013). A key piece of the framework is the CSfW's descriptor relevance to a range of contexts, which is unlike previous attempts to link Workforce Needs to Learning Products (DIICSRTE & DEEWR 2013). The link between the Skill Clusters, Skill Areas and their relevant Focus Areas is shown in Table 1. Skill Area descriptors are intended to be used by educators to shape learning activities. This is to provide students with an opportunity to build key Employability Skills that will be required of them in their early career employment as well as their future careers. These Employability Skills can be considered to be the required Standards of Performance that secondary education should be striving to meet.

Table 1 - CSfW Framework (DIICSRTE & DEEWR 2013)

	Skill Cluster	Skill Area	Focus Areas
Skill Cluster 1	Navigate the world of work	1a. Manage career and work life	Identify work options; Gain work; Develop relevant skills and knowledge
		1b. Work with roles, rights and protocols	Work with roles and responsibilities; Operate within legal rights and responsibilities; Recognise and respond to protocols
Skill Cluster 2	Interact with others	2a. Communicate for work	Respond to communication systems, practices and protocols; Speak and listen; Understand, interpret and act; Get the message across
		2b. Connect and work with others	Understand self; Build rapport; Cooperate and collaborate
		2c. Recognise and utilise diverse perspectives	Recognise different perspectives; Respond to and utilise diverse perspectives; Manage conflict
Skill Cluster 3	Get the work done	3a. Plan and organise	Plan and organise workload and commitments; Plan and implement tasks
		3b. Make decisions	Establish decision making scope; Apply decision making processes; Review impact
		3c. Identify and solve problems	problems; Apply problem-solving processes; Review outcomes
		3d. Create and innovate	Recognise opportunities to develop and apply new ideas; Generate ideas; Select ideas for implementation
		3e. Work in a digital world	Use digitally based technologies and systems; Connect with others; Access, organise, and present information; Manage risk
Influencing Factors		- Existing skills and knowledge - Familiarity with the context - Complexity of tasks - Nature and degree of support - Level of autonomy	- Degree of motivation - Self-belief and resilience - Cultural and value-based factors - External factors

2.4.2 Employability Skills in Mathematics

Mathematics is at the core of many career pathways, both in vocational and professional roles. Vocational careers in the building industry such as: electrician, plumber, builder, cabinet maker, brick layer, and landscaper all require mathematics as an essential prerequisite to the associated training and as a component of their everyday duties. Employees in these industries are required to possess proficient mathematical skills in topics like measurement, geometry, trigonometry, and financial interest. In many tertiary courses and professional pathways, mathematics is a core skill, especially in Engineering, Nursing, Medicine, Accountancy, Business Management, Economics, Statistics and Education. Not only is a high level of mathematics competency essential to complete the daily work duties required in these careers, but it is also a discerning factor in the recruitment process for graduates entering these industries (Durrani & Tariq 2012). Due to this outstanding requirement for mathematics across many career pathways, there is a large focus on developing mathematical skills throughout both secondary and tertiary studies. However, this focus may currently be misdirected.

The majority of the content that is covered in secondary mathematics courses is delivered in a highly theoretical format. Mathematics is often taught through similar styles of questioning in mostly familiar contexts, with very little opportunity for students to plan, organise, or problem solve. In addition to this, the work is generally delivered in a way that limits the student to only working through the problems autonomously rather than collaboratively. This method of teaching develops students to perform well on the similar styles of problems and contexts that are often present in standardised tests and exams. However, the students may struggle when presented with unfamiliar contexts, complex tasks, and collaborative work. This can be attributed to a potential lack of opportunity for students to develop the Employability Skills and General Capabilities within a mathematical context that are listed under each of the Skill Clusters (See Table 1) provided by the CSfW (DIICSRTE & DEEWR 2013). While the students' raw mathematical ability may be well developed, their ability to apply it in a real scenario is limited due to the types of tasks they have been previously presented and their lack of experience working in a collaborative environment. To overcome this shortfall, a higher focus on authentic assessment and learning activities is required in the mathematics classroom. This is in addition to providing students with opportunities to plan, organise and solve problems in a collaborative team. Authentic assessment and learning is defined by Avery (1999) as the "construction of knowledge through disciplined inquiry that has value beyond the classroom". Authentic learning provides students with an opportunity to apply employability skills, practicing the skill areas shown in the CSfW Developmental Framework (DEEWR 2012) (See Table 1).

The absence of contextualized, collaborative and authentic mathematical tasks in secondary education is at odds with the complex mathematics standards of performance required for successful employment and everyday life. In the latter years of secondary education, this mismatch also has the potential to disadvantage students preparing to enter the workforce or begin tertiary study. To assess this gap, the following research and evaluation of employability and learning skills in assessment will be limited to the context of Stage 1 Mathematics in the SACE Curriculum. Stage 1 of the SACE Curriculum is the second last year of secondary education, and can be considered as a critical point for students to develop the required employability skills and learner skills as they begin the final stage of their secondary education.

2.4.3 Fostering and Developing the Skills for Lifelong Learning

Traditionally, education has focused on transferring the foundational academic skills to students, such as basic reading and writing, numeracy, and scientific knowledge. These foundational academic skills have always been viewed as essential and the discriminators of lifelong success. This further perpetuates the notion that a highly academic individual will be successful in their career and make a positive contribution to society based on that factor alone. This concept is outdated and simply no longer applicable in the twenty-first century. Foundational academic skills are still important, but they do not alone determine success. For students to be prepared for a rapidly changing workplace and to make positive contributions to society, they must be able to work collaboratively, effectively communicate, problem solve, and hold a high level of social and emotional proficiency. The intention is not to substitute the teaching of foundational academics, but to supplement them with programs to develop the competencies and character qualities that are essential to being a lifelong learner (WEF 2016).

The World Economic Forum (WEF), in collaboration with The Boston Consulting Group, has published a report that identifies the skill gap that is becoming prevalent in the twenty-first century. The report also defines the sixteen crucial proficiencies that will be essential to help graduate students be prepared for the jobs of the future. In addition to this, these skills also provide them with the ability to prosper and thrive in their social and interpersonal interactions. This type of learning is referred to by WEF (2016) as social and emotional learning (SEL).

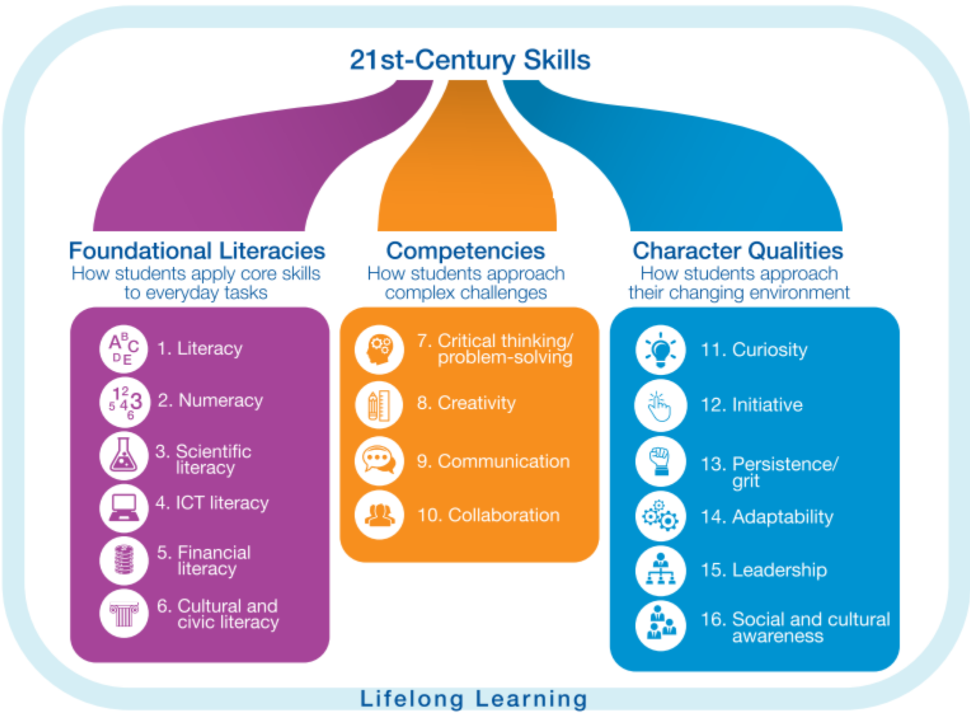


Figure 5 - 21st Century Skills as Developed by WEF (2016)

The sixteen 21^{st} Century Skills identified by WEF (2016) (See Figure 5) are separated into three groups: Foundational Literacies, Competencies and Character Qualities. These skills align very closely to the Employability Skills that are outlined in the CSfW Developmental Framework (DEEWR 2012), but are categorized into three different groups. The Foundational Literacies group summarises the core skills that students apply to their work and everyday tasks; these are very similar to the foundational academic skills that have been taught in education for the last few decades. The only difference is that they are no longer the primary component of education, but just a subset. The Competencies group are how student approach challenges and unfamiliar contexts. They are a culmination of the skills that allows students to process, apply and communicate information in a collaborative environment. These could also be viewed as team based and problem-solving skills. The Character Qualities group are connected closely with the student's personal development, how they react to their environments and their relationships with other people (WEF 2016). The Competencies and the Character Qualities skill groups are the primary components that are developed through social and emotional learning (SEL). SEL prepares students for a changing workplace and an evolving economy. However, it runs much deeper than just a student's professional success. There are many other consequential benefits that will be realized through SEL, individuals will be prepared to thrive and navigate society and the associated challenges that they will face daily. Due to this wide impact, SEL is intended to not only be implemented in primary and secondary curricula, but also used to help parents guide their children's development of social and emotional skills (WEF 2016).

Davidson (2013) projects that sixty-five percent of children entering primary school will work in jobs that do not exist today. This dramatic change from the current workplace will require a high level of adaptability, initiative, and social and emotional skills to navigate the new environment. Even for manual or administrative jobs there will be a higher requirement for digitization of common tasks and the ability to navigate nuanced communication (WEF 2016). This trend and evolution of the work place sets a new standard of performance for what is required to be successful. It is the overall responsibility of parents, guardians, and the education system to make sure that students are prepared to meet these standards.

2.5 Development of the Australian Curriculum

The Shape of the Australian Curriculum document (ACARA 2012c) was first approved by the Interim National Curriculum Board in May 2009. The document was produced by the Australian Curriculum and Assessment Authority (ACARA) under the guidance of the Melbourne Declaration on Educational Goals for Young Australians (Barr et al. 2008). Its intention was to create a standard Australian curriculum to improve the educational outcomes for all young Australians (ACARA 2012a). This document provided a guide for the development of an Australian Curriculum for English, mathematics, science and history. In the three years following the approval, The Shape of the Australian Curriculum underwent a process of amendments to reach the most recent version 4.0 that was approved by the ACARA Board in late 2012 (ACARA 2019a). With each amendment, the scope of the document was broadened to include additional year levels and provide support for developing curricula for students with disabilities. At Version 2.0, published in October 2010, The Shape of the Australian Curriculum was amended to support the implementation of Foundation to Year 10 Australian Curriculum and also give context for further stages of development to incorporate senior secondary year levels. By Version 4.0 the document was inclusive of Foundation to Year 12 curriculum for English, mathematics, science and history. In addition to this, it had also been modified to be suitable for the diverse range of students that are enrolled in Australian schools (ACARA 2012c).

The rationale that prompted the development of the curriculum was to bring Australia's education system into alignment with other first world nations, and also meet the needs of complex environmental, social, and economic pressures (ACARA 2012c). Many Asia-Pacific nations are growing at a faster rate than Australia, and at the time of the Australian Curriculum's conception, the Australian education system was falling behind the advancement of other Asia-Pacific nations. Globalisation and technological changes have altered the demands on education and skills required in the job market, and the Australian education system is required to be competitive and adaptable to these changes (ACARA 2012b). This focus within the Australian Curriculum reiterates the views of Reis and Durkin (2018) and Tapscott (1996); due to the changes in the job market and the requirements for employability skills, the education system must evolve.

Many of the educational goals outlined within the Australian Curriculum development process highlight the need for developing general capabilities. This includes employability skills that can be applied across a range of work environments and professions. The Australian Curriculum requires that students develop general capabilities that underpin their thinking and how they operate across a multitude of challenges. This is to develop a capacity to be flexible, analytical, and easily move between disciplines to develop new skills and expertise (ACARA 2012a). These targets anticipate the non-technical requirements that were outlined by the Core Skills for Work (CSfW) Developmental Framework (DIICSRTE & DEEWR 2013), which as discussed previously, identified the key employability skills that the Australian education system should strive to teach. Reviewing this link from the perspective of the Curriculum-Evaluation Diamond (Mohandas, Wei & Keeves 2003), it can be seen that the Curriculum Objectives outlined in the Australian Curriculum are driven by the needs of the workforce. These objectives also align with the standards of performance that have been outlined in the CSfW Developmental Framework (DIICSRTE & DEEWR 2013).

2.6 Australian Curriculum – General Capabilities and the CSFW Framework

The Australian Curriculum includes seven General Capabilities: Literacy, Numeracy, Information and Communication Technology Capability, Critical and Creative Thinking, Personal and Social Capability, Ethical Understanding, and Intercultural Understanding. Each of these capabilities have been selected to help equip Australian students to meet the requirements of workplace performance when they conclude their secondary education (ACARA 2019b). These capabilities are primarily discussed and outlined in the Foundation to Year 10 curriculum, with only essential references to the capabilities in the Senior Secondary Australian Curriculum (ACARA 2019d). The capabilities for senior secondary are discussed in more detail, with specific reference to learning outcomes in the state-based curricula for senior secondary education, such as the South Australian Certificate of Education (SACE) curriculum. The Foundation to Year 10 General Capabilities and their relevance to the Core Skills for Work Developmental Framework is outlined in the following sections.

2.6.1 General Capabilities - Literacy

The Literacy General Capability can be simplistically split into two individual processes. Comprehending texts through listening, reading, and viewing, and composing texts through speaking writing and creating (ACARA 2019c). The essence of this capability is to provide students with a way to decipher, process, and share the information that is presented to them. In mathematics, this can be seen as the ability to communicate mathematical reasoning within a variety of contexts, including equations, tables, graphs, and symbols (SACE 2019c). This capability aligns with Skill Area 2A - Communicate for Work, from the CSfW Framework (DIICSRTE & DEEWR 2013). This skill area identifies the necessity for high performance employees to be able to recognise communication protocols and etiquette, and also communicate across a number of modes, systems and processes.

2.6.2 General Capabilities – Numeracy

The Numeracy General Capability aims to build a student's ability to develop and apply knowledge and skills to use mathematics across their schooling, everyday life, and into their future careers. This capability is intended to not just to be focused on in the mathematics classroom, but rather applied across all curriculum areas in a wide range of contexts (ACARA 2019c). Numeracy skills are recognised as a key factor in workplace performance, they are covered by both the Core LLN and Employability Skills in the CSfW framework (DIICSRTE & DEEWR 2013). This is due to numeracy skills being transferable to a wide range of contexts, including both technical processes and also everyday life.

2.6.3 General Capabilities – Information and Communication Technology (ICT)

The ICT Capability underpins what the CSfW refers to as *Working in a Digital World* (DIICSRTE & DEEWR 2013). It aims to develop a student's ability to use ICT to access, create, communicate information and ideas, solve problems and work collaboratively in a range of curriculum areas (ACARA 2019c). The CSfW has a higher focus on communication as a component of this skill area, referring to the capacity for an individual to connect with other people, share information, and navigate the emerging risks and etiquettes that are associated with using ICT. Skill areas other than communication are also recognised by the CSfW. It identifies an expert performer in the digital world as someone who can "*Uses a broad range of strategies to store, access and organise virtual information, recognising that design choices will influence what information is retrieved, and how it may be interpreted and used… "* (DIICSRTE & DEEWR 2013).

2.6.4 General Capabilities – Critical and Creative Thinking

Due to the complex working environments in which students will be required to work during their careers, they must be prepared to innovate and be adaptable to unfamiliar situations. This may require them to be creative and solve problems with a broad range of information inputs and outputs. Because of this, the fourth General Capability is Critical and Creative Thinking. This capability encourages students to collect, analyse, and synthesise information to generate new ideas and possibilities (ACARA 2019c). Each of these skills is highly valued under the *Create and Innovate* CSfW skill area, which highlights the importance for students to explore and develop lateral thinking techniques. Additional to this, high work performers are also expected to facilitate an environment and a climate which fosters and facilitates creativity and innovation, emphasising the importance of accepting the need for change and responsiveness (DIICSRTE & DEEWR 2013).

2.6.5 Personal and Social Capability, Ethical Understanding, and Intercultural Understanding

A study by Troth et al. (2012) has explored the relationship between emotional and communicational skills, and how it affects individual and team's on-task performance. This study was prompted by the increase in team-based structures in organisations and the growing need for improving the performance of those teams (Hecht & Natalie 2004). Emotional skills were differentiated into four skill groups: individual awareness of own emotions, awareness of others' emotions, managing own emotions, and managing others' emotions. All participants in the study were ranked against each of these skill groups so that their impact on the team's performance could be measured. The results of the study suggested that higher team-level emotional skills generally improve the team's communication and task performance (Troth et al. 2012). This supports the importance of the Personal and Social General Capability, highlighting the industry-based requirement for productive teams that can pool a broad range of emotional skills.

The Australian Curriculum specifically stresses the importance of developing students' ability to regulate their emotions, and make responsible decisions while working cohesively and effectively in teams (ACARA 2019c). Closely linked to this capability is the *Communicate for Work* and *Connect and Work With Others* skill areas outlined in the CSfW Developmental Framework (DIICSRTE & DEEWR 2013). This skill area highlights the importance of building rapport with others, by having a strong self-awareness and understanding your own abilities, values, expectations, emotions, and behavior. This includes also identifying and appropriately responding to the social rules of the context of work, and communicating with others with the required etiquette and protocols (DIICSRTE & DEEWR 2013). This Skill Area from the CSfW also links closely to the remaining two General Capabilities; Ethical Understanding and Intercultural Understanding.

Ethical and Intercultural Understanding cover the social and moral responsibilities that students must meet, ensuring that they are aware of the influence that their values, behavior and actions have on others. They must also be mindful of other cultures, languages and beliefs. A component of these capabilities is related to students developing an ability to inquire, find meanings, collect proof, and show evidence when faced with ethical issues. The intention is for the students to be accountable for their understanding of key issues that are present in our democratic community (ACARA 2019c).

2.6.6 Overview of the General Capabilities and the CSfW Developmental Framework

There is no mandate for the CSfW to be implemented and referred to in the development of the Australian Curriculum, as it is to be used as an additional resource to develop tools and material in education (Hutchison 2013). However, as shown in the previous section, there are strong links between this framework and many of the General Capabilities specified in the Australian Curriculum. This reaffirms that there is a connection between the two frameworks, both striving to help students and workers meet the Standards of Performance that are required to be successful in the contemporary workplace environment (Mohandas, Wei & Keeves 2003).

2.7 SACE Curriculum Objectives

Within Australia, each state and territory education department publish and manage their own curriculum and subject outlines. Each state and territory are also responsible for determining how the Australian Curriculum content and achievements standards are incorporated into their curriculum. This ensures that all knowledge, understanding, and skills are to be taught and learned at the specified achievements standards outlined by the Australian Curriculum. As of 2019, there are fifteen senior secondary subjects across English, mathematics, science, history, and geography endorsed and approved by the Australian Curriculum as a starting point to develop state and territory specific courses (ACARA 2019e). For example, the 2019 Subject Outline for Stage 1 Mathematics in Australia is published and distributed by the South Australian Certificate of Education (SACE) to facilitate the consistent and reliable approach to teaching mathematics in South Australia (SACE 2019c). This document is intended to prepare students not only for future study, but also for the requirements of the contemporary workforce.

Consistent with the Australian Curriculum, the aforementioned SACE Subject Outline references the same seven General Capabilities. This outline also shows some correlation and evidence of consultation with the CSfW framework. Many of the target capabilities for students overlap the Skill Areas and Focus Areas presented in Table 1, derived from the CSfW framework (DIICSRTE & DEEWR 2013). Of particular interest is the Subject Outline's relevance to the Skill Cluster 3, "Get the Work Done", Table 1 - CSfW Framework (DIICSRTE & DEEWR 2013). This Skill Cluster places particular focus on how students process the information they are presented and how they use it to create, innovate, make decisions, and problem-solve in a digital world. These skill areas show a common theme, how well does the student process information? This theme is repeated in the Stage 1 Mathematics Subject Outline (SACE 2019c), particularly under the Critical and Creative Thinking capability. The subject guide intends to promote the student's ability to apply knowledge, problem-solve, develop critical reasoning skills, and make connections between a wide range of concepts and sets of information.

2.8 Overview of the Curriculum Objectives

The extensive research by both DIICSRTE and DEEWR (2013) and DEEWR (2012) has indicated that Employability Skills are key dictators of work performance and should be developed through both secondary and tertiary education. This is in line with the SACE (2016) Strategic Plan for 2016-2020, which states that one of the key deliverables for SACE curriculum is supporting subjects that "Develop general capabilities that empower young people to be successful in their chosen pathways". These General Capabilities, also referred to as 'Employability Skills' (Bunney, Sharplin & Howitt 2014), are outlined in the Australian Curriculum. The report published by ACARA (2012b), The Shape of the Australian Curriculum Version 3.0 closely links back to the views of Tapscott (1996), knowledge will be a key commodity in the twenty-first century workplace. Because of this, schools must develop and provide a strong foundation of learning that allows students to develop a set of general skills, behavior, and dispositions that are applicable across a wide range of subjects and contexts. This focus within the ACARA General Capabilities (ACARA 2012b) and the SACE Strategic Plan (SACE 2016) highlights that there is a strong correlation between the standards of performance that are outlined in the CSfW (DEEWR 2012), the 21st Century Learner Skills (WEF 2016), and the current Curriculum Objectives. However, the curriculum objectives alone do not determine the focus of the learning and assessment in the classroom. The focus is predominantly provided by the SACE Performance Standards. These standards guide the development of assessment and measurement of student performance.

2.9 SACE Performance Standards for Assessment

Each SACE Stage 1 and Stage 2 Subject Outline has a tailored set of SACE Performance Standards. These are used to describe the five levels of achievement against which students can be graded (SACE 2019c). For Stage 1, the five levels of grading are between A and E. Each grade cannot be weighted with a 'plus' or 'minus' suffix to indicate when a student's achievement sits above or below the grade band (e.g. B-, B+). However, this changes for Stage 2 subjects with students eligible for 'plus' and 'minus' grades, opening up the grading to fifteen levels of achievement. To ensure assessment integrity and allow for benchmarking of SACE accredited subjects, there are a range of resources to assist schools and teachers to plan, deliver, and assess each subject. In addition to this, the SACE Board is also responsible for the moderation of school assessment. The board reviews the effectiveness of school assessment processes and feedback information, with the intention to monitor, review and improve assessment. In many cases, this includes ensuring that each set of SACE Performance Standards are applied fairly to the relevant assessment tasks (SACE 2018).

Referring back to the Curriculum Evaluation Diamond proposed by Mohandas, Wei and Keeves (2003) (See Figure 2), the Curriculum Objectives must drive Student Assessment, which in turn links back to the Standards of Performance. In the context of SACE, the SACE Subject Outline and the Australian Curriculum must drive the development of Student Assessment. If students are not assessed in relation to the curriculum objectives, in this case the General Capabilities, then the teaching and learning will not be focused on developing these capabilities.

2.10 Relevance of Assessment – Accountability

Assessment is a valuable tool. It provides information related to student learning that can be used as an accountability mechanism for government, schools, teachers, parents, universities, and students. The accountability process ensures that schools are justifying the expenditure of the public, through both taxation and school fees. Additionally, it allows stakeholders to assess if the educational outcomes for students are aligned with the agreed needs of the economy, society, and also the workforce (Brady 2012). When related to the Curriculum Evaluation Diamond model (Mohandas, Wei & Keeves 2003), accountability can be seen as the conduit that ensures each facet in the relationship is connected and meeting the requirements and needs of its interdependencies. For example, assessment can be used to measure that the objectives set by the curriculum, and also by the Standards of Performance demanded by the economy and industry, are being satisfactorily met through the learning activities students are presented. For this to occur, education assessment, and its relevant achievement standards, must first be aligned with these objectives and Standards of Performance. If these General Capabilities, Employability Skills, and other highly valued work performance factors are not measured, then no accountability or conclusions can be made. Additionally, if a particular topic is not assessed then there is the potential that it will not be promoted or focused on in the previous learning.

2.11 Student Views on Assessment

Assessment is a key tool used for accountability, however if it is not directed appropriately it can lead to a disillusion amongst students, teachers, parents, and school authorities. Joughin (2009) explores this concern further, unpacking the relationship between assessment and the impact on student perception and focus. He believes that students and teachers will both only focus and promote what they know is to be assessed. Students in particular will adapt their approaches to learning to meet assessment requirements and the standards against which they are to be graded. If the assessment and the associated grading standards are not aligned with the curriculum objectives, then these curriculum objectives will not be at the center of students' learning focus. Ramsden (2002) reaffirms this view, proposing that "from our students' point of view, assessment always defines the actual curriculum". In other words, the culmination of all student work and focus throughout the year is aimed towards the assessment regardless what is stipulated in the curriculum. In addition to this flaw, if students are to only focus on learning what is to be assessed, or to learn an expected series of answers and responses, then they also risk only achieving a surface approach to learning. A surface approach refers to students deliberately only learning what is needed of them to meet the required achievement standards, rather than taking a deeper approach to learning that leads to them truly understanding a topic, related skills, and thinking processes (Joughin 2009). For this reason, it is important to ensure that assessment is engaging and leads to learning that benefits students in their development as learners. Assessment can be used to shape future complex learning and informs future teaching practice. This occurs if the assessment task also functions as an opportunity for students to learn. This is referred to as Assessment for Learning.

2.11.1 Assessment Approaches – Assessment of Learning

Assessment can be broken into three distinct categories, each with their own objectives and outcomes. These are: Assessment of Learning, Assessment as Learning, and Assessment for Learning. The three key discriminating factors being 'of', 'as', and 'for'. The type of assessment most people will be familiar with, even if they are unfamiliar with the terminology, is Assessment of Learning. During Assessment of Learning, the sole focus is to measure what students have learned against outcomes and standards (Education Standards Authority 2019). The most common application of this assessment type is during exams, standardised testing such as NAPLAN, and other assessments that occur at predefined times. Assessment of Learning is generally associated with ensuring accountability, to inform schools, parents, students and government stakeholders of student performance. This form of assessment has limited expectations of students learning from the assessment or shaping their future learning from the experience; however, it does not mean that the results cannot be used to inform future teaching practices (Brady 2012).

2.11.2 Assessment Approaches – Assessment for Learning

Assessment for Learning can simply be described as a process of assessment that helps students to learn better, as opposed to helping them achieve a better mark (Education Standards Authority 2019). This approach helps students improve, by setting clear goals for the learning activity and providing opportunities for students to develop a deeper understanding of the content of the assessment. In addition to this, Assessment for Learning promotes an approach that encourages and fosters students to view learning as a lifelong commitment – by learning through the tests, trials, and challenges with which they are presented. This does not discredit the approach of Assessment of Learning. However, it needs to be considered that for students to continue to develop the General Capabilities (ACARA 2019c) and employability skills, there needs to be opportunities for students to show evidence of those skills. There must also be a consistent and reliable way to measure their proficiency in these skills with the aim of aiding future improvement and assessment. While it may be possible for students to show evidence of their proficiency against the General Capabilities in a structured or timed assessment task, such as a test or exam, this may not be the most effective medium to demonstrate employability skills.

The General Capabilities are linked to Employability Skills, but can be seen as a foundational understanding rather than a mirrored replication. The focus areas outlined in Table 1 - CSfW Framework (DIICSRTE & DEEWR 2013) are highly collaborative and require students to be flexible, creative, and learn to process information to solve unique and unfamiliar problems. This poses concerns for consistency within the context of

Assessment of Learning. The individual proficiency of each student to demonstrate employability skills may directly increase or decrease the performance of the team. This in turn may falsely lift or drop the apparent performance of other members of the team. This factor may complicate the process of focusing and controlling the assessment to gain an accurate measurement of an individual student's ability during an Assessment of Learning. Therefore, in the context of General Capabilities and Employability Skills, there may be merit in primarily assessing these skills with a focus on Assessment for Learning. This would mean that the goal would be to move away from purely just measuring a student's ability, but rather to help the student to set goals, promote deeper understanding, and encourage a self-reflective and rich experience during the assessment.

3 METHODOLOGY

3.1 INTRODUCTION

To meet the needs of the contemporary knowledge economy (Tapscott 1996), students need to be equipped with a set of skills that will allow them to be successful in a fast moving, constantly changing, and diverse work environment. Historically the preparation of students for the workforce involved equipping them with occupation-specific skills and qualifications that allowed them to be successful in a defined and narrow field. However, the modern employee will no longer be able to rely solely on a single trade, professional qualification, or traineeship to be adequate to meet the needs of the economy. No matter their chosen pathway, many employees will be required to reskill and change career focus many times throughout their working life (Reis & Durkin 2018). This may make many of their technical or discipline-specific skills redundant through each job change. In addition to this, many job roles require employees to process, decipher and apply vast amounts of knowledge. These two key changes highlight the importance of Employability Skills that are transferable and generic across many professional and vocational pathways. These can be referred to as the standards of performance required by the modern economy.

The Curriculum-Evaluation Diamond developed by Mohandas, Wei and Keeves (2003) represents how these aforementioned Standards of Performance are linked with the educational system and how its associated curricula and assessments should be developed. The Core Skills for Work (CSfW) Developmental Framework (DIICSRTE & DEEWR 2013) outlines the employability skills that are valued and requested by the external stakeholders of education, including the workforce, tertiary education and volunteer organisations. These Standards of Performance stipulated by the external stakeholders of education should drive the development of Curriculum Objectives, and indirectly Student Assessment within the education system. If Employability Skills are promoted and assessed by the Australian Curriculum, individual state and territory curriculums, young Australians can be provided with the necessary skill set that allows them to be successful within the modern knowledge economy.

3.2 METHODOLOGY FRAMEWORK

As per the guidance provided by Neuman (2014), the following research was carried out using qualitative methods due to the complexity and nature of the data that was analysed. There is no statistical relationship between the curriculum objectives, the standards of performance, and the school-based assessments. The data is not related to an experiment, nor does it have a cause-and-effect relationship. In addition to this, the study is limited to a specific context, the SACE Stage 1 Mathematics Curriculum, with links to the Australian Curriculum and the Standards of Performance outlined by the CSfW Developmental Framework (DIICSRTE & DEEWR 2013). The outcomes of this study cannot be generalised outside of this scope, and will not be considered as entirely transferable to other curricula and areas of assessment. However, the conclusions and insights of this study provide an informative baseline to alter the way that twenty-first century learner and employability skills are taught for secondary mathematics in both the SACE and the Australian Curriculum.

There are no active participants or student data analysed in this research, thus limiting the ethical responsibilities. This is discussed further under the Ethical Considerations of this chapter. Student data was not collected due to the timing constraints and the complications for ethical approval. Therefore, quantitative data will not be made available to assess student performance when incorporating employability skill assessments in the curriculum. All data will be obtained from publicly available documents and school-based assessments that have been provided by a partnering secondary school.

3.3 Data Collection

The three elements of the Curriculum-Evaluation Diamond (Mohandas, Wei & Keeves 2003) that are explored in relation to employability and learning skills in education are the Standards of Performance, Curriculum Objectives, and Student Assessment. These three elements have been highlighted in the below diagram (See Figure 6) to show their relationship in the model. For each of these elements, a relevant set of publications and documents have been selected that are appropriate to the context of the research. These sets of publications and documents formed the data that the qualitative analysis was primarily based on. Where the data is publicly available, full credit and recognition is given to the author and source. However, for data obtained from private sources, the author and associated organisation has been kept anonymous due to the information not being publicly available. This private data includes any information or documents that are obtained from an educational institution. An overview of the data sources and their relationship to the research is outlined in the following sections.

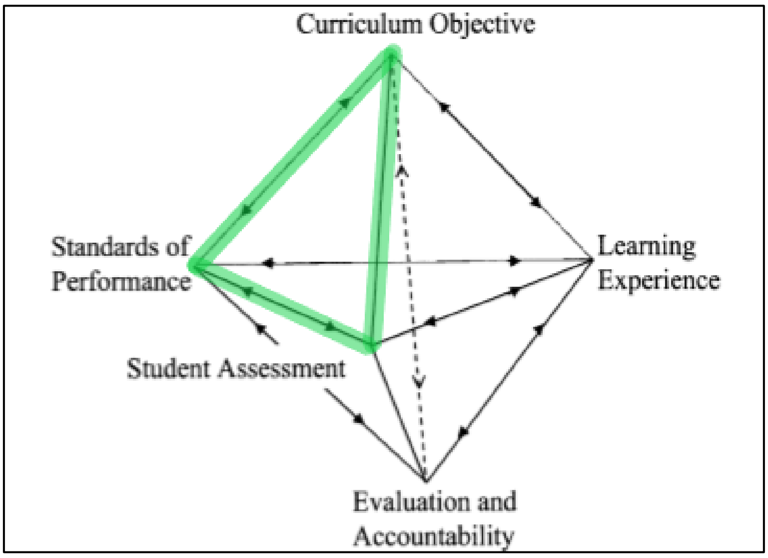


Figure 6 - The Curriculum Evaluation Diamond (Highlighted) (Mohandas, Wei & Keeves 2003)

3.3.1 Data Collection - Standards of Performance

The Standards of Performance were selected from both national and an international source; this provides a global perspective of the learning and employment requirements of the twenty-first century. The nationally recognised Standards of Performance for employability skills is the Core Skills for Work (CSfW) Developmental Framework produced by DIICSRTE and DEEWR (2013). This framework defines a list of the employability skills required by the Australian industry to meet the expectations of workplace performance. There are three skill clusters that form the CSfW framework, these are broken down further into ten skill areas (See Table 1). The CSfW framework document was reviewed to ascertain the relationship between the industry standards of performance, curriculum objectives, and student assessments that are delivered in the secondary education system. Similarly, the report published by The World Economic Forum in collaboration with The Boston Consulting Group (2016) identifies the sixteen crucial proficiencies and skills (See Figure 5) that will be essential to develop learning skills in the twenty-first century (WEF 2016). This report forms the international component of the standards of performance in the Curriculum Diamond Model. This complemented the CSfW Developmental Framework (DIICSRTE & DEEWR 2013) to ensure that the Standards of Performance are reviewed from a global perspective. Both of these reports are publicly available and form the initial component of the data collection.

3.3.2 Data Collection – Curriculum Objectives

The second link in the Curriculum-Evaluation Diamond Model (Mohandas, Wei & Keeves 2003) is the Curriculum Objectives. These should be aligned with the employability and learner skills that are recognised as the Standards of Performance for the twenty-first century. Given the locality of the University of Adelaide, the chosen context is the Australian Education System, specifically the South Australian Certificate of Education (SACE). All Australian curricula, including the SACE, must be produced in conjunction with the Australian Curriculum outline that is developed by the Australian Curriculum, Assessment and Reporting Authority (ACARA). ACARA is an independent statutory authority which has been mandated by the Australian Government to produce a unified curriculum and objectives for all Australian students, from the foundational to the senior years of their education. For this research, only the first level of the senior secondary component of education was evaluated. This point in a student's education is at a critical time. It is generally where they are beginning to prepare to start tertiary study or enter the workforce in either a part-time or full-time capacity. Specifically of interest is the General Capabilities that are a component of the Australian Curriculum. These General Capabilities are outlined in detail on the Australian Curriculum Introduction web page published by ACARA (2019c). This information formed the primary document for analysis of each of the capabilities, which are summarised in detail in the Results section of this document.

As of 2019, there are fifteen senior secondary subjects across English, mathematics, science, history and geography endorsed and approved by the Australian Curriculum as a starting point to develop state and territory specific courses (ACARA 2019e). Under the guidance of the Australian Curriculum the South

Australian Certificate of Education has developed subject outlines for Stage 1 Mathematics (SACE 2019c) and Stage 2 General Mathematics (SACE 2019b). These two documents are aligned with the Australian Curriculum, both referencing Capabilities that mimic the General Capabilities published by ACARA (2019c). To ensure that there is consistency between ACARA and SACE Capabilities, both these sets of documents were included in the data collection and reviewed accordingly.

3.3.3 Data Collection – Performance Standards for Student Assessment

The Australian Curriculum provides guidance on the objectives that should be included in the SACE curriculum. However, the SACE produces its own set of Performance Standards that are used to measure student outcomes against the objectives specified in the subject outline. The SACE Performance Standards include five levels of achievement against which students can be graded (SACE 2019c). For Stage 1, the five levels of grading are between A and E. Each grade cannot be weighted with a 'plus' or 'minus' suffix (e.g. B-, B+) to indicate when a student's achievement sits above or below the grade band. To review the alignment between the SACE Curriculum Objectives, the General Capabilities and the SACE Performance Standards, a copy of the Performance Standards and the grade level descriptors was adapted. This was obtained from the Stage 1 Mathematics Subject Outline (SACE 2019c) and the Stage 1 General Mathematics Subject Outline (SACE 2019b). The Stage 1 Essential Mathematics Subject Outline (SACE 2019a) was omitted from the data set as it closely replicates the other two subjects at Stage 1. An example of both documents can be viewed in the Appendices in Table 19 and Table 20. The descriptors for grades lower than a D-Grade were omitted from the adapted SACE Performance Standards. Only the A-Grade descriptors were to be reviewed against the Curriculum Objectives and General Capabilities. A sample of the other grade descriptors were included to show how the descriptors are scaffolded to accurately capture student performance. Given that the intention is for students to strive for the top-grade descriptor as a target, only the A-Grade descriptor was reviewed to determine its alignment with the General Capabilities and Curriculum Objectives.

3.3.4 Data Collection – School Based Student Assessments

The final data set that was reviewed was the school-based assessments for Stage 1 Mathematics (Maths Methods) and General Mathematics. This is the most critical piece of the data collection as theoretically the school-based assessment should be the culmination of the Australian Curriculum and the SACE Curriculum. These documents closely link to the capabilities that are referenced in both curriculums. The assessment documents were provided by a co-educational secondary school located in Adelaide, South Australia. This sample set was not intended to be reflective of the assessments that are provided by all SACE Stage 1 Mathematic courses. However, the same set of Performance Standards are applicable to all SACE Stage 1 Mathematic courses regardless of the school. Therefore, it can be assumed that all students are being measured against the SACE curriculum, and thus the General Capabilities in a similar way.

The assessment data that was provided was limited to specific topics within the chosen subjects. For General Mathematics, only two topics were chosen to review assessments from. These were Measurement and Applications of Trigonometry. For Mathematics (also referred to as Mathematical Methods), three topics were chosen to review assessments from. These were Trigonometry, Geometry and Introduction to Differential Calculus. These topics were chosen due to their applicability to many career pathways and general life skills. This increased their potential for relevance to the Core Skills for Work Developmental Framework (DIICSRTE & DEEWR 2013) and the 21st Century Learning Skills (WEF 2016).

3.4 Ethical Considerations

All facets of the following research practices and activities were evaluated. This was to ensure that they were compliant with the ethical obligations of those conducting the research and the policies of the educational institution the research is conducted on behalf of. This includes respecting the policies and obligations of any associated partners. In addition to this, education research has an overarching human factor that must also be considered. Due to the centrality of children in the process of secondary education, the moral and legal obligations of conducting research in this environment must be carefully considered. This is to ensure that the privacy and wellbeing of students is maintained throughout all data collection processes and other research activities.

This research is conducted over a three-month period due to the constraints of the course. Therefore, there are intrinsic limitations that reduce the scope for data collection and the research activities that can be successfully completed within the allotted time frame. Ethical approval for primary data collection, such as classroom results or observations of students, must first be approved by the Human Research Ethics Committee of the University of Adelaide. This process ensures that all data collection methods and research practices in the study are compliant with the ethical obligations of the university and are morally justified. Given the timeline of the Master of Teaching Dissertation, this approval process would have exceeded the available time permitted by the course. Therefore, alternative data collection methods and research practices were explored. This omitted the collection of primary data from the partnering secondary school. To ensure ethics approval was not required, no student information or results were collected during this study. Additionally, the partnering secondary school has been deidentified from the provided data and the authors' names removed from all of the student assessment documents.

As noted by Mertens (2014), qualitative researchers must be cognisant of the possible uses of their research and the implications of their opinions and critical analysis of common practice. This is particularly important when the observations and conclusions call for social or organisational change. Because of this, it must be noted that the research practices and observations that are made in the course of this research are in relation to a specific context and subject area. This research is conducted as a review of the Australian Curriculum, but more precisely the South Australian Certificate of Education Stage 1 Mathematics curricula. Furthermore, the assessment examples that were obtained in the data collection process are only taken from one school within the region of Adelaide, South Australia. This limits the research to a very defined context, and therefore the applicability of the conclusions may not extend past the boundaries of this subject and the curricula that it is aligned with.

3.5 Part 1 – Analysing the SACE Performance Standards

The Australian Curriculum promotes seven General Capabilities that bare many similarities to the Employability Skills that the CSfW stipulates. These same General Capabilities are then also replicated in the SACE Curriculum Subject Outlines for Stage 1 Mathematics and Stage 1 General Mathematics. However, for these capabilities and employability skills to be promoted and focused on in the classroom, they must also be assessed. As it stands, neither the Australian Curriculum nor the SACE Subject Outlines provide guidance on how the general capabilities and employability skills are to be assessed and graded. Currently all SACE Stage 1 and Stage 2 assessments are to be marked against the Performance Standards that are provided in each course subject outline. Using qualitative data analysis methods, the first part of the study examines the language, wording and intention of the Performance Standards for SACE Stage 1 General Mathematics and SACE Stage 1 Mathematics (Mathematical Methods). The intention in this analysis was to ascertain to what degree each of the Australian Curriculum General Capabilities and CSfW Employability Skills are aligned to the Performance Standard's grade level descriptors. Then to identify the extent the descriptor capture students' competency against these standards. The grade descriptors from B to E for each of the Performance Standards are variations of the A grade level descriptors, with the wording reflecting the students' varying levels of competency against the standard. Because of this, only the A grade level descriptor was assessed from each of the SACE Performance Standards to avoid repetition. The Performance Standards for both General Mathematics and Mathematical Methods are identical, other than the final descriptor of the Reasoning and Communication component of the table. Merging the tables to form a single set of SACE Performance Standards that covers both subjects avoids repetition in the analysis of the SACE Subject Outlines for Stage 1 Mathematics.

3.5.1 Analysing the SACE Performance Standards - Definitions

To guide the analysis of each grade descriptor under the two chosen SACE Performance Standards, Table 2 was developed to provide definitions of the wording used to describe the relationship and linkage between the descriptors, the Australian Curriculum General Capabilities, and the CSfW Employability Skills. The key discriminator between each phrase, and how it relates to the relationship between the documents, is the similarity of wording between the three pieces of information being analysed, as well as the intention and basic meaning that is conveyed in the text. These phrases were included in the thematic analysis of the SACE Performance Standards.

Table 2 – Definitions – Analysing the SACE Performance Standards

Phrase	*Definition*
Directly Linked	For there to be a direct link between the skill/capability and the SACE Performance Standard grade descriptor, the descriptor must reference the same wording and/or phrases as the CSfW Employability Skills and Australian Curriculum General Capabilities. The descriptions for each Employability Skill will be taken from the Skill/Focus Areas described in Table 1 and also in the Core Skills for Work Developmental Framework (DIICSRTE & DEEWR 2013). The General Capability descriptions will be taken from the Stage 1 Mathematics Subject Outline (SACE 2019c) which is produced in alignment with the Australian Curriculum.
Moderately Linked	Moderate links between the skill/capability and the SACE Performance Standard grade descriptors will be distinguishable by the use of some similar phrases and wording, and the link may be not strongly promoted.
Attempted Links	The skill/capability descriptions and the SACE Performance Standard grade descriptors may not share any similar phrases and wording; however, the intent of the descriptor captures the basic meaning of the skill/capability.
No Links	The SACE Performance Standard grade descriptor are not linked directly or indirectly to the skill/capability descriptions. There are no similar wording, phrases or intent in the meaning of the text.

3.5.2 Thematic Colour Coding

To provide a visual aid to see the relationship between the Performance Standards grade descriptors and the skills/capabilities, the text of the Performance Standards was first analysed using thematic coding. Thematic Colour Coding is used to identify themes, classifications and similar sections of text using a predefine colour code system (Gibbs 2007). The colour coding system allows any correlation between the documents to be identified easily, with each skill and capability being represented by a unique colour. This colour is then applied to any section of text or specific wording that correlates to the chosen skill or capability. This process assisted with building the framework for the thematic analysis of the documents.

3.6 Part 2 – Analysing School Based Assessments Against the General Capabilities

Individual schools in the South Australian Certificate of Education system are required to develop and administer assessments that are in line with the SACE subject outlines provided for each subject. The SACE Stage 1 Mathematics Subject Outline specifies that students must demonstrate their learning in a 20-credit subject. This is achieved by completing at least four skill and applications tasks (SATs) and at least two mathematical investigations (SACE 2019c). The Assessment Design Criteria for both these assessment types does not specify that students must demonstrate evidence of learning or development in relation to the Australian Curriculum and the SACE General Capabilities. However, individual schools may choose to design their assessments to incorporate features that provide students the opportunity to demonstrate the relevant skills against the General Capabilities. For this reason, it is important to review school-based assessments to further explore how they are constructed and the skills that are being assessed.

The school-based assessments, provided by the partnering secondary school, were analysed at a high level to discern the intended objectives and skill areas that were assessed by the task. Brady (2012) has outlined many of the common strategies for assessing student achievement in the classroom. This provides insight into the nature of each assessment type, as well as explaining the benefits, limitations and guidelines for implementation. This resource was used to analyse the school-based assessment to ascertain its suitability for developing employability and learner skills, specifically the General Capabilities.

A brief thematic analysis of each document was completed. During this analysis, the assessment was compared against the General Capabilities at an individual task and question level. This provided a more thorough review of the assessment. Table 21 in Appendix B of this document includes an adapted version of the General Capabilities compiled from ACARA (2019c). This table was the primary document used for the thematic analysis of the school-based assessments. In addition to analysing links between the school-based assessment documents and the General Capabilities, the function of the document was also explored by the analysis. In line with the work of Coffey (2014), it was important to understand the author's original intention of the document, and how it is to be read, understood and used. This is important as the intended audience, context, and function of the document all alter its content and the way that it is constructed. By understanding the above, an educated analysis can be conducted on the document to justify either an alignment or misalignment with the General Capabilities.

3.7 Research Limitations - Issues of Validity, Credibility and Transferability

This research is conducted over a three-month period due to the constraints of the course. Therefore, there are intrinsic limitations that reduce the scope for data collection. This restricted the collection of assessment data from multiple schools, relying on only a single data set from one educational context. While this does affect the transferability and credibility of the observations made from this assessment data, the limited data set can still provide an insight into how common mathematics assessment types develop and measure the General Capabilities.

The analysis of the SACE Performance Standards against the General Capabilities was restricted to only standards from the SACE Stage 1 General and Mathematical Methods curriculum. The observations made during this analysis are transferable within this context, but they may not be applicable to other year levels and courses.

4 RESULTS – DOCUMENT ANALYSIS

The review of the ACARA General Capabilities (ACARA 2019c) against the Core Skills for Work Developmental Framework (DIICSRTE & DEEWR 2013) is provided in Section 2.6 (Australian Curriculum – General Capabilities and the CSFW Framework) of this document. In this section, the analysis of the two frameworks showed that they were closely aligned. The key skill areas of the CSfW were represented by one or many of the General Capabilities. The Numeracy Capability sits slightly outside the scope of the CSfW Developmental Framework, as these skills are covered by Core Language, Literacy and Numeracy Skills (LLN Skills) (DEEWR 2012). These skills make up one of the three key components that contribute to work performance. However, to not extend the scope of this research to include LLN Skills, the Numeracy General Capability will be considered to be a part of Skill Cluster 3 of the CSfW Developmental Framework, specifically Skill Area 3c "Identify and Solve Problems" (See Table 1). This decision was made due to mathematics and numeracy being key skill areas in many problem-solving processes.

In addition to the CSfW Employability Skills, the 21st Learner Skills outlined by the World Economic Forum also align with the ACARA General Capabilities (See Figure 5 and Table 1). The CSfW Employability Skills and the WEF 21st Century Learner Skills are to be considered as the global Standards of Performance that determine future success. Therefore, it is significant that the ACARA General Capabilities are aligned with both of these frameworks. Because of this, it is not necessary to review the CSfW Employability Skills and WEF 21st Century Learner Skills directly against the SACE Performance Standards or any of the school-based assessments. Instead, these documents will be reviewed through a thematic comparison to the General Capabilities. These capabilities have been summarised and adapted from ACARA (2019c). Where it is specifically relevant, some mention has been made to the CSfW Employability Skills and WEF 21st Century Learner Skills.

4.1 REVIEWING THE GENERAL CAPABILITIES AGAINST THE SACE PERFORMANCE STANDARDS

All tables in the following sections that summarise the General Capabilities (e.g. Table 4) are adapted from the Australian Curriculum introduction to the General Capabilities (ACARA 2019c). Each table summarises all the key ideas and the underlying elements that constitute the General Capabilities.

4.1.1 Colour Coding - SACE Stage 1 General Mathematics Performance Standards

The following General Capabilities have been highlighted with a specific colour. This colour coding will be used to identify similarities and relationships in other documents, for the purpose of the thematic comparison and analysis. The same colour coding convention was used consistently through the analysis.

- Literacy -Green
- Numeracy - Turquoise

- Information and Communication (ICT) Capability – Teal
- Critical and Creative Thinking - Grey
- Personal and Social Capability – Dark Yellow
- Ethical Understanding - Pink
- Intercultural Understanding – Red

4.1.2 Literacy Capability Review

There are moderate links between the Literacy General Capability and the SACE Performance Standards grade descriptors, indicated by the thematic colour coding in Table 3. The grade descriptors have a strong emphasis towards developing and communicating knowledge and understanding within a mathematical context. Keywords include accurate, efficient, concise, and logical, requiring the student to display an understanding of sentence and text structures to maintain cohesion and precision in their writing. There is some evidence in the grade descriptors that students are expected to demonstrate an ability to interpret visual information and text to draw conclusions and produce mathematical results. However, the descriptor does not assess the comprehension of texts and mathematics through listening. This omission may be intentional, to not create barriers for students with hearing or auditory processing impairments. However, it is a critical skill recognised in the ACARA General Capabilities and also in the CSfW Skill Area 2a, Communicate for Work (See Table 4).

Table 3 - Literacy Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 4 - Literacy Capability in the Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Literacy	The Literacy continuum incorporates two overarching processes: Comprehending texts through listening, reading and viewing; and Composing texts through speaking, writing and creating.	Grammar Knowledge	Use knowledge of sentence structures
			Use knowledge of words and word groups
			Express opinion and point of view
		Word Knowledge	Understand learning area vocabulary
			Use spelling knowledge
		Text Knowledge	Use knowledge of text structures
			Use knowledge of text cohesion.
		Visual Knowledge	Understand how visual elements create meaning
		Composing texts through speaking, writing, and creating	Compose spoken, written, visual and multimodal learning area texts
			Use language to interact with others
			Deliver presentations.
		Comprehending texts through listening, reading and viewing	Navigate, read and view learning area texts
			Listen and respond to learning area texts
			Interpret and analyse learning area texts.

4.1.3 Numeracy Capability Review

As to be expected, the descriptors are directly linked to the Numeracy Capability. This is primarily due to the descriptors being specifically developed for a mathematics subject, rather than an interdisciplinary subject. The descriptors focus on assessing mathematical understanding and reasoning, both of which are key idea elements of the Numeracy General Capability in Table 6. In addition to this, there is also a reference in the Performance Standards to students being required to select mathematical techniques and apply them to both routine and complex problems. While this does suggest that students' problem-solving skills will be challenged, it does not specify that students are able to solve problems in authentic contexts. This is a shortfall of the descriptor. It does not assure that the assessment will present students with problems that are associated with real-life situations, or are truly reflective of the mathematical skills that are required beyond the classroom.

The remaining Key Idea Elements in the Numeracy Capability (See Table 6) are all related to mathematics for general life skills, such as estimating measurement, using money and operating clocks/calendars. None of these are referred to in the SACE Performance Standards in Table 5. However, it must be noted that these are included in the scope of topics in the SACE Stage 1 Mathematics Subject Outline (SACE 2019b).

Table 5 – Numeracy Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 6 – Numeracy Capability in the Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Numeracy	Develop the knowledge and skills to use mathematics confidently across other learning areas Recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully	Using Measurement	Estimate and measure with metric units
			Operate with clocks, calendars and timetables.
		Estimating and calculating with whole numbers	Understand and use numbers in context
			Estimate and calculate
			Use money
		Recognising and using patters and relationships	Solving problems in authentic contexts
		Using fractions, decimals, percentages, ratios, and rates	Interpret proportional reasoning
			Apply proportional reasoning
		Using spatial reasoning	Visualise 2D shapes and 3D objects
			Interpret maps and diagrams.
		Interpreting statistical information	Interpret data displays
			Interpret chance events.

4.1.4 Information and Communication Technology Capability Review

There are only attempted links between the SACE Performance Standards and the ICT Capability Key Ideas and Elements. The descriptors in Table 7 only mention the use of ICT in the context of finding solutions to routine and complex problems, which is only called out in two Key Idea Elements of the ICT General Capability. The remainder of the ICT General Capability Key Idea Elements are omitted from the Performance Standard descriptors. There is no mention of collaborative work, or the use of ICT for communication and planning. Each of these skills are imperative in the twenty-first century, as outlined in the CSfW Framework (DIICSRTE & DEEWR 2013). In addition to this, there is no reference in the descriptors to students using digital data. Applying mathematical understanding and reasoning to digital data is a key component of working in a digital world, to access, organise and present information (see Table 1).

Table 7 – ICT Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 8 – ICT Capability in the Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Information and Communication Technology (ICT)	Managing and operating ICT, while applying social and ethical protocols and practices Students develop capability in using ICT for tasks associated with information access and management, information creation and presentation, problem-solving, decision-making, communication, creative expression and empirical reasoning Students need the knowledge, skills and confidence to make ICT work for them at school, at home, at work and in their communities	Investigating with ICT	Define and plan information searches
			Locate, generate and access data and information
			Select and evaluate data and information.
		Creating with ICT	Generate ideas, plans and processes
			Generate solutions to challenges and learning area tasks.
		Communicating with ICT	Collaborate, share and exchange
			Understand computer-mediated communications.
		Managing and Operating ICT	Select and use hardware and software
			Understand ICT systems
			Manage digital data.

4.1.5 Critical and Creative Thinking Capability Review

From a surface review of the descriptors, they have moderate links to the Critical and Creative Thinking General Capability (Table 10). Yet, the intention of the descriptors does not promote the depth of learning that is called for by the capabilities. There is a focus in each of the descriptors on student solving problems, both routine and complex, in a variety of contexts. However, the descriptor does not focus on the process that is involved in solving problems, generating ideas and seeking alternate solutions. Instead, the descriptor appears to be built around students applying the set processes outlined in the subject, as opposed to developing their ability to apply logic and reasoning, as well as transferring knowledge into new or authentic contexts. One element of the SACE Performance Standards that does critically assess the General Capability is the final Reasoning and Communication descriptor. This relates to students developing and testing conjectures, and provides an opportunity to assess student performance against the third and fourth Key Ideas in Table 10.

Table 9 - Critical and Creative Thinking Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 10 - Critical & Creative Thinking Capability - Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Critical and Creative Thinking	Students generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems using unfamiliar information and new ideas	Reflecting on thinking and processes	Think about thinking (metacognition) Reflect on processes Transfer knowledge into new contexts.
	Critical and creative thinking involves students thinking broadly and deeply using skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation	Inquiring – identifying exploring and organising information and ideas	Pose questions Identify and clarify information and ideas Organise and process information.
	Creative, innovative, enterprising and adaptable, with the motivation, confidence and skills to use critical and creative thinking purposefully.	Analysing, synthesising, and evaluating reasoning and procedures	Apply logic and reasoning Draw conclusions and design a course of action Evaluate procedures and outcomes.
	Recognise or develop an argument, use evidence in support of that argument, and draw reasoned conclusions	Generating ideas, possibilities, and actions	Imagine possibilities and connect ideas Consider alternatives Seek solutions and put ideas into action.

4.1.6 Personal and Social Capability Review

There are no links between the SACE Performance Standard descriptors (See Table 11) and the Australian Curriculum Personal and Social Capability (See Table 12). There is no evidence of any opportunity for students to develop self-awareness, social awareness and social management skills. Students may work collaboratively in the classroom; however, this does not play a part in how they are assessed. An argument could be made that the Self-Management skill is partially assessed in the grade descriptors. Indeed, a student would potentially struggle to meet the requirements of each of the descriptors if they did not have the ability to work independently and show discipline towards their work. However, overall, the SACE Performance Standards do not endorse or encourage the demonstration of Personal and Social Capabilities in the classroom and during assessment tasks.

Table 11 - Personal and Social Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 12 - Personal and Social Capability in the Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Personal and Social Capability	Students learn to understand themselves and others, and manage their relationships, lives, work and learning more effectively Involves students in a range of practices including recognising and regulating emotions, developing empathy for others and understanding relationships, establishing and building positive relationships, making responsible decisions, working effectively in teams, handling challenging situations constructively and developing leadership skills	Self-management	Express emotions appropriately
			Develop self-discipline and set goals
			Work independently and show initiative
			Become confident, resilient and adaptable.
		Self-awareness	Recognise emotions
			Recognise personal qualities and achievements
			Understand themselves as learners
			Develop reflective practice.
		Social awareness	Appreciate diverse perspectives
			Contribute to civil society
			Understand relationships.
		Social management	Communicate effectively
			Work collaboratively
			Make decisions
			Negotiate and resolve conflict
			Develop leadership skills.

4.1.7 Ethical Understanding Capability Review

There are no links between the SACE Performance Standards (See Table 13) and the Australian Curriculum Ethical Understanding Capability (Table 14). Students are not assessed on the ability to explore values, rights and responsibilities. They are also not assessed on their understanding of current ethical concepts, or show evidence on their ability to reflect on their actions. This is not surprising, as historically mathematics is not associated with ethical concepts and judgement. However, there are many connections between the ethical decisions that must be made in a professional environment with regards to the accuracy and suitability of mathematical solutions and problems. One such example could be the calculations and algorithms that are used in flight and space travel. In such circumstances, those involved may have to make ethical decisions regarding the level of accuracy and confidence in their work. This is important when the failure to provide accurate solutions may have consequences on human life and the environment.

Table 13 - Ethical Understanding Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 14 – Ethical Understanding Capability in the Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Ethical Understanding	Identify and investigate the nature of ethical concepts, values and character traits, and understand how reasoning can assist ethical judgement Students build a strong personal and socially oriented ethical outlook that helps them to manage context, conflict and uncertainty, and to develop an awareness of the influence that their values and behaviour have on others	Exploring values, rights and responsibilities	Examine values
			Explore rights and responsibilities
			Consider points of view.
		Understanding ethical concepts and issues	Recognise ethical concepts
			Explore ethical concepts in context.
		Reasoning in decision-making and actions	Reason and make ethical decisions
			Consider consequences
			Reflect on ethical action.

4.1.8 Intercultural Understanding Capability Review

There are no links between the SACE Performance Standards (See Table 15) and the Australian Curriculum Intercultural Understanding Capability (Table 16). Students are not expected to have an understanding of cultural diversity and identity, and are not also expected to show evidence of exploring cultural knowledge, perspectives and practices. This a disappointing omission from the SACE Performance Standards, as there is an opportunity to explore intercultural education within the context of mathematics in the SACE Curriculum.

Table 15 - Intercultural Understanding Capability Colour Coded SACE Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence. Effective development and testing of valid conjectures.

Table 16 - Intercultural Understanding Capability - Australian Curriculum - Adapted from ACARA (2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Intercultural Understanding	Learn to value their own cultures, languages and beliefs, and those of others	Recognising culture and developing respect	Investigate culture and cultural identity
			Explore and compare cultural knowledge, beliefs and practices
			Develop respect for cultural diversity.
	Understand how personal, group and national identities are shaped, and the variable and changing nature of culture	Interacting and empathizing with others	Communicate across cultures
			Consider and develop multiple perspectives
			Empathise with others.
		Reflecting on intercultural experiences and taking responsibility	Reflect on intercultural experiences
			Challenge stereotypes and prejudices
			Mediate cultural difference.

4.2 REVIEWING SCHOOL-BASED ASSESSMENTS AGAINST THE GENERAL CAPABILITIES

4.2.1 Stage 1 Mathematics – Assessment Plans

Assessment Plans are provided in Appendix D to give context to how each of the reviewed assessments are incorporated into the Stage 1 Mathematics course. These tables list the Assessment Type and Weighting, the details of the assessment, the Performance Standards that are addressed, and also the conditions that the students will complete the assessment in. The relevance of each assessment to the assessment plan will be outlined in each of the following sections, where important to the analysis of the document.

4.2.2 Stage 1 General Mathematics – Assessment Overview

For Stage 1 General Mathematics, three assessments were analysed across two topics, Measurement and Applications of Trigonometry. This included an investigation task. The first two assessments analysed were Skill and Application Tasks (SATs) in the form of written teacher-devised short-answer tests. A teacher-devised test is normally developed by the individual teacher for use in their particular classroom, and is not intended for wide distribution or to meet the needs of other classes. Summative tests, of this form, are created to measure student achievement against focused outcomes. In the event they are summative, the test can inform students and teachers which areas of the curriculum to target in their future work. In general, teacher-devised tests provide an accurate description of student work (Brady 2012). However, according to Brady (2012), this form of assessment provides limited opportunity to capture thinking and problem-solving skills. It also denies students any opportunities to work collaboratively.

The autonomous nature of tests does not allow students to demonstrate any self-management or social-management skills. This limits their development and also assessment against the second skill cluster of the CSfW Developmental Framework, *Interact with Others* (See Table 1 - CSfW Framework (DIICSRTE & DEEWR 2013). In addition to the lack of collaboration in this assessment format, there is only a small relevance between this form of assessment and the third skill cluster of the CSfW Framework. Students are not expected to plan or collect information for this assessment. All information is presented in an organised format, removing any need for students to manage any complexity. This is not unusual, as the assessment is potentially replicating the types of questions and tasks that are provided in the classroom environment. The most notable observation of both assessment tasks are how they are constructed around the key questions and key concepts provided under each Subtopic description in the SACE Subject Outline. If the intention of the assessment is to solely capture student ability against each of these key concepts, then both assessments are suitably designed for this purpose. However, this approach provides little opportunity to develop or measure many of the SACE or Australian Curriculum General Capabilities.

4.2.3 Stage 1 General Mathematics – Measurement Test

Both provided Skills and Application Tasks (SATs) are similarly constructed and serve a common purpose. Yet, the two assessments differ in length and how the questions are presented. Because of this, they were analysed separately to accurately identify any correlation with the General Capabilities.

The Measurement Short Answer Test was seven pages long, containing fifteen questions for a total of ninety-two marks. The allocation of marks suggests that the predominate grading for the student will be provided by the marks, and not entirely by the SACE Performance Standards.

Questions one, two, and four are testing the student's basic understanding of scientific notation, decimal places, and conversions of measurement (See Figure 7). These questions are worth 14 marks in total, providing simple marks for students with little requirement for complex calculations, problem solving, or investigation. These skills meet Key Ideas one and four under the Numeracy General Capability (See Table 21), specifically Key Element 1a, 4a, and 4b.

1. Use your calculator to calculate $4.2\times10^{6}\times6.3\times10^{-10}$, giving your answer in scientific notation. [1 marks]

2. Round:
   (a) 37 to the nearest 10
   (b) 6.0784 to two decimal places
   (c) 436 to two significant figures. [3 marks]

4. Convert:
   (a) 6.3 m to cm
   (b) 5.2 m^2 to mm^2
   (c) 850,000 m^2 to hectares
   (d) 0.584 m^3 to cm^3
   (e) 7400000 mL to kL
   [10 marks]

Figure 7 - Stage 1 General Mathematics Measurement Test (Questions 1, 2 and 4)

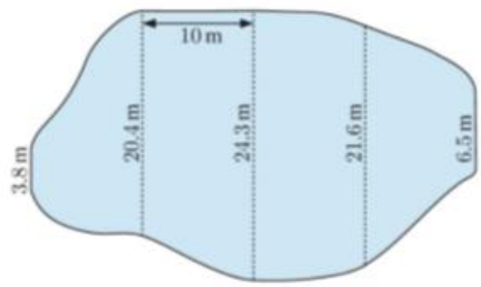
Questions 3, 7, 9, 11, 12, 13, 14, and 15 are similarly constructed, all providing the students an opportunity to apply mathematical understanding to a theoretically contextualised question (Example shown in Figure 8). Students are provided with all the key information, and are not required to collect or interpret any complex information to attempt the questions. The key information for each question is provided in the written text of the question, and not always graphically presented. This challenges students to develop and exhibit their Literacy Capabilities, specifically Key Idea Element 6a (Table 21). Students are provided the opportunity to, again, display their capability against Key Idea Elements 4a and 4b. Additionally, they can solve a problem within an authentic context, meeting the requirements of Key Idea Element 3a. However, the deeper problem-solving processes and reasoning, that are required by the Critical and Creative Thinking capability, are not challenged in these questions.

7. George wants to tile his bathroom floor with 10.5 *cm* by 10.5 *cm* tiles. The area of the floor is $3.76\ m^2$. Determine how many tiles he will need, assuming 10% extra are required for tiles which must be cut. [7 marks]

Figure 8 - Stage 1 General Mathematics Measurement Test (Question 7)

Question eight differs from the other parts of the test, as this question challenges students' ability to estimate and interpret visual information. This specifically addresses the Numeracy Capability Key Idea Element 2a, as students are required to visualise and approximate what shapes are present in each quadrant of the dam (See Figure 9)

A dam has the dimensions shown. Each region is 10 *m* wide. Estimate the area of the dam.



[4 marks]

Figure 9 - Stage 1 General Mathematics Measurement Test (Question 8)

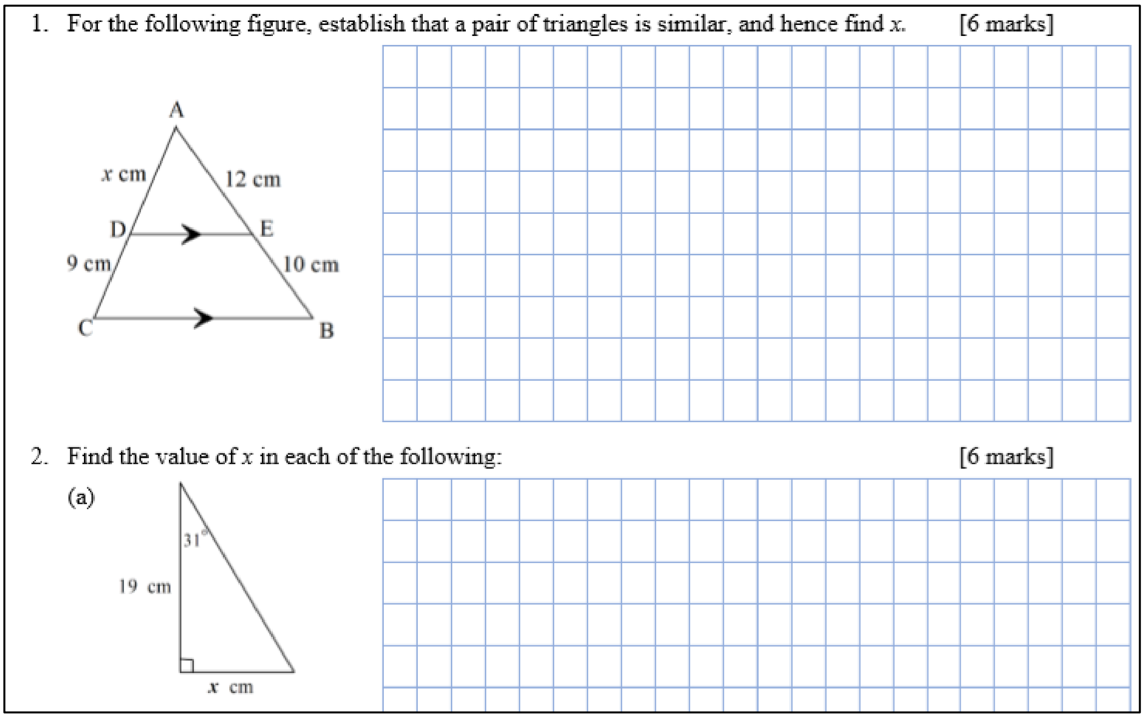
The remaining questions five, six and ten are similar in their presentation. Students are presented with generic questions that test their basic understanding of the underlying concepts, each of these only covering the Numeracy Capability Key Idea Elements 1a and 2a (Table 21).

There is no evidence in the assessment that shows that students will be measured against any of the other remaining General Capabilities and the associated Key Ideas, other than what has been presented above.

4.2.4 Year 11 General Mathematics – Applications of Trigonometry Test

The Applications of Trigonometry Short-Answer Test was six pages long, containing ten questions for a total of fifty-three marks. The allocation of marks suggests that the predominate grading for the student will be provided by the marks, and not entirely by the SACE Performance Standards.

Questions one to six are similarly constructed, providing generic 'textbook style' questions that measure the students' basic understanding of the underlying concepts. Students are required to "solve for x" or "θ" by applying rules of similarity, trigonometry, or Pythagoras Theorem in theoretical contexts with no authentical relevance. Each of these questions only covers the Numeracy Capability Key Idea Elements 2a and 2b (Table 21). The intention of these questions is to check general understanding and application of the key concepts from this sub-topic. They do not expand or challenge the student's problem-solving ability. Examples of these questions are provided below (See Figure 10).



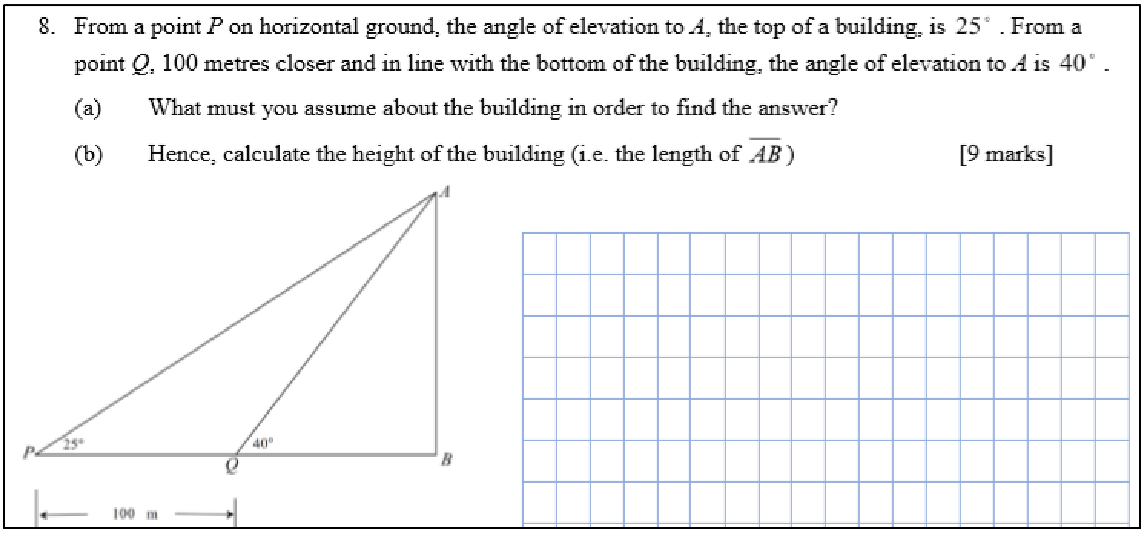
1. For the following figure, establish that a pair of triangles is similar, and hence find x. [6 marks]

2. Find the value of x in each of the following: [6 marks]

(a)

Figure 10 - Stage 1 General Mathematics Applications of Trigonometry Test (Question 1 & 2)

Questions 7 to 10 provide additional context. This allows students the opportunity to demonstrate problem solving skills and knowledge of interpreting visual and textual information. To access all the information from the question, students must match the textual and visual information. This is an important component as it draws on some of the Literacy General Capability, in particular Key Idea Element 4a and 6a (Table 21). Similar to Questions one to six, Questions seven to ten assess the Numeracy Capability Key Idea Elements 2a and 2b (Table 21). An example of one of these questions is provided below (See Figure 11).



8. From a point P on horizontal ground, the angle of elevation to A, the top of a building, is 25°. From a point Q, 100 metres closer and in line with the bottom of the building, the angle of elevation to A is 40°.

(a) What must you assume about the building in order to find the answer?

(b) Hence, calculate the height of the building (i.e. the length of $\overline{AB}$) [9 marks]

Figure 11 - Stage 1 General Mathematics Applications of Trigonometry Test (Question 8)

4.2.5 Stage 1 General Mathematics – Measurement Investigation (Outdoor Chessmen)

To facilitate a complete review of the assessment of Stage 1 General Mathematics for the Measurement sub-topic, an investigation assessment was also provided by the partnering secondary school. From the Assessment Plan for this unit (See Table 22), it can be seen that this assessment, titled "Outdoor Chessmen", accounts for thirty-five percent of the overall grade. This is in comparison to approximately twenty percent for the Skills and Applications Test provided for the same unit (Discussed in Section 4.2.3 above). Students are provided three weeks to complete the investigation, which must be submitted in a folio format. Given that the weighting of this assessment accounts for a large portion of the student's overall grade, it is probable that the skills required to complete this assessment would be a key focus in the classroom prior to the assessment. This is based upon the views of Ramsden (2002), who proposes that "from our students' point of view, assessment always defines the actual curriculum". In other words, the culmination of all student work and focus throughout the year is aimed towards the assessment, regardless of what is stipulated in the curriculum.

The investigation is broken into five parts: design, estimating and calculating volume, calculating surface area, calculating costs, and the final report. Each of these parts targets a different set of skills, providing the student the freedom to be creative within the bounds of the assessments structure. This type of project simulates the more complex design projects that students may be involved in either at home or in the work place. To help understand what skill areas this investigation aligned with, each part of the assessment was independently reviewed in relation to the General Capabilities. An example of various parts of the investigation is included where relevant.

4.2.5.1 Part 1 – The Design

To encourage students to challenge themselves with their design, there are some constraints provided. Students must include at least two types of shapes and have at least four parts: one of which has planar faces, one that has a curved surface, and one shape that has a pointed vertex. This is an important part of the investigation as it sets the expectations for the students. It also ensures they will be challenged to develop and exhibit the Numeracy General Capability 5a "Visualise 3D shapes" (Table 21), as they develop complex systems of shapes. This part also potentially encourages students to use their Critical and Creative Thinking General Capability, primarily Key Idea Element 2b, 2c and 3b (Table 21). The student will be required to organise and process information, especially in regards to the constraints of the task. From this they must clarify any ambiguous information and also design a course of action.

4.2.5.2 Part 2 – Estimating and Calculating Volume

This section requires students to draw on their basic understanding of volume calculations and formulas. They must then apply this understanding to a real context with a higher level of complexity as they consider their design. This process involves students transferring their existing knowledge into new and authentic contexts, developing and assessing the Critical and Creative Thinking Key Idea Element 1c (Table 21).

4.2.5.3 Part 3 and 4 – Calculating Surface Area and Cost

Part 3 of the investigation challenges and assesses the same set of skills as Part 2, but using a different set of formulas and calculations. Part four provides an extension on the two previous sections, requiring the student to calculate the cost of their design using the provided metrics. This activity aligns well with many of the Key Idea Elements of the General Capabilities, particularly with the requirement for students to convert units and estimate financial costs. Both of these skills are listed under the Numeracy Key Idea Elements 1a, 2a, 2b, and 2c. The problem is also relevant to many authentic contexts for mathematics, and therefore also incorporates Key Idea Element 3a from the same capability. This Key Idea Element specifies that students must be able to "solve problems in authentic contexts" (See Table 21). In addition to the Numeracy Capability, students are required to use their text comprehension skills to discern the key information from the instructions, incorporating Literacy Key Idea Element 6a.

4.2.5.4 Part 5 – Developing the Report

The final section of the investigation instructs students to develop a report that includes an introduction, 3D sketches of their design that are appropriately scaled and profiled, and also outlines all calculations from Parts 2 to 4. This section primarily evaluates the students Literacy Capability, but they are also required to discuss their processes and thinking throughout the investigation. This component evaluates all elements of the first Key Idea in the Critical and Creative Thinking Capability. Students are required to generate and evaluate their knowledge, clarify their ideas, and potentially suggest alternatives to their current design.

From the Literacy Capability, Key Idea Elements 1a, 1b, 3a, 3b, 4a, 5a, and 5b (See Table 21) are all assessed by the report section. This is due to the requirement for students to compose text using visuals and their knowledge of mathematical terminology and processes.

The instructions for this part encourage students to create and present a 3D model using Computer Aided Design software (CAD); however, it is not mandatory. If this component is incorporated by students, it greatly widens the skills that are involved in the activity, specifically drawing on key Idea Elements 4a, 4b, and 4c in the Information and Communication Technology (ICT) Capability.

4.2.5.5 Stage 1 General Mathematics – Measurement Investigation Summary

The Outdoor Chessmen Investigation is an example of what Brady (2012) refers to as project based work. Project work is defined as a substantial piece of work on a designated topic that allows students to organise and present information using text, pictures, diagrams and graphs. Brady (2012) also notes that project and investigation work is generally assessed by performance assessment strategies, which in the case of the SACE are the Performance Standards (An example is shown in Table 19). The advantages of this form of assessment are the opportunities for collaborative work, problem solving, and implementing planning processes. However, it appears that the Chessmen Investigation is not able to facilitate collaborative work. This omits one of the primary benefits of this type of assessment. It also removes an opportunity for students to be assessed against the Personal and Social Capability and Intercultural Understanding Capability from the General Capabilities (See Table 21). One of the recognised downfalls of this assessment type is the subjective nature of the assessment, particularly if the task criteria and rubric is not clearly specified. This task is to be assessed against the SACE Performance Standards, which the analysis in section 4.1 has proven to poorly reflect the General Capabilities in many areas. For this reason, if students were to exhibit skills from the other areas of the General Capabilities, such as showing Critical and Creative Thinking and adept use of ICT, that would not be captured by the current rubric. This is primarily because these skills are not recognised in the current Performance Standards for Stage 1 General Mathematics.

4.2.6 Stage 1 Maths Methods - Overview

For Stage 1 Maths Methods, three assessments were analysed across three topics, Differential Calculus, Non-Right-Angled Trigonometry, and Quadratic Functions. One investigation task was included for the Quadratic Functions sub-topic. The first two assessments analysed were Skill and Application Tasks (SATs) in the form of written teacher-devised short-answer tests. As discussed in section 4.2.2, summative tests of this form are created to measure student achievement against focused outcomes (Brady 2012).

4.2.7 Stage 1 Maths Methods – Introduction to Differential Calculus Test

The Introduction to Differential Calculus Short Answer Test was eight pages long, containing thirteen questions for a total of seventy-three marks. Although there is an allocation of marks for each question, the introduction of the test does stipulate in the Assessment Conditions that students will be marked against the Performance Standards for Stage 1 Mathematics. This suggests that a teacher marking the test may use both the allocation of marks and the student's performance against the standards as an indication of their achievement, this may blur the objectives of the assessment for students.

To give contextual relevance to the assessment, the first question of the test presents the student with a data set that is related to an individual riding on a ski lift. The question follows on to ask several questions relating to the scenario, each question requiring students to apply their understanding of differential calculus to a real application (See below in Figure 12). This question does not stretch students to use or develop skills across a wide variety of General Capabilities, but it does require the application of many of the Key Idea Elements from the Numeracy Capability. The data table in the question is presented in metric units relating to a potentially non-familiar context, incorporating Key Idea Elements 1a, 2a, 3a and 6a (See Table 21).

1.	Charlie is riding on a ski lift. Her height above ground level is measured every 50 seconds and is recorded in the table below.

Time (seconds)	0	50	100	150	200	250
Height (metres)	0	86	172	258	344	430

(a) Is the ski lift increasing in height at a constant rate? Explain your answer.
(b) Draw a graph of time against height.
(c) Find the rate of change of height. [6 marks]

Figure 12 - Stage 1 Maths Methods Intro to Differential Calculus Test (Question 1)

The remaining questions from two to thirteen are not related to a context, they also do not challenge a student's critical and creative thinking or problem-solving skills. The majority of these questions are routine problems, and are scaffolded so that the difficulty of the question increases throughout the test. However, the increasing difficulty is only related to the student's ability to recall mathematical processes and their understanding of how to apply these processes to routine problems. The questions do not challenge students with higher order thinking skills, such as transferring knowledge into new contexts, connecting ideas, or organising and processing information. These missing skills are all elements of the Critical and Creative Thinking Key Idea Elements shown in Table 21 – Australian Curriculum General Capabilities – Adapted from (ACARA 2019c). An example of these questions is shown in Figure 13.

12. Consider the curve with equation $y = -2x^3 + x^2 - x + 3$
(a) Show that the equation of the tangent to the curve at the point where $x = -1$ is $y = -9x - 2$

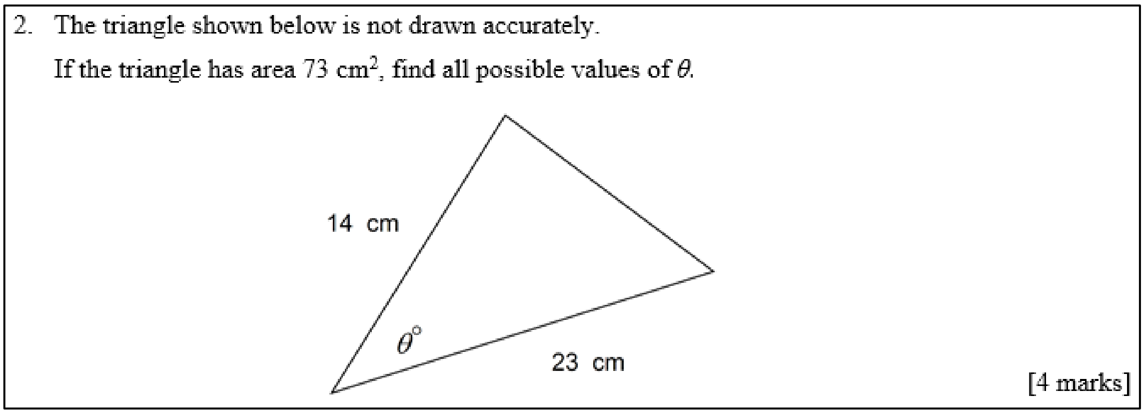
Figure 13 - Stage 1 Maths Methods Intro to Differential Calculus Test (Question 12)

4.2.8 Stage 1 Maths Methods – Non-Right-Angled Trigonometry Test

The Stage 1 Methods Non-Right-Angled Trigonometry test is consistent with the general formatting and presentation of questions seen in the previously analysed tests. The total assessment is worth twenty percent of the overall grade for the school-based component of the course, shown by the Assessment Plan in Table 24.

This test includes twelve questions for a total of seventy-two marks. However, it differs to the Differential Calculus test in Section 4.2.7 in that there is no introduction that specifies students will be marked against the SACE Performance Standards. This indicates to the student that their performance will be solely measured on the allocation of marks per solution. This provides very little opportunity for the student to exhibit any additional understanding, especially the demonstration of skills and understanding that sits outside the allocation of marks that would be represented by the SACE Performance Standards. This opens up the possibility that students' results may not accurately portray their mathematical understanding and knowledge of concepts and relationships. This skill is captured by the Concepts and Techniques section of the Performance Standards shown in Table 19.

Questions one through to seven provide the student with an opportunity to demonstrate understanding of the basic coursework covered in the unit; the questions are also similarly formatted. This section requires students to develop and show evidence against the Numeracy Capability Key Idea Elements 1a. This is due to the inclusion of metric units, as well as allowing them to interpret data and calculate solutions, thus incorporating Key Idea Elements 6b and 2b. There is no evidence of addressing other areas of the General Capabilities in this question section. A question that is representative of this section is included below (See Figure 14).


2. The triangle shown below is not drawn accurately.
If the triangle has area 73 cm^2, find all possible values of θ.

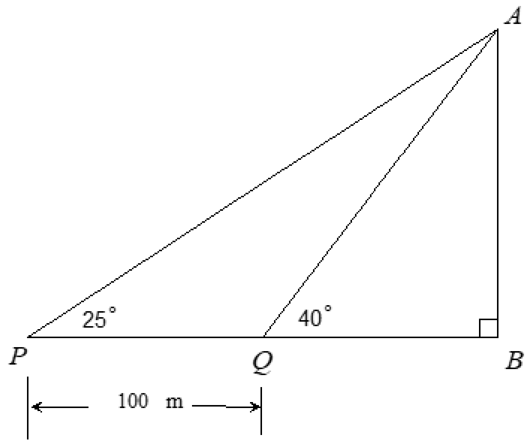
[4 marks]

Figure 14 - Stage 1 Maths Methods Non-Right-Angled Trigonometry Test (Question 2)

Question nine differs to the previous questions presented, as it is made relevant to an authentic context. Van Merriënboer and Kirschner (2013) recognized that "*to help students develop an understanding of a domain, theoretical and practical knowledge should be integrated into authentic learning tasks"*. This approach to learning and also assessment provides students with a deeper understanding of their content. This deep understanding is generated from linking theory to real world practices, and allowing the students to apply their knowledge in new and unfamiliar situations. To measure a student's deep understanding of the content, then it is important to ensure that they are presented with contextualised questions in assessment tasks. Question nine also provides students an opportunity to demonstrate their skills against the Numeracy Capability, including Key Idea Elements 1a, 2a, 2b, 3a, and 5b (See Table 21).

9. From a point P on horizontal ground, the angle of elevation to A, the top of a building $\overline{AB}$, is 25°.

From a point Q, 100 metres closer and in line with the bottom of the building, the angle of elevation to A is 40°. Calculate the height of the building (ie. the length of $\overline{AB}$).



[8 marks]

Figure 15- Stage 1 Maths Methods Non-Right-Angled Trigonometry Test (Question 9)

The complexity of questions ten through to twelve, which is a bonus question, all extend the required skills beyond what is outlined in the Numeracy General Capability. Students are required to transfer their knowledge and mathematical understanding of basic concepts. They must then apply this learning to more complex problem-solving activities, meeting the requirements of Key Idea Elements 1c and 3a from the Critical and Creative Thinking Capability (See Table 21). The bonus question at the end of the test (See Figure 16) is unique in this problem set, it asks the student to prove an existing answer by showing the appropriate working. This requires the student to be adaptable and synthesise the presented information with their existing understanding, demonstrating Key Idea Element 3a “Apply logic and reasoning”.

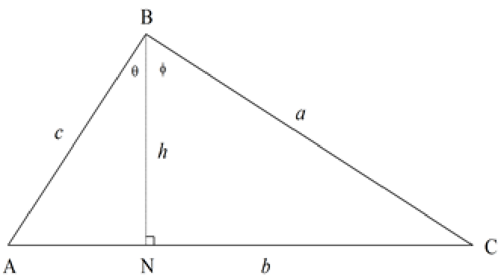
BONUS

By applying the area formula for a non-right angled triangle to the triangles drawn alongside show that:

$$\sin(\theta+\phi)=\frac{h}{a}\sin\theta+\frac{h}{c}\sin\phi$$

Hence, show that:

$$\sin(\theta+\phi)=\sin\theta\cos\phi+\cos\theta\sin\phi$$



[7 marks]

Figure 16 - Stage 1 Maths Methods Non-Right-Angled Trigonometry Test (Question 12 - Bonus)

4.2.9 Stage 1 Maths Methods – Quadratic Functions to Build a Bridge Investigation

Differing to the weighting of the Stage 1 General Maths Investigation, the provided Quadratics Function Investigation for Stage 1 Maths Methods is indicated to only be worth twenty percent of the overall mark for the Semester 1 component of the unit (See Table 24 - Stage 1 Maths Methods - Assessment Plan Semester 1). Considering that the Stage 1 General Mathematics investigation accounted for thirty-five percent of the overall grade, this decreased weighting for this assessment can be interpreted in two ways: the weighting is lower due to the increased number of topics in the Semester and the need to balance the allocation of marks across all topics, or it is lower because there is a decreased focus on this assessment type. Regardless of the intention, the perceived value in this assessment may be reduced for students because of this weighting. This potentially creates a decreased overall focus on the differing skills required to complete the task.

The Quadratics Functions to Build a Bridge Investigation is a contextualised assessment, introducing the task in the form of a letter from a company. This letter requests the design of a bridge for a gorge along the River Torrens (See Figure 17). The task has two requirements, complete all calculations for the design of the bridge, and present the design and calculations in a report. Students are provided with preliminary data that outlines the constraints of their design (See Figure 18), but overall students are given freedom to create their own design to meet the needs of the company. This component of the investigation challenges students to develop and exhibit their competency against the Critical and Creative Thinking General Capability, specifically Key Idea Elements 1c, 2b, 2c, 3a, 3b, 3c, and 4a. Each of these elements are linked to a component of the design process and the development of the report. Key Idea Elements 3c and 4b have the potential to be incorporated if students challenge themselves to reflect on their processes and discuss alternative approaches to meeting the design criteria. Both of these reflective processes are linked to the marking sheet for the investigation, under the Conclusion section of the Marking Sheet (See Figure 19).

The aforementioned Marking Sheet is a helpful guide for students as it provides clarity and objectives for the student to meet during the task. In the review of a Stage 1 General Mathematics investigation assessment in the previous section 4.2.5.5, it was recognised that often project or investigation assessment types can be subjective in nature. This occurs if the task criteria and rubric is not clearly specified. However, in the case of this investigation, students are given clear expectations in the Marking Sheet (Figure 19). The marks are divided into four sections, with each of the underlying descriptors being referenced to the appropriate SACE Performance Standard.

In addition to the opportunity for students to develop their Creative and Critical Thinking General Capability, many of the Numeracy General Capability skills are incorporated throughout this task. The Key Idea Elements that students would develop and exhibit at a minimum by completing the task are 1a, 2a, 2b, 3a, 4a, 5a, and 5b. Most notable of these elements is the opportunity for students to apply proportional reasoning to check their design and calculations. Calculation checks are required to ascertain the appropriateness of the results in regards to the specified envelope of the design criteria. This element is omitted from the previous assessments, and is a key skill that provides the individual the opportunity to reflect and evaluate their own work.

5 Discussion – Overview of the Document Analysis

5.1 Review of the General Capabilities against the SACE Performance Standards

The SACE Performance Standards are at the center of student measurement during school-based assessments. It is the driver for task development as well as the reference for student performance in a given SACE approved course. The subject outline for Stage 1 Mathematics (Maths Methods) and General Mathematics clearly recognises the importance of the General Capabilities and the need for their incorporation within every area of the curriculum. Yet, this focus is not recognised in the SACE Performance Standards. It is accepted that the SACE Performance Standards must measure student ability against the core subject skills, in this case: mathematical understanding, knowledge, and application. However, the descriptors within the Performance Standards must not solely reference these core subject skills. They must also promote the inclusion and development of the General Capabilities. In the case of the Stage 1 Mathematics and General Mathematics Performance Standards, there is an obvious omission and lack of relevance to the General Capabilities. The results of the analysis of the SACE Performance Standard descriptors and the General Capabilities are shown in Table 17. The SACE Performance Standard descriptors can also be viewed in detail in Appendix A.

The Numeracy General Capability is well represented in the SACE Performance Standards, with many of the descriptors directly linking to the Numeracy Key Element Ideas. The only omission is a specific reference to students being able to solve problems in "authentic contexts", a key component of the General Capabilities. The alignment between the two documents can be attributed to the fact the descriptors are specifically developed for a mathematics subject rather than aiming towards an interdisciplinary focus.

The Literacy General Capability follows similarly. This capability shows moderate links to the Performance Standards due to the requirement for students to show evidence and effectively communicate using logical and concise arguments. This suggests that there is a focus on student's ability to control language and convey meaning within a mathematical context. This exemplifies the student's overall use of words, sentence structure and ability to create cohesive text. There is also specific reference to the student's ability to interpret data, which may not always be presented numerically and instead hidden within text. This itself satisfies that a student is able to comprehend texts outside of a general reading context, and that they can apply their reading and comprehension skills to a problem outside the discipline of literacy.

Following the Literacy and Numeracy General Capabilities, the similarities and alignment of the SACE Performance Standards are drastically reduced. There are only attempted links to a requirement for students to display knowledge and capability in using ICT within the context of mathematics, with only a weak reference to students' use of technology. Without any other specificity, this component of the descriptor could be met by the student simply using a calculator in class. This reduces the opportunity for students to display proficient skill in selecting and using ICT to communicate and solve problems.

There is also evidence that the SACE Performance Standards have been developed with an intention to include the Critical and Creative Thinking General Capability. However, the formation of the descriptors and the use of language do not promote or expect that students will develop a depth of learning against this capability. There is no reference to solving problems or seeking alternate solutions within authentic contexts. In addition to this, students are not expected to be able to apply their logic and reasoning skills to reflect on their processes and evaluate their procedures and outcomes. This results in only skimming the surface of student development of critical and creative thinking processes.

The final three General Capabilities, Personal and Social Capability, Ethical Understanding, and Intercultural Understanding, are entirely omitted from the SACE Performance Standards (See Table 17). There is no reference to any of the Key Idea Elements that are included in these General Capabilities. This is concerning, as these are crucial components that are highly recognised by the CSfW Developmental Framework(DIICSRTE & DEEWR 2013) and also the 21st Learner Skills Framework (WEF 2016).

Table 17 - SACE Performance Standards vs. General Capabilities Matrix

SACE Performance Standards vs. General Capabilities	Literacy	Numeracy	ICT	Critical and Creative Thinking	Personal and Social Capability	Ethical Understanding	Intercultural Understanding
CT 1 (Concepts & Techniques)	Orange	Green	Orange	Orange	Orange	Orange	Orange
CT2	Orange	Green	Orange	Green	Orange	Orange	Orange
CT3	Orange	Green	Orange	Green	Orange	Orange	Orange
CT4	Orange	Orange	Green	Green	Orange	Orange	Orange
RC 1 (Reasoning & Communication)	Green	Green	Orange	Orange	Orange	Orange	Orange
RC 2	Green	Green	Orange	Orange	Orange	Orange	Orange
RC 3	Green	Green	Orange	Orange	Orange	Orange	Orange
RC4	Green	Green	Orange	Green	Orange	Orange	Orange
RC5	Green	Green	Orange	Green	Orange	Orange	Orange
RC6	Green	Green	Orange	Green	Orange	Orange	Orange

Green indicates an allignment between the documents

5.2 Review of the School-Based Assessments Against the General Capabilities

The review of the provided school-based assessments for Stage 1 Mathematics and General Mathematics yielded similar observations as the review of the SACE Performance Standards, which was discussed in the previous section. This confirmed that a misalignment of the SACE Performance Standards to the General Capabilities has a ripple effect. The assessments produced by the school do not strongly emphasise the measurement of students' ability against the General Capabilities.

The six Stage 1 Mathematics and General Mathematics assessments that were reviewed comprised of four teacher-devised tests and two investigations. Across the test-based assessments, there was a strong link between the Numeracy General Capability and the skills required to complete each part of the assessments. This is to be expected, as general numeracy is at the core of both these subjects. There was also a limited connection between the Literacy Capability and the investigation assessments, primarily due to the written report component of each of these tasks. However, the alignment of the Literacy Capability did not carry across to the test-based assessments; each of these assessments showed very little evidence of measuring student ability against the Literacy Capability.

The investigations assessments also challenged students' Critical and Creative Thinking Capability. In the Stage 1 Maths Methods investigation (See 4.2.9), students develop a report that encourages them to examine their processes and think critically about their approach to the task. This component of the assessment appears to be slightly undervalued by the assessor, only being attributed to a small portion of the available marks. Referring back to the research of Joughin (2009), a students' attention will always be primarily focused on what is assessed rather than what is encouraged. Therefore, this component of the assessment may not be a primary focus for students. For the remaining assessments, elements of the teacher-devised tests did show some correlation to the Critical and Creative Thinking Capability. These questions only constituted less than twenty percent of the available questions, as the primary emphasis was on assessing mathematics ability and not critical thinking in the context of mathematics.

The Information and Communication Technology (ICT) Capability is not incorporated in the teacher-devised test assessments, which is acceptable given the study conditions students must complete the assessment under. However, there was opportunity for the incorporation of ICT in both investigations that was not utilised. The task instructions only prompted students to use technology, rather than making it a necessary tool to complete the task. Furthermore, in Section 5.1, it was observed that some of the General Capabilities were not represented in the SACE Performance Standards. This omission has proven to have ongoing effects on the development of assessments, with the three remaining General Capabilities: Personal and Social Capability, Ethical Understanding, and Intercultural Understanding all being entirely missing from the school-based assessment that were observed. There are no references to any of the Key Idea Elements that are included in these General Capabilities. This may stem from the fact that mathematics is taught as a standalone subject instead of being integrated into the rest of the curriculum.

5.3 REVIEW OF THE CURRICULUM EVALUATION DIAMOND

As discussed in Section 2.3 – (Development of the Tyler Model), the Curriculum-Evaluation Diamond developed by Mohandas, Wei and Keeves (2003) represents the relationship between Standards of Performance, Curriculum Objectives, and Student Assessment. An example of this model is provided in Figure 2. The relationship between each element of the Curriculum Evaluation Diamond was assessed within the context of Stage 1 Mathematics in the SACE Curriculum by the document analysis in Section 4 and the literature review in Section 2. The culmination of this relationship analysis is summarised in Table 18, showing the individual documents sets for each of the relationships in the Curriculum Evaluation Diamond and their relative alignment.

Table 18 - Curriculum Evaluation Alignment Overview

Relationship in the Curriculum Evaluation Diamond	**Document Set (1)**	**Document Set (2)**	**Alignment of the Document Sets**
Standards of Performance (1) vs. Curriculum Objectives (2)	- Core Skills for Work Developmental Framework (DIICSRTE & DEEWR 2013) - 21st Learner Skills (Soffel 2016; WEF 2016)	- ACARA General Capabilities (ACARA 2019c) - SACE Curriculum Capabilities (SACE 2019b, 2019c)	There is a strong alignment between the Standards of Performance set by the CSfW and 21st Learner Skills and the General Capabilities that are outlined by ACARA in the SACE Curriculum.
Curriculum Objectives (1) vs. Assessment Practices (2) (Performance Standards)	ACARA General Capabilities (ACARA 2019c)	SACE Performance Standards (SACE 2019b, 2019c)	The General Capabilities are poorly reflected in the Stage 1 Mathematics SACE Performance Standards, only recognising the Numeracy, Literacy, and Critical and Creative Thinking Capabilities.
Curriculum Objectives (1) vs. Assessment Practices (2) (School-Based Assessments)	ACARA General Capabilities (ACARA 2019c)	School-Based Assessments	Similar to the alignment of Curriculum Objectives to the Performance Standards, there is a poor reflection of the General Capabilities in the analysed assessments for Stage 1 Mathematics. The two assessment types analysed only recognised the Numeracy, Literacy, and Critical and Creative Thinking Capabilities.

6 CONCLUSION AND RECOMMENDATIONS

This study proposed that there is a disconnection between the skills developed and assessed in the classroom and the standards of performance required to enter the workforce and be a successful citizen. This disconnection was predicted to stem from a misalignment of the Curriculum Objectives and the Performance Standards that are used to measure student performance. In this section, the relationships between external standards of performance, curriculum objectives and student assessment are evaluated. The goal of this evaluation is to form conclusions regarding the ability of the current South Australian Curriculum for Stage 1 Mathematics to develop employability and learner skills.

6.1 THE IMPORTANCE OF EMPLOYABILITY AND LEARNER SKILLS IN EDUCATION

To meet the needs of the contemporary knowledge economy (Tapscott 1996), students need to be equipped with strong employability and learner skills that will allow them to be successful in their career pathway and everyday life. For this to occur, employability and learning skills must be an intrinsic part of the Australian Curriculum, state and territory curricula. They must also be evident in the descriptors of all assessment performance standards. This relationship forms part of the Curriculum-Evaluation Diamond developed by Mohandas, Wei and Keeves (2003), based upon the Tyler Curriculum Triangle (Tyler 1949). This model summarises the link between the education system and the standards of performance required in the contemporary society. If these skills are not promoted and developed during secondary education, students will be entering the workforce, starting tertiary education, and beginning their citizenship without the key skills for them to be successful. It is not the responsibility of the workplace or tertiary educational institutions to teach these skills. They should already be well developed and intrinsic to the way that an individual interacts and operates within society.

6.2 THE MISSING LINK IN EDUCATION FOR EMPLOYABILITY AND LEARNER SKILLS

The General Capabilities developed by the Australian Curriculum and Assessment Authority (ACARA) was shown to be closely linked to the employability and learner skills. Both of these skill sets are recognised as the standards of performance by the Core Skills for Work Developmental Framework (DIICSRTE & DEEWR 2013) and the 21st Learner Skills Framework (WEF 2016). These General Capabilities form a key component of the Curriculum Objectives in the SACE, emphasising the importance for students to develop employability and learner skills during classroom activities. This strong link between standards of performance and curriculum objectives was evidently shown throughout the review of these documents (See Section 2.6). However, these curriculum objectives are not suitably promoted by the SACE Stage 1 Mathematics Performance Standards intended for school-based assessments. This omission creates a disconnection between the Curriculum Objectives and the Student Assessment element in the Curriculum-Evaluation Diamond (Mohandas, Wei & Keeves 2003).

6.3 Evaluating the Assessment of Curriculum Objectives

To assess the link between the Curriculum Objectives (General Capabilities) and the Student Assessment Standards (SACE Performance Standards), both documents were analysed using a colour coded thematic analysis. This analysis provided a visual representation of the alignment of the document sets, which could then be reviewed in more detail. From this analysis, the only credible alignment between the General Capabilities and the SACE Stage 1 Mathematics Performance Standards was observed when reviewing the Numeracy Capability (See Table 17). This is not unexpected, as the subject is inherently linked with this capability. The omission of the other capabilities is more concerning, as it suggests that mathematics in the SACE Curriculum is intended to be taught by schools as a standalone skill rather than as a key skill to be applied in a range of contexts and applications. The impact of this decision has ongoing consequences for students; there are very few applications in life and also in career pathways that require an individual to solve isolated mathematical problems without them being a subset of a larger problem or process. By not preparing students for these complex situations, the core skills they have learned at school have no value in a practical application. The effect of this omission on assessment tasks was evaluated further by analysing the alignment of school-based assessments to the General Capabilities. This decision to evaluate school-based assessment is based on the postulate that, if a skill is not assessed and measured, then there is no mechanism for a school to determine if it is being actively promoted in classroom activities.

6.4 The Omission of the General Capabilities in School-Based Assessment

The poor representation of the General Capabilities in the SACE Performance Standards was identified to have a flow on effect in the development of school-based assessments for Stage 1 Mathematics, highlighting the view that, if a skill is not explicitly assessed, then it is also not promoted or developed (Joughin 2009). Only the Numeracy and Literacy Capability were strongly assessed by the tasks, in addition to a limited requirement for students to demonstrate Critical and Creative Thinking Capability to complete the investigation tasks. The four remaining General Capabilities, Information and Communications Capability, Personal and Social Capability, Ethical Understanding, and Intercultural Understanding, were all omitted from the assessments. This omission can be attributed, in part, to the type of student assessments that were provided for analysis.

6.4.1 The Effect of Assessment Types on Measuring the General Capabilities

Test-based assessments are the primary and accepted method of student performance measurement in secondary education; however, this poses complications for students to use ICT and develop their interpersonal, ethical, and intercultural understanding due to the constraints of the test conditions. This links back to observations by Brady (2012); this form of assessment provides limited opportunity to capture thinking and problem-solving skills as well as denying students any opportunities to work collaboratively. Additionally, the autonomous nature of this assessment does not allow students to demonstrate any self-management or social-management skills. This affirms the observations that were made regarding the alignment of the General Capabilities to the analysed school-based assessments. The analysed assessments do not measure a student's full range of capabilities, nor do they assess the employability and learner skills that a student needs to enter and be successful in a contemporary society.

6.5 RECOMMENDATIONS

6.5.1 Impact on Student Development – What Needs to Change?

The absence of contextualized, collaborative, and authentic mathematical tasks in secondary education is at odds with the complex standards of performance required for successful employment and supporting everyday life skills. Employability and Learner Skills should be as much a part of the curriculum as mathematics, English, science and health. Students should be given the opportunity to be collaborative, plan and organise their tasks, manage and present information using ICT, and recognise the diverse cultures and perspectives to coexist in society. This alteration to the focus of mathematics education would require a change in classroom activities. There is still a place for routine problems in isolated mathematical contexts; however, students must be stretched beyond these types of problems once they have a strong grounding in the basic mathematical operations. This can be achieved through the implementation of project-based tasks, for both classroom activities and assessment. Project-based tasks are generally focused on real contexts that students will face outside of education, allowing them to apply a broad range of skills and be collaborative. This opens up the potential for students to develop strong communication, personal, and social capabilities. Many real-world contexts have an ethical component, allowing students the opportunity to develop awareness and navigate the complex values, rights, and responsibilities that are attributed to real-world decision-making and actions. In addition to incorporating project work, interdisciplinary studies also pose an opportunity for students to integrate their core skills in a variety of applications. However, the current construct of the Australian Curriculum and the SACE limits opportunities to incorporate these courses and activities.

6.6 ASSESSMENT LIMITATIONS RELATED TO THE CURRENT CURRICULUM FOR SACE

The current SACE Stage 1 Mathematics Performance Standards constrain the opportunities to diversify the assessment types used to measure student performance. For teachers to have the liberty to create assessments that measure the General Capabilities, there must be Performance Standard descriptors that align to these skill sets. For this to occur, the SACE Curriculum Subject Outlines must be updated to modify the descriptors and also the accepted assessment types for mathematics. Currently, test-based assessments are a primary form of measurement in the Stage 1 Mathematics Outlines (SACE 2019c), and cannot be removed in the current course format. Until examinations are removed from the course outlines, test based assessments will be required to ensure that students are prepared for the rigours of an examination.

6.7 INTERDISCIPLINARY LEARNING – TRANSFORMING EDUCATION

The review of the SACE Curriculum, in relation to the General Capabilities, has highlighted the need for expanding the scope of secondary education courses to focus on more than just isolated core skills. There are many obstacles that prevent the full incorporation of the General Capabilities in classroom activities and assessments if schools continue to teach subjects in isolation. Already, some schools have begun implementing interdisciplinary classes for senior years of secondary education, including the Australian Science and Mathematics School and also Adelaide Botanic High School. Both schools encourage a focus on innovative and authentic curriculum; they intend to create a self-directed learning environment that develops the general capabilities of students to prepare them for the twenty-first century. This involves creating a highly contextualised curriculum that allows students to apply their knowledge to applications they are expected to face outside of the classroom (ABHS 2019; Bissaker, Davies & Heath 2011).

For this style of learning to be freely used within the majority of educational contexts, there must be a suitable framework put in place within the SACE Curriculum to allow schools the freedom to integrate courses and better represent the General Capabilities in classroom activities and assessments.

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APPENDIX A – SACE PERFORMANCE STANDARDS

The below tables have been taken from the SACE Stage 1 Curriculum for 2019, and include grade band descriptors for grades A to D.

Table 19 - SACE Stage 1 Mathematics Performance Standards (Grade A-D) (SACE 2019c)

	Concepts and Techniques	Reasoning and Communication
A	CT 1 - Comprehensive knowledge and understanding of concepts and relationships. CT 2 - Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. CT 3 - Successful development and application of mathematical models to find concise and accurate solutions. CT 4 - Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	RC 1 - Comprehensive interpretation of mathematical results in the context of the problem. RC 2 - Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. RC 3 - Proficient and accurate use of appropriate mathematical notation, representations, and terminology. RC 4 - Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. RC 5 - Effective development and testing of valid conjectures.
B	Some depth of knowledge and understanding of concepts and relationships. Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts. Some development and successful application of mathematical models to find mostly accurate solutions. Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems.	Mostly appropriate interpretation of mathematical results in the context of the problem. Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations. Mostly accurate use of appropriate mathematical notation, representations, and terminology. Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments. Mostly effective development and testing of valid conjectures.
C	Generally competent knowledge and understanding of concepts and relationships. Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in a variety of contexts. Successful application of mathematical models to find generally accurate solutions. Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems.	Generally appropriate interpretation of mathematical results in the context of the problem. Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations. Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy. Generally effective communication of mathematical ideas and reasoning to develop some logical arguments. Development and testing of generally valid conjectures.
D	Basic knowledge and some understanding of concepts and relationships. Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in some contexts. Some application of mathematical models to find some accurate or partially accurate solutions. Some appropriate use of electronic technology to find some accurate solutions to routine problems.	Some interpretation of mathematical results. Drawing some conclusions from mathematical results, with some awareness of their reasonableness or limitations. Some appropriate use of mathematical notation, representations, and terminology, with some accuracy. Some communication of mathematical ideas, with attempted reasoning and/or arguments. Attempted development or testing of a reasonable conjecture.

Table 20 - SACE Stage 1 General Mathematics Performance Standards (Grade A-D) (SACE 2019b)

	Concepts and Techniques	Reasoning and Communication
A	CT1 - Comprehensive knowledge and understanding of concepts and relationships. CT2 - Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. CT3 - Successful development and application of mathematical models to find concise and accurate solutions. CT4 - Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	RC 1 - Comprehensive interpretation of mathematical results in the context of the problem. RC 2 - Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. RC 3 -Proficient and accurate use of appropriate mathematical notation, representations, and terminology. RC 4 - Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. RC 5 - Formation and testing of appropriate predictions, using sound mathematical evidence.
B	Some depth of knowledge and understanding of concepts and relationships. Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts. Attempted development and successful application of mathematical models to find mostly accurate solutions. Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems.	Mostly appropriate interpretation of mathematical results in the context of the problem. Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations. Mostly accurate use of appropriate mathematical notation, representations, and terminology. Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments. Formation and testing of mostly appropriate predictions, using some mathematical evidence.
C	Generally competent knowledge and understanding of concepts and relationships. Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in different contexts. Application of mathematical models to find generally accurate solutions. Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems.	Generally appropriate interpretation of mathematical results in the context of the problem. Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations. Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy. Generally effective communication of mathematical ideas and reasoning to develop some logical arguments. Formation of an appropriate prediction and some attempt to test it using mathematical evidence.
D	Basic knowledge and some understanding of concepts and relationships. Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in context. Some application of mathematical models to find some accurate or partially accurate solutions. Some appropriate use of electronic technology to find some accurate solutions to routine problems.	Some interpretation of mathematical results. Drawing some conclusions from mathematical results, with some awareness of their reasonableness. Some appropriate use of mathematical notation, representations, and terminology, with some accuracy. Some communication of mathematical ideas, with attempted reasoning and/or arguments. Attempted formation of a prediction with limited attempt to test it using mathematical evidence.

APPENDIX B – ACARA GENERAL CAPABILITIES

Table 21 is adapted from the Australian Curriculum introduction to the General Capabilities (ACARA 2019c). It summarises the key ideas and the underlying elements that constitute each of the General Capabilities. This table is used to evaluate other documents to identify elements that are related to the General Capabilities. Each of the Key Idea Elements have been numbered to provide a means of referencing particular sections of the table.

Table 21 – Australian Curriculum General Capabilities – Adapted from (ACARA 2019c)

General Capability	Description	Key Ideas	Key Idea Elements
Literacy	The Literacy continuum incorporates two overarching processes: Comprehending texts through listening, reading and viewing; and Composing texts through speaking, writing and creating.	1. Grammar Knowledge	a. Use knowledge of sentence structures
			b. Use knowledge of words and word groups
			c. Express opinion and point of view
		2. Word Knowledge	a. Understand learning area vocabulary
			b. Use spelling knowledge
		3. Text Knowledge	a. Use knowledge of text structures
			b. Use knowledge of text cohesion.
		4. Visual Knowledge	a. Understand how visual elements create meaning
		5. Composing texts through speaking, writing, and creating	a. Compose spoken, written, visual and multimodal learning area texts
			b. Use language to interact with others
			c. Deliver presentations.
		6. Comprehending texts through listening, reading and viewing	a. Navigate, read and view learning area texts
			b. Listen and respond to learning area texts
			c. Interpret and analyse learning area texts.
Numeracy	Develop the knowledge and skills to use mathematics confidently across other learning areas Recognising and understanding the role of mathematics in the world and having the dispositions and capacities to	1. Using Measurement	a. Estimate and measure with metric units
			b. Operate with clocks, calendars and timetables.
		2. Estimating and calculating with whole numbers	a. Understand and use numbers in context
			b. Estimate and calculate
			c. Use money

<table>
<tr><td rowspan="9"></td><td rowspan="9">use mathematical knowledge and skills purposefully</td><td>3. Recognising and using patterns and relationships</td><td>a. Solving problems in authentic contexts</td></tr>
<tr><td rowspan="2">4. Using fractions, decimals, percentages, ratios, and rates</td><td>a. Interpret proportional reasoning</td></tr>
<tr><td>b. Apply proportional reasoning</td></tr>
<tr><td rowspan="2">5. Using spatial reasoning</td><td>a. Visualise 2D shapes and 3D objects</td></tr>
<tr><td>b. Interpret maps and diagrams.</td></tr>
<tr><td rowspan="2">6. Interpreting statistical information</td><td>a. Interpret data displays</td></tr>
<tr><td>b. Interpret chance events.</td></tr>
<tr style="display:none"></tr>
<tr style="display:none"></tr>
<tr><td rowspan="10">Information and Communication Technology (ICT) Capability</td><td rowspan="10">Managing and operating ICT, while applying social and ethical protocols and practices

Students develop capability in using ICT for tasks associated with information access and management, information creation and presentation, problem-solving, decision-making, communication, creative expression and empirical reasoning

Students need the knowledge, skills and confidence to make ICT work for them at school, at home, at work and in their communities</td><td rowspan="3">1. Investigating with ICT</td><td>a. Define and plan information searches</td></tr>
<tr><td>b. Locate, generate and access data and information</td></tr>
<tr><td>c. Select and evaluate data and information.</td></tr>
<tr><td rowspan="2">2. Creating with ICT</td><td>a. Generate ideas, plans and processes</td></tr>
<tr><td>b. Generate solutions to challenges and learning area tasks.</td></tr>
<tr><td rowspan="2">3. Communicating with ICT</td><td>a. Collaborate, share and exchange</td></tr>
<tr><td>b. Understand computer-mediated communications.</td></tr>
<tr><td rowspan="3">4. Managing and Operating ICT</td><td>a. Select and use hardware and software</td></tr>
<tr><td>b. Understand ICT systems</td></tr>
<tr><td>c. Manage digital data.</td></tr>
<tr><td rowspan="7">Critical and Creative Thinking</td><td rowspan="3">Students generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems using unfamiliar information and new ideas</td><td rowspan="3">1. Reflecting on thinking and processes</td><td>a. Think about thinking (metacognition)</td></tr>
<tr><td>b. Reflect on processes</td></tr>
<tr><td>c. Transfer knowledge into new contexts.</td></tr>
<tr><td rowspan="3">Critical and creative thinking involves students thinking broadly and deeply using skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation</td><td rowspan="3">2. Inquiring – identifying exploring and organising information and ideas</td><td>a. Pose questions</td></tr>
<tr><td>b. Identify and clarify information and ideas</td></tr>
<tr><td>c. Organise and process information.</td></tr>
<tr><td>Creative, innovative, enterprising and adaptable,</td><td>3. Analysing, synthesising, and evaluating</td><td>a. Apply logic and reasoning</td></tr>
</table>

	with the motivation, confidence and skills to use critical and creative thinking purposefully.	reasoning and procedures	b. Draw conclusions and design a course of action
			c. Evaluate procedures and outcomes.
	Recognise or develop an argument, use evidence in support of that argument, and draw reasoned conclusions	4. Generating ideas, possibilities, and actions	a. Imagine possibilities and connect ideas
			b. Consider alternatives
			c. Seek solutions and put ideas into action.
Personal and Social Capability	Students learn to understand themselves and others, and manage their relationships, lives, work and learning more effectively Involves students in a range of practices including recognising and regulating emotions, developing empathy for others and understanding relationships, establishing and building positive relationships, making responsible decisions, working effectively in teams, handling challenging situations constructively and developing leadership skills	1. Self-management	a. Express emotions appropriately
			b. Develop self-discipline and set goals
			c. Work independently and show initiative
			d. Become confident, resilient and adaptable.
		2. Self-awareness	a. Recognise emotions
			b. Recognise personal qualities and achievements
			c. Understand themselves as learners
			d. Develop reflective practice.
		3. Social awareness	a. Appreciate diverse perspectives
			b. Contribute to civil society
			c. Understand relationships.
		4. Social management	a. Communicate effectively
			b. Work collaboratively
			c. Make decisions
			d. Negotiate and resolve conflict
			e. Develop leadership skills.
Ethical Understanding	Identify and investigate the nature of ethical concepts, values and character traits, and understand how reasoning can assist ethical judgement Students build a strong personal and socially oriented ethical outlook that helps them to manage context, conflict and uncertainty, and to develop an awareness of the influence that their values and behaviour have on others	1. Exploring values, rights and responsibilities	a. Examine values
			b. Explore rights and responsibilities
			c. Consider points of view.
		2. Understanding ethical concepts and issues	a. Recognise ethical concepts
			b. Explore ethical concepts in context.
		3. Reasoning in decision-making and actions	a. Reason and make ethical decisions
			b. Consider consequences
			c. Reflect on ethical action.

Intercultural Understanding	Learn to value their own cultures, languages and beliefs, and those of others Understand how personal, group and national identities are shaped, and the variable and changing nature of culture	1. Recognising culture and developing respect	a. Investigate culture and cultural identity
			b. Explore and compare cultural knowledge, beliefs and practices
			c. Develop respect for cultural diversity.
		2. Interacting and empathizing with others	a. Communicate across cultures
			b. Consider and develop multiple perspectives
			c. Empathise with others.
		3. Reflecting on intercultural experiences and taking responsibility	a. Reflect on intercultural experiences
			b. Challenge stereotypes and prejudices
			c. Mediate cultural difference.

Appendix C – Maths Methods Assessments

QUADRATIC FUNCTIONS AND BUILDING A BRIDGE

You have received a letter from a company seeking your help.

This investigation requires detailed mathematical working , which is to be presented back to the company in the form of a written portfolio.

An introduction , calculations , discussion and analysis are all expected features of your report.

BUILD A BRIDGE INDUSTRIES

29 Arch Road

Quiet Waters

SA 5871

Dear Student

Our company has been hired to build a walkway bridge over a gorge along the River Torrens. A suitable design is shown in the diagram on the following page . It is a suspension bridge where the walkway is suspended from the main steel cable , which is anchored on the sides of the gorge and is supported by two pillars. The main suspension cables can be considered to be parabolic curves. You will be required to do the following :

1. Calculate the entire length of steel needed for the suspension cables , and the support cables.
2. Present the above information in a report , clearly showing how you obtained your results.

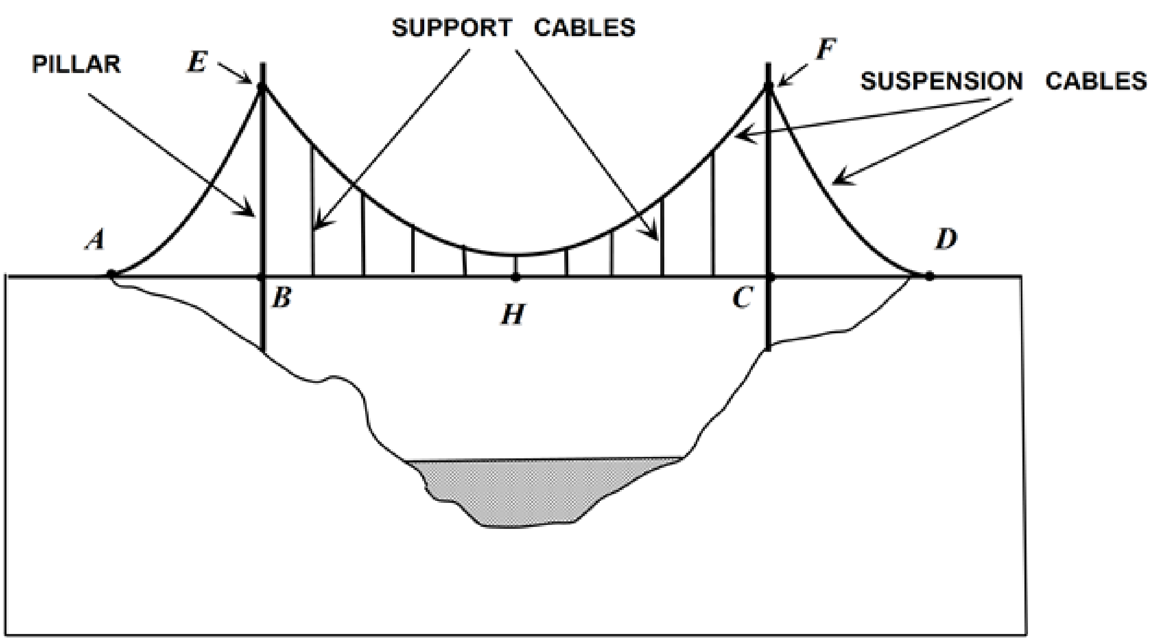
We trust that we have provided you with sufficient information. Please contact us if further assistance is required.

Yours Sincerely

Perry Bowler

(Design Manager)

Figure 17 – Stage 1 Maths Methods Quadratics Investigation Page 1



RIVER TORRENS SUSPENSION BRIDGE : DATA

1. The gorge, from A to D is 50 metres wide.

2. $AB = CD = 10$ metres.

3. At the centre of the bridge, the main steel cable is to be 2 metres above the walkway.

4. The vertical walkway support cables are to be 3 metres apart.

5. The distance BE has not been decided, but should be between 15 and 20 metres.

Figure 18 - Stage 1 Maths Methods Quadratics Investigation Page 2

MARKING SHEET MATHEMATICAL METHODS

Investigation 1: Quadratics

STUDENT NAME: ______________________________

	Performance standard	CT				RC					MARK
		1	2	3	4	1	2	3	4	5	
Introduction											
a. The **purpose** of the investigation	RC4										/2
b. A brief outline of any preliminary **assumptions**											/2
c. The **method** you will use to reach your final answer, including any relevant formulae	RC4										/2
Finding a Solution											
a. Carefully **draw a graph** of the bridge on a set of axes. Make *H* the origin.	CT1, CT2										/4
b. Determine the **quadratic functions** for the suspension cables.	CT1, CT2, CT3, RC4										/6
c. Substitute values into your functions (from part b) to obtain the lengths of the **support cables**.	CT1, CT2, CT3, RC1, RC4										/6
d. To determine the length of the **suspension cables**, an approximation technique can be used. Divide the cable into smaller sections using the divisions made by the support cables. Pythagoras' Theorem can then be used to determine the length of each part of the suspension cable.	CT1, CT2, CT3, CT4, RC1, RC4										/15
e. **Final Calculation**: calculate the total amount of steel required for the support and the suspension cables.	CT1, CT2										/2
Conclusion											
a. **Summarise** your results and conclusions in the context of the problem	RC1, RC4										/3
b. Discuss the **reasonableness/limitations** of your results.	RC2, RC4										/2
c. Any **adjustment** needed to your calculations? Any **recommendations** for improving accuracy?	RC2, RC4										/2
Communication											
a. **Neat** and easy to understand report with correct use of **mathematical notation.**	RC3, RC4										/3
Total											/49

Figure 19 - Stage 1 Maths Methods Quadratics Investigation Marking Sheet

APPENDIX D – ASSESSMENT PLANS

Table 22 - Stage 1 General Mathematics - Assessment Plan Semester 1

Stage 1 General Mathematics

Assessment Overview

The table below provides details of the planned tasks and shows where students have the opportunity to provide evidence for each of the specific features of both assessment design criteria.

Assessment Type and Weighting	Name and details of assessment	Assessment Design Criteria		Assessment conditions (e.g. task type, page limit, time allocated, supervision)
		C&T	R&C	
Skills and Applications Tasks Weighting 65%	Students demonstrate mathematical knowledge and skills from **Topic One: Investing and Borrowing**. The content covers key questions and key concepts within subtopics 1.1 and 1.2. Students apply their knowledge and skills to a range of routine and complex questions. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1, 2, 4	1, 2, 3	Supervised written assessment. One A4 page of handwritten notes permitted. Total time: 50 minutes
	Key questions and key concepts from **Topic Two: Measurement** is the focus of a range of routine and complex questions in SAT 2. Students demonstrate mathematical knowledge and skills of key questions and key concepts from measurement subtopics 2.1, 2.2, 2.3 and part of 2.4 (scales). Students apply their knowledge and skills to a range of routine and complex questions in a variety of contexts. Most questions require the aid of electronic technology. Correct use of notation and terminology are required.	1, 2, 4	1, 2, 3, 4	Supervised written assessment. Students will be provided with formulae for perimeter, area and volume and surface area. Total time: 50 minutes
	Topic Three: Statistical Investigation. Mathematical knowledge and skills based upon the key questions and key concepts from all subtopics are assessed. The assessment includes both routine and complex problems, some requiring interpretation and comparison of two or more sets of data. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1, 2, 4	1, 2, 3, 5	Supervised written assessment. One A4 page of handwritten notes permitted. Total time: 50 minutes
Mathematical Investigation Weighting 35%	In this task students are required to design one piece for an outdoor chess set using a combination of mathematical solids. They will then cost the construction of their design including casting in lightweight concrete and coating in a decorative paint. Scope for complexity is provided by the choice of piece to model and the mathematical solids used. Students are required to consider the reasonableness of their results by examining the underlying assumptions of their mathematical model.	1, 2, 3	1, 2, 3, 4, 5	3 weeks to complete. Some class time is allowed to support verification. **Maximum of 8 A4 pages.** Appropriate investigation report format as described in the General Mathematics subject outline.

***Four assessments**. Please refer to the Stage 1 General Mathematics subject outline.*

Table 23- Stage 1 General Mathematics - Assessment Plan Semester 2

Stage 1 General Mathematics

Assessment Overview

The table below provides details of the planned tasks and shows where students have the opportunity to provide evidence for each of the specific features of both assessment design criteria.

<table>
<tr><th rowspan="2">Assessment Type and Weighting</th><th rowspan="2">Name and details of assessment</th><th colspan="2">Assessment Design Criteria</th><th rowspan="2">Assessment conditions
(e.g. task type, page limit, time allocated, supervision)</th></tr>
<tr><th>C&T</th><th>R&C</th></tr>
<tr><td rowspan="3">Skills and Applications Tasks

Weighting
65%</td><td>Students demonstrate mathematical knowledge and skills from <u>Topic Four: Applications of Trigonometry</u>. The content covers key questions and key concepts within subtopics 4.2, 4.3, and 4.4. Students apply their knowledge and skills to a range of routine and complex questions.
The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results and considerations of limitations and assumptions.
Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.</td><td>1, 2, 4</td><td>1, 2, 3, 4</td><td>Supervised written assessment.
One A4 page of handwritten notes permitted
Total time: 50 minutes</td></tr>
<tr><td>Key questions and key concepts from <u>Topic Six: Matrices and Networks</u> is the focus of a range of routine and complex questions in SAT 2. Students demonstrate mathematical knowledge and skills in the key concepts of matrices (subtopic 6.1). Students apply their knowledge and skills to a range of routine and complex questions in a variety of contexts. Correct use of notation and terminology are required.</td><td>1, 2, 4</td><td>1, 2, 3, 4</td><td>Supervised written assessment.
One A4 page of handwritten notes permitted
Total time: 50 minutes
• Part 1: 15 minutes (no calculator)
• Part 2: 35 minutes (calculator permitted)</td></tr>
<tr><td><u>Topic Five: Linear and Exponential Functions and their Graphs.</u>
Mathematical knowledge and skills based upon the key ideas and key content from subtopics 5.1 and 5.2 are assessed. The assessment includes both routine and complex problems, some requiring interpretation of results in context. Construction of graphical representations may be required to support their problem-solving strategies.
Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.</td><td>1, 2, 4</td><td>1, 2, 3, 4</td><td>Supervised written assessment.
One A4 page of handwritten notes permitted
Total time: 50 minutes</td></tr>
<tr><td>Mathematical Investigation

Weighting
35%</td><td>Students are required to demonstrate their understanding and skills in applying concepts from subtopic 6.2 to formulate and solve a network-based problem drawn from their local environment. Once a solution has been found they are expected to consider the effects of modifying the original parameters of the problem. This could be either because of a change in conditions or a desire to upgrade the system under consideration.</td><td>1, 3</td><td>1, 2, 3, 4, 5</td><td>3 weeks to complete. Some class time is allowed to support verification.
Maximum of 8 A4 pages.
Appropriate folio format as described in the General Mathematics subject outline.</td></tr>
</table>

Four assessments. *Please refer to the Stage 1 General Mathematics subject outline.*

Table 24 - Stage 1 Maths Methods - Assessment Plan Semester 1

The table below provides details of the planned tasks and shows where students have the opportunity to provide evidence for each of the specific features of both assessment design criteria.

Assessment Type and Weighting	Name and details of assessment	Assessment Design Criteria		Assessment conditions (e.g. task type, page limit, time allocated, supervision)
		C&T	R&C	
Skills and Applications Tasks Weighting 80%	**SAT 1: Quadratics.** Students demonstrate mathematical knowledge and skills from Topic 2. The content covers key questions and key concepts within subtopics 2.1. Students apply their knowledge and skills to a range of routine and complex questions. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3	1,3	Supervised written assessment. Total time: 70 minutes Calculator permitted 1 A4 page of handwritten notes.
	SAT 2: Functions & Relations. Students demonstrate mathematical knowledge and skills from Topic 2. The content covers key questions and key concepts within the subtopic 1.4. Students apply their knowledge and skills to a range of routine and complex questions. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3	1,3	Supervised written assessment. Total time: 70 minutes Calculator permitted 1 A4 page of handwritten notes.
	SAT 3: Polynomials. Key questions and key concepts from Topic 2. The content covers key questions and key concepts within subtopic 2.2. SAT 3 is divided into two parts: Part 1: Routine type questions covering first components from subtopic 2.2. Calculations without electronic technology (e.g. Finding and stating different parts of the cubic, solving cubics given a linear factor, finding cubics given zeros, Using the discriminant along with sign diagram, factorising cubics, Part 2: Questions more complex in nature covering components from the latter part of 2. Calculations with access to electronic technology. (eg finding exact zeros, sketching cubics, domain & range of cubics, practical application of cubics) The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Construction of graphical representations may be required to support their problem-solving strategies. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3	1,2,3	Supervised written assessment. Part 1.: 40 minutes No calculator permitted Part 2.: 30 minutes Calculator permitted 1 A4 page of handwritten notes.
	SAT 4: Non Right Angled Trigonometry. Key questions and key concepts from Topic 3. The content covers key questions and key concepts within subtopic 3.1. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Construction of graphical representations may be required to support their problem-solving strategies. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3,4	1,2,3	Supervised written assessment. Total time: 70 minutes Calculator permitted 1 A4 page of handwritten notes.
	SAT 5: The Unit Circle, Radian Measure & Trigonometric Functions. Key questions and key concepts from Topic 3. The content covers key questions and key concepts within subtopics 3.2 and 3.3. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Construction of graphical representations may be required to support their problem-solving strategies. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3,4	1,2,3	Supervised written assessment. Total time: 70 minutes Calculator permitted 1 A4 page of handwritten notes.
Mathematical Investigation Weighting 20%	**Quadratics & Building a Bridge.** This investigation is predominately based on sub topic 2.1. Students use right angled trigonometry and quadratic functions to work out the length of steel cabling needed to build a suspension bridge over the River Torrens. Students also explore the concept of calculating the length of a curved piece of cable by breaking it down into smaller parts and then using Pythagoras or the distance formula to estimate the length needed. They also need to provide a write up in the form of a tender that explains how they reached their conclusion in detail.	1,2,3	1,2,3,4,5	3 weeks to complete. Some class time is allowed to support verification. Maximum of 8 A4 pages. Appropriate investigation report format as described in the Mathematics subject outline.

Table 25 - Stage 1 Maths Methods - Assessment Plan Semester 2

Stage 1 Mathematics
Assessment Overview

The table below provides details of the planned tasks and shows where students have the opportunity to provide evidence for each of the specific features of both assessment design criteria.

Assessment Type and Weighting	Name and details of assessment	Assessment Design Criteria		Assessment conditions (e.g. task type, page limit, time allocated, supervision)
		C&T	R&C	
Skills and Applications Tasks Weighting ____%	**SAT 1: Counting and Statistics.** Students demonstrate mathematical knowledge and skills from Topic 4. The content covers key questions and key concepts within subtopics 4.1, 4.2, 4.3 and 4.4. Students apply their knowledge and skills to a range of routine and complex questions. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3,4	1,2,3,4	Supervised written assessment. Total time: 60 minutes Calculator permitted 1 A4 page of handwritten notes
	SAT 2: Calculus. Key questions and key concepts from Topic 6. The content covers key questions and key concepts within subtopics 6.1, 6.2, 6.3, 6.4 and 6.5. SAT 2 is divided into two parts: Part 1 will be completed without a calculator and involve first principles and the derivatives of polynomials. Part 2 will be completed with a calculator and focus on more complex derivations, the properties of derivatives and applications. Conjecture work will be incorporated. Routine questions will address questions on rate of change and computation of polynomial functions. Complex questions will involve first principles and application of derivatives. Conjecture question(s) will be presented. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3,4	1,2,3,4	Supervised written assessment. Part 1 : 30 minutes No calculator permitted Part 2 : 30 minutes Calculator permitted 1 A4 page of handwritten notes
	SAT 3: Growth and Decay. Key questions and key concepts from Topic 5. SAT 3 will cover content from the entire topic. Routine questions will focus on the use of logarithm and indices rules and surd to index form and visa-versa. Complex questions will involve exponential functions, their features and characteristics. It will also consider the application of logs in base 10 and the interpretation of real-life scenarios. The complex questions require students to apply the key concepts to solve problems in a variety of contexts and some require interpretation of the results. Appropriate and effective use of electronic technology is expected. Clear and logical communication of solutions and correct use of notation and terminology are required.	1,2,3,4	1,2,3,4	Supervised written assessment. Total time: 60 minutes Calculator permitted 1 A4 page of handwritten notes
Mathematical Investigation Weighting ____%	**Modelling With Derivatives – Cake Tin Optimisation.** This investigation is based on Topic 6 – Introduction to Calculus. Students develop a conjecture on how to optimise the volume of an open cake tin, given it is to be made from cutting the corners of a piece of square tinplate. The model is further explored when students consider cutting the corners from a rectangular plate to form the cake tin. Conjectures will be made based on observations made from calculations completed. Students are then given the opportunity to prove their conjectures through the use of calculus.	1,2,3,4	1,2,3,4,5	1 week to complete. Some class time is allowed to support verification. Maximum of 8 A4 pages. Appropriate investigation report format as described in the Mathematics subject outline.

Four assessments. *Please refer to the Stage 1 Mathematics subject outline.*