Driving Force?

Motivations of Senior Mathematics Students enrolled in National Certificate of Educational Achievement (NCEA) Level III Statistics & Modelling.

A thesis presented in partial fulfilment of

the requirements for the degree of:

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Abstract

The objective of this study was to explore how senior mathematical students made sense of their mathematical experience through the New Zealand National Certificate of Educational Achievement (NCEA) qualifications system, and from that exploration to understand what factors motivated these students and to which factors these students attributed their mathematical success.

The research is based on Constructivist Theory, with ethnomethodology as the methodological approach. The methodological tool utilised in the study was an online questionnaire. The students who completed the questionnaire attended an urban, co-educational, decile 8 secondary school in New Zealand. The participants were students aged 16 years old and over, enrolled in a full year NCEA Level 3 Statistics and Modelling Achievement Standards programme in 2013.

The students in the sample were aware that there were set criteria within each grade for NCEA Level 3 Statistics and Modelling assessment tasks. The students were mindful that achievement was measured in discrete units. Evidence from the research suggests that to maximise student learning within the NCEA qualifications system, Level 3 Statistics and Modelling needs to be taught as a collective, cohesive statistics curriculum.

The students in the sample attributed their highest mathematical outcomes to ability, effort and the teacher and their lowest mathematical outcomes to lack of ability, lack of effort and the level of difficulty of the assessment. The findings highlighted the importance of prioritising the teacher and student relationship. In the study, only 12% of students were convinced that their teacher was interested in them at an individual level. NCEA Level 3 Statistics and Modelling teachers need to be aware of the influence of the teacher and student relationship on student achievement.

The findings from the research have implications for teaching and learning. The research evidence indicates a need for NCEA Level 3 Statistics and Modelling students to be aware of the non-numerical content and grade criteria expectations of the Statistics and Modelling Achievement Standards prior to committing to the course.

Candidate's Statement

I certify that the research project entitled:

Driving Force?

Motivations of Senior Mathematics Students enrolled in National Certificate of Educational Achievement (NCEA) Level III Statistics & Modelling.

and submitted as part of the Master of Education, is the result of my own work except where otherwise acknowledged and that this research project (or any part of the same) has not been submitted for any other degree to any other university or institution.

Signed: ______________________________

Jackie Fraser Webb

Date: ______________________________

Acknowledgements

"I can do all things through Christ which strengtheneth me."

Philippians 4:13, King James Version

I have been very blessed to have some amazing people share the journey to thesis completion. They have been my "Driving Force".

To the Board of Trustees, Principal and the Mathematics Department from the school who gave their consent for this study, thank you for your commitment to the research and for allowing access to your NCEA Level 3 Statistics and Modelling classrooms. To the 98 students who shared their perceptions and beliefs about mathematics, thank you. I appreciate your participation, honesty and candidness.

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I am very blessed to have a cohort of delicious "mummy friends". The influence of these special women is woven throughout the pages of this script. They have cared for my children, fed my family, proof read my work and let me speak incessantly about motivation while we swam and ran.

To my family, thank you for your love, tolerance and inspiration through the years of Masters study and research. Thank you to my parents for always believing in me and to my three precious children. I pray that you will have the same life-long love of learning as your Mum.

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Chapter One

Introduction

1.1 Introduction

Success matters. It matters at school. It matters in life… and yet not all students are successful.

Why do some students pursue excellence while others do the minimum required? This important question leads to other questions such as: How do students engage with their learning? How do students engage with mathematics? And how do students engage with assessment? Three fundamental questions channelled the development of this thesis.

We live in a time of economic competition, employment scarcity and dramatic technological change. In times of financial recession, there is a societal expectation that students in secondary school would be working harder than ever to ensure their place in tertiary institutions or trade apprenticeships or the employment market. However, teachers are increasingly reporting that students are harder to engage and less interested than ever before.

It would appear that mathematics is unique in its ability to polarise students and adults alike. When students are younger they experience mathematics' learning with joy. They expect to be good at it and show resilience in the face of frustration when presented with a new challenging mathematical task. Unfortunately this does not continue, in fact, it diminishes with age. Throughout their secondary school career, students increasingly perceive mathematics for its utilitarian value rather than intrinsic enjoyment (Cotton, 2001; Ernest, 2000; Meyer, McClure, Walkey, McKenzie, & Weir, 2006). Often, by adulthood, people resign themselves to belonging in the "not good at maths camp".

Assessment is perceived to be the primary driver of the education system (Hipkins, 2010). The New Zealand Qualifications Authority adopted the National Certificate of Educational Achievement (NCEA) as the national secondary school qualifications system in 2002. The purpose of NCEA was to ensure that more students left school with qualifications. To make that happen assessment moved towards a standards based qualification system. A decade after the implementation of NCEA, research into the effects that the assessment system is having on students' willingness to engage is becoming more established. NCEA has proven to have both positive and negative influences on student motivation. The gains in motivation of high achievers are not similarly reflected in the motivation patterns of students with a lower attainment record (Hipkins, 2010). Research has shown that students whose motivation is to do the minimum requirement to pass, rather than trying their best, receive the lowest number of credits (Hodis, Meyer, McClure, Weir, & Walkey, 2011; Meyer et al., 2006; Meyer, McClure, Walley, Weir, & McKenzie, 2009; Meyer, McClure, Weir, Walkey, & McKenzie, 2009).

As a secondary school mathematics teacher, I had a compelling reason to research student motivation. My own professional practice could only improve by a deeper understanding of student engagement.

This chapter is divided into three mains sections: the background to the research, the research focus and the thesis overview. The background of the study is discussed with reference to motivation, mathematics, NCEA and NCEA Level 3 Statistics and Modelling. The research focus provides discussion on the research question and the key objectives of the study. The thesis overview provides an outline of the thesis and a brief summary of chapter content.

1.2 Background to Research

1.2.1. Motivation

> "There is a driving force more powerful than steam, electricity and atomic energy: the *will*."
>
> Albert Einstein

The title of this thesis is "Driving Force". A driving force has been defined as "the impetus, power, or energy behind something in motion"(Dictionary.com, 2013). With reference to motivation in education, the 'something in motion' is the learning, and the student's impetus, power or energy is the force that drives the learning.

Motivation matters. There is an overwhelming body of research to prove it (for example, Carr, 1996; Dowson & McInerney, 2003; Ellsworth, 2009; Middleton & Jansen, 2011; Moe, 2011b; Pink, 2009). Motivation has been defined as "the process whereby goal-directed activities are instigated and sustained" (Schunk, Meece, & Pintrich, 2014). A student successful in their learning needs to have the essential knowledge, skills and competencies. However, in order to hold these requisites of success, the student must be prepared to invest energy, focus and effort (Sternberg, 2010). A student's motivation activates engagement in the learning task, enables persistency of effort in the face of failure and frustration, and mediates the level of effort given by the student.

Two key theories relating to the motivational orientations of students are attribution and self-efficacy. Attribution theorists suggest that students make a judgement on their level of responsibility for an educational outcome, based on the perceived cause of success or failure. Weiner's Attribution Theory (1985) originally cited four significant attributions that students make for their achievement outcomes: ability, effort, task difficulty and luck. The emotional reaction to the attributed cause creates, in the student, expectations of the level of future success and directs their behaviour (Martin & Dowson, 2009; Weiner, 1985; Yailagh, Lloyd, & Walsh, 2009).

The flow on effect of student attribution is represented in Figure 1.1 Attribution Theory (adapted from Sternberg, 2010):

Figure 1.1 Attribution Theory

When investigating why students do what they do, students' beliefs in their own abilities have a huge influence over the choices they make. Originally developed by Bandura (1977, 1997), self-efficacy theories propose that students will persist and expend effort on learning tasks that they believe themselves capable of and avoid learning tasks that they believe exceed their abilities. The relationship between efficacy expectations and outcome expectation, adapted from Bandura (1997) is represented in Figure 1.2 Self-efficacy Theory:

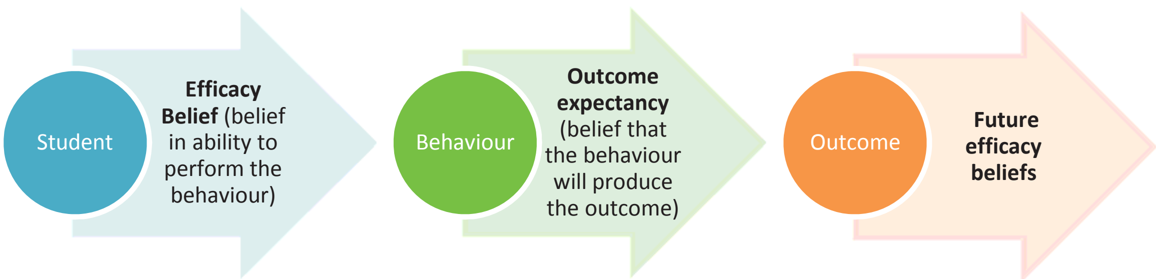

Figure 1.2 Self-efficacy Theory

The research shows that there is a complex connection between student attributions, student efficacious beliefs and successful achievement outcomes (Ellsworth, 2009; Fast et al., 2010; Hock, Deshler, & Schumaker, 2009; Martin & Dowson, 2009; Middleton & Jansen, 2011; Skaalvik & Skaalvik, 2009; Usher, 2009; Usher & Pajares, 2009; Yailagh et al., 2009).

1.2.2 Mathematics

The role of mathematics takes many forms within society. These, and their spheres of power and influence, are numerous. It has been argued that "mathematics is so present as to be like the air around us" (Davis, 2001, p. 19). Given that "society is increasingly formalized and mathematized" (Gellert, Jablonka, & Keitel, 2001, p. 90), there could perhaps be an expectation that mathematical attitudes would reflect this perspective within New Zealand classrooms. Success in mathematics leads to advantage, both academic and in the employment market, and from that understanding mathematics has come to be described as a 'critical filter' (Sells, 1973). Studies continue to show that school mathematics is viewed as being challenging, difficult and attainable only by an elite (Boaler & Greeno, 2000; Orton, 1994), with only half of the student population enjoying and achieving recognised success (Ernest, 2000). Therefore, a mathematics qualification continues to be a scarce resource, which is valued, if not somewhat revered by society.

Given the increasing "mathemacy" of society (Cotton, 2001; Davis, 2001), students who are committed and motivated to succeed in mathematics are integral to society's development and progress. Within our mathematics classrooms, we need students who have the "will and the skill" to succeed (Middleton & Jansen, 2011, p. 39).

1.2.3 NCEA

Teaching, learning and assessment are all integral to the education process. Assessment fulfils many roles within education. According to educational research, assessment can:

i. Enable students to learn what they know about a subject and learn about themselves as learners (Gilmore & Smith, 2008)
ii. Direct student learning for both the student and the teacher (Meyer, McClure, Weir, et al., 2009)
iii. Provide certification of individual students (Black & Wiliam, 1998)
iv. Arouse student interest and motivation (Brown & Hirschfield, 2007)
v. Enable public accountability of institutions and teachers (Black & Wiliam, 1998; Pfannkuch, 2001)
vi. Provide evidence of students' potential to succeed in the future (Gilmore & Smith, 2008)
vii. Provide criteria for selection and grouping of students (Meyer, McClure, Weir, et al., 2009)

viii. Be an engine that drives systematic curricula reform (Black & Wiliam, 1998).

The New Zealand National Certificate of Educational Achievement (NCEA) was developed in response to the numbers of secondary school students leaving school without qualifications (New Zealand Qualifications Authority, 2013). The introduction of NCEA in 2002 was a move away from the traditional high stakes, external examinations of School Certificate, Sixth Form Certificate and University Bursary, to a standards-based assessment system. The intention of the criterion referenced NCEA system was to strengthen connections between student learning and achievement outcomes, measuring how a student performs against a particular learning outcome rather than comparing how a student performs in relation to other students (Meyer et al., 2006; Meyer, McClure, Weir, et al., 2009). The Ministry of Education's goal via the assessment system was to address the learning needs and improve education outcomes for *all* students (Ministry of Education, 2001).

The move towards a standards-based assessment system is consistent with the trend towards assessment for learning rather than assessment of learning (Rawlins et al., 2005). Within the senior secondary school, NCEA provides three levels of a national qualification and comprises a mix of internal and external assessments. Within each Achievement Standard, students can gain one of four the following four grades, Not Achieved, Achieved, Merit and Excellence. In 2008, Merit and Excellence Endorsements were introduced for additional recognition of high achievement across all subject standards. In 2011, course endorsement was introduced to enable students with strong performances in single subjects to gain Excellence or Merit endorsements in those courses. From 2011 to 2013, NCEA Achievement Standards have been remodelled. The process began with Level 1 in 2011, NCEA Level 2 in 2012 and in 2013 NCEA Level 3. The remodelling was implemented following concerns over credit parity and duplication across Achievement Standards and to align the standards with the new New Zealand Curriculum (New Zealand Qualifications Authority, 2013).

Hattie's (2013) introduction to Madjar and McKinley's (2013) book "Understanding NCEA", suggests that the NCEA qualifications system reflects the modern working environment. Credits and courses provide ways to learn new things, internal and external assessments provide different tasks and there are multiple ways to measure performance.

Madjar and McKinley (2013) provide the following advice to NCEA students: "It is up to you how hard you want to work and which assessments you want to attempt" (p. 18). Assessment and motivation are inextricably linked. Successful achievement outcomes on assessment tasks are in a sense the desired result of motivated learning behaviour. Equally, assessment tasks can cue certain motivational behaviours and efficacy beliefs (Brookhart, 2013).

1.2.4 NCEA Level 3 Statistics and Modelling

At NCEA Level 3, students choosing to continue in their mathematical studies have the option of enrolling in either Statistics and Modelling, or Calculus. At the start of a NCEA Level 3 course, typically students have had twelve years of mathematical learning in the schooling system and at least two years involvement with NCEA (Level 1 and 2). The students' experiences provide familiarity with mathematics in the classroom and NCEA. The cohort of students chosen for this study is the first to have been assessed using the remodelled NCEA at Levels 1 and 2, and Level 3 in 2013. The changes to the Achievement Standards and the students' prior experiences with mathematics at school and NCEA were the rationale behind choosing NCEA Level 3 Statistics and Modelling students for the study.

Individual schools decide on which Achievement Standards they will offer for the NCEA Level 3 Statistics and Modelling course. The students in the research study sample had just completed an internal assessment for the Achievement Standard 91580 'Investigate Time Series', which was worth four credits. The assessment required the students to produce a report over four class periods, during which the teacher was able to ask the students questions about their report writing process.

The NZQA website (New Zealand Qualifications Authority, 2013) states that the 'Investigate Time Series' achievement standard is derived from Level 8 of The New Zealand Curriculum, and is related to the achievement objective 'Carry out investigations of phenomena using the statistical enquiry cycle'. The achievement standard requires the students to: use existing data sets, find, use, and assess appropriate models, seek explanations, and make predictions, use informed contextual knowledge, communicate findings and evaluate all stages of the cycle.

The achievement criteria for attaining the grade "Achieved" requires investigating time series data showing evidence of using each component of the statistical enquiry cycle. A "Merit" grade requires investigating time series data, *with justification,* and involves linking components of the statistical enquiry cycle to the context, and referring to evidence such as statistics, data values, trends or features of visual displays in support of statements made. To achieve the excellence criteria, a student must investigate time series data, with *statistical insight*. This involves integrating statistical and contextual knowledge throughout the statistical enquiry cycle, and may include reflecting about the process, considering other relevant variables, evaluating the adequacy of any models or showing a deeper understanding of models.

1.3 Research Focus

There were three key strands that underpinned the direction of the thesis. These were engagement and desire to learn, engagement and desire to learn mathematics, and engagement and desire to learn within the NCEA assessment system. This is represented in Figure 1.3 Research Strands:

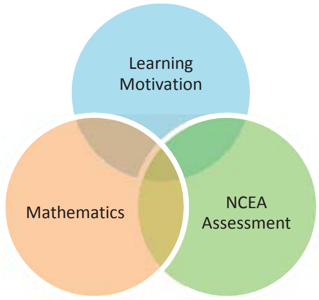

Figure 1.3 Research Strands

The overlap between these three components led to the research question:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The objective of the research is to explore how senior mathematical students make sense of their mathematical experience through the NCEA qualifications system, and from that exploration to understand what factors motivate these students in their mathematical studies and to what students attribute mathematical success.

1.4 Thesis Overview

The thesis is divided into three sections. Section I provides the background and rationale for the study, through this introductory chapter and the Literature Review in Chapter Two. The literature review explores established learning motivation research and then focusses on the motivational theories of attribution and self–efficacy. Research specific to motivation and mathematics and motivation and NCEA is then reviewed.

Section II (Chapters Three, Four and Five) describes the logistics and findings of the study in response to the research question. Chapter Three concerns the research method and design. The chapter describes the methodological approach taken, the research project process, and relevant validity and reliability measures for the study. The data that emerged from the questionnaire are explored in Chapter Four. Chapter Five provides the analysis and discussion of the findings under two main subheadings: i) making sense of NCEA and ii) student motivational influences and attributions.

Section III of the thesis (Chapter Six) summarises the findings from the study. Chapter Six is divided into four areas of discussion: chapter summaries, limitations of the study, implications for teaching and learning, and recommendations for future research.

The thesis overview is summarised Figure 1.4 Thesis Overview:

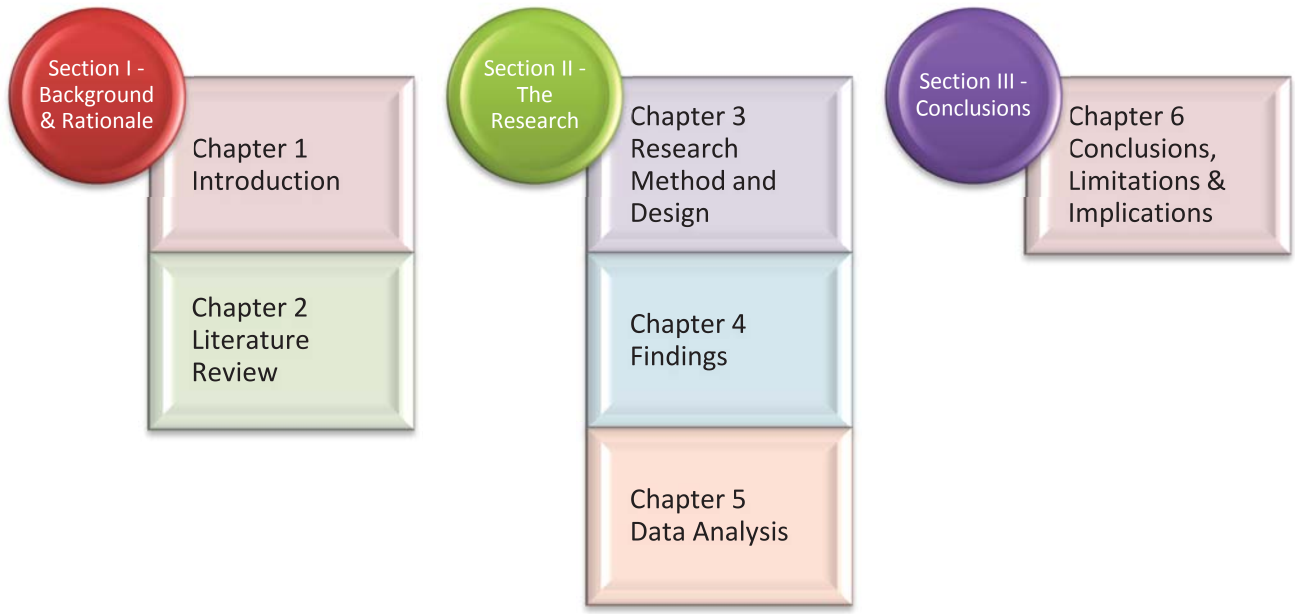

Figure 1.4 Thesis Overview

1.5 Summary

This first chapter has introduced the research question for the study:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The key objectives of the research were established, first, as being to explore the way in which senior mathematical students make sense of their experiences within the NCEA qualifications system. The second intention of the research was to seek understanding of the factors that motivate these students and to what they attribute their mathematical success.

The research question was developed, following an introduction into the areas of learning motivation, mathematics, and NCEA. The literature review in the next chapter will elaborate on these three strands of research.

Chapter Two

Literature Review

2.1 Introduction

The research question for the study is:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The purpose of the literature review is to explore previous empirical evidence involving the research strands of motivation, mathematics and NCEA. The review seeks to demonstrate what the wider evidence shows in relation to the research question, in order to establish what is known and what is not known about the question. An examination of both theoretical and research literature has been included in the review. Theoretical literature provides current thinking and theorising on the themes and research literature describes current knowledge through empirical evidence. The second intention of the literature review is to locate my research question in relation to the previous literature.

The literature review was developed by funnelling from the general literature on learning motivation, through to theories of attribution and self-efficacy, and finally to research specific to motivation and mathematics and motivation and NCEA.

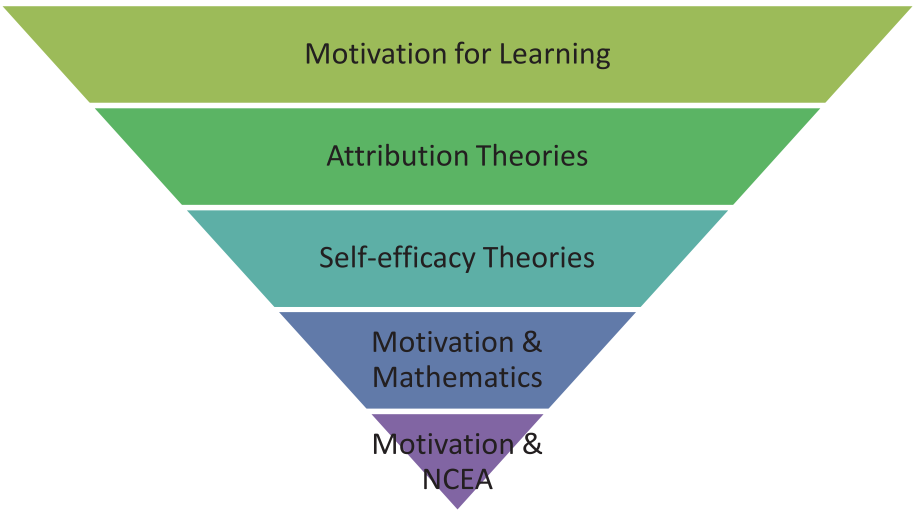

Figure 2.1 Literature Review Process

2.2 Motivations for Learning

There is an established library of literature on learning motivations and student motivation orientations and the effects that these have on student achievement.

Schunk and his associates (2014) define *motivated learning* as the "motivation to acquire skills and strategies rather than to perform tasks" (p. 377). When students are motivated they become interested and receptive learners (Posamentier & Krulik, 2012). Hodis and colleagues' research (Hodis et al., 2011) demonstrated that students' negative motivation patterns were predictive of underachievement across the final three years of secondary school.

Motivations for learning can be divided into two broad categories: extrinsic motivation and intrinsic motivation. Extrinsic motivation takes place outside of the learner's control, for example, rewards, peer acceptance, praise, and avoidance of punishment. Intrinsic motivation occurs within the learner, for example, desire for mastery of a subject, competition, to impress others, or a desire to be autonomous.

In their article summarising the findings from research on learning motivation in mathematics over the last 20 years, Middleton and Spanias (2002, p. 9) list the following five statements as the "solid, verifiable evidence on what factors influence motivation" :

- Motivation hinges on how students attribute their successes and failures.
- Motivations are learned.
- Intrinsic motivation is better than engagement for a reward.
- Teachers matter.
- Inequalities are influenced by how different groups are taught mathematics.

I have chosen to focus on how students attribute and interpret their mathematical outcomes and the influence that this may have on future outcomes. The other four "cornerstone" statements about student motivation for learning mathematics are referred to briefly throughout the literature review in reference to student attribution.

When students begin their formal learning career at school they seem to have a natural desire to learn. Younger children have a high expectation of success and will persist in the face of frustration and failure. Unfortunately, over time learner resilience diminishes, in the face of perceived inability or failure, motivation to learn dwindles (Hock et al., 2009; Pressley & Ghatala, 1989).

For the purposes of the study, motivated and non-motivated are not viewed as mutually exclusive categories, and motivation for learning is perceived to be deeply personal and unique to each student and the setting. As argued by Larroa and Jazmin (2013), "human motivation is likely to be linked to what makes each human being unique" (p. 34).

Middleton and Jansen (2011) suggest that a student's motivational orientation is a multi-dimensional inter-relationship between classroom organisation, social setting, teacher enthusiasm, assessment, the student's belief about their ability, and the importance of mathematics.

2.3 Attribution Theory

Attribution Theory provides a framework for the inter-relationship between attributions, effort and achievement. Weiner's Attribution Theory (1985) proposes that the attributions that people make for their successes and failures form their emotional and motivational reaction to the outcomes and their future behaviour. Students may attribute any given outcome to causes such as effort, ability, assessment, luck or other causes. Attributions are categorised according to their locus, stability and controllability (Martin & Dowson, 2009). The locus dimension of Weiner's theory refers to whether the cause is *internal*, for example, ability, effort, enjoyment or *external*, for example, the teacher, difficulty of assessment, or luck. The stability dimension of Attribution Theory concerns the constancy of the cause and controllability refers to the student's perception of how much influence they have over the outcome.

Table 2.1 Weiner's Attribution Model summarises Weiner's original attribution model (1985):

Table 2.1 Weiner's Attribution Model

Stability Dimension	**Locus of causality**	
	Internal	*External*
Stable	Ability	Task difficulty
Unstable	Effort	Luck

When students attribute a failure to perceived stable causes, such as lack of ability, they are likely to lose interest and motivation in the subject, whereas, if they attribute failures to unstable attributes, such as effort, they are more likely to persevere or try harder (Meyer et al., 2006). If a student attributes lack of ability as their reason for failing, and they believe that ability is fixed they may be inclined to not attempt a similar task in the future. A sense of "helplessness" can occur in the student as they lose hope and stop trying (Yailagh et al., 2009). Conversely, if students attribute failure to lack of effort, they have an expectation of success if they commit greater effort. This phenomenon has been described by Dweck (2006) as the *fixed mindset* and the *growth mindset*. In the context of the classroom, one perspective regards intelligence as something that you demonstrate, for the other, intelligence is something that you develop. Middleton and Jansen (2011) summarise the research into student beliefs for their academic success in the following statement "attributing successes to a combination of the internal factors, namely ability and effort, and attributing non-success to a lack of effort leads to highly productive academic behaviours and subsequent performance" (p. 91).

Attributions do not operate in isolation for an individual student. The dimensions in Weiner's Attribution Theory are shaped by the feedback and opinions of others. Similarly, the attributions from significant others can have an impact on students' future behaviour and emotions. A teacher's, parent's or peer's inferences about the cause of an event have the potential to influence the student's reaction. For example, if a parent attributes a student's success to excellent effort and hard work, this can induce positive feelings of pride for the student. Equally, if a parent explicitly attributes a low achievement outcome to ability, the student may stir up negative feelings of shame (Martin & Dowson, 2009).

2.4 Self-Efficacy

Attribution has been found to be related to self-efficacy (Shores & Shannon, 2007; Yailagh et al., 2009). Self–efficacy is the belief that students have in their own capabilities (Usher & Pajares, 2009). It is the confidence that students have in their ability to achieve certain outcomes. Efficacy expectations determine the level and duration of effort people will commit in the face of challenge (Bandura, 1977). Research has established four sources of efficacy expectations: mastery experience, vicarious experience, social persuasions, and emotional and physiological states (Bandura, 1977; Fast et al., 2010; Hoffman, 2010; Skaalvik & Skaalvik, 2009; Usher & Pajares, 2009).

The *mastery experience* is the most powerful source of self-efficacy beliefs (Usher & Pajares, 2009). When students complete a task, they assess their results and make conclusions about their competency, alongside objective performance. Success raises efficacy and failure lowers it. However, once a strong sense of efficacy has developed, the effect of a failure is mitigated (Yailagh et al., 2009). Mastery success is especially powerful and long lasting if the task is challenging .

Vicarious experience is gained as students compare their success and competency to that of their peers. By observing others, students make a prediction of their own success based on their perceived similarities and the perceived competence of the person being observed (Martin & Dowson, 2009; Middleton & Jansen, 2011). A classroom environment where students learn, share and encourage each other can promote opportunities for mathematical role models from which students can gain positive self-efficacy beliefs (Bandura, 1997).

The *social persuasions* of others, through encouragement of trusted parents, teachers and peers, have the capacity to increase students' confidence in their competency (Usher & Pajares, 2009). However, unfortunately, social persuasions are more effective in their ability to operate negatively on students' self-efficacy (Bandura, 1997).

Emotional and physical states affect a student's ability to perform well. For example, fatigue and discouragement impact on the levels of effort required for success and, if they continue, have the potential to negatively impact efficacy (Middleton & Jansen, 2011).

In the research, high self-efficacy consistently strongly correlates with students' academic achievement (Jain & Dowson, 2009; Middleton & Jansen, 2011; Skaalvik & Skaalvik, 2009; Usher & Pajares, 2009).

According to Meyer and colleagues (2009), the impact of teacher behaviour on student motivation originated in the 1913 writings of Dewey. Martin and Dawson (2009) argue that it is through the modelling and supportive communication of teachers that students gain a sense of self-efficacy. The authors refer to the emerging concept of "connective instruction", suggesting that teachers who scaffold teaching practice on relational foundations are more likely "to foster motivated, engaged and achieving students" (Martin & Dowson, 2009, p. 344). With regard to the teacher's ability to capture the interest of the students, research has shown that the "effectiveness package" is 7% what the teacher says, 38% the teacher's tone of voice and enthusiasm and 55% the teacher's body language (Posamentier & Krulik, 2012, p. ix). Moe (2011b) argues that teachers have the opportunity to motivate their students by teaching in ways that foster motivation and also by modelling passionate motivational behaviours. In her article "Motivated teachers motivate students", Moe proposes that teachers play a crucial role in shaping not only the knowledge that students require, but also the willingness to acquire it. Tschannen-Moran and Woolfolk Hoy (2001) suggest that teachers are more effective at fostering self-efficacy in their students if they identify positive efficacious beliefs in their teaching. Studies have shown that a mathematics teacher's attitude towards mathematics as a subject has the greatest influence over student perceptions of the subject (Boaler & Greeno, 2000; Cotton, 2001). Teachers' motivation is an important influence on students' motivation.

Beyond the individual teacher is the environment for learning. The classroom culture can affect achievement motivation through opportunities for co-operative learning. In co-operative learning students work in small groups or teams on an academic learning task (Slavin, 2010). Students are encouraged to help each other to reach their achievement goals. When compared to individualistic, competitive classroom culture, research has shown that co-operative learning is more effective for many learning, higher level thinking and problem solving tasks (Martin & Dowson, 2009; Slavin, 2010). Co-operative learning theorists argue that self-efficacy is enhanced through successful negotiation of shared goals, mutual rewards and the collective use of intellectual and physical resources (Slavin, 1995, 2012). A student with a positive motivational learning orientation can "spread motivation to others" (Moe, 2011b, p. 281).

2.5 Motivation and Mathematics

When considering motivation for learning in the literature, Middleton and Jansen (2011) argue that mathematics is a special case. In relation to mathematics, motivation reflects perhaps the "societal displeasure with the study of mathematics, which sadly infects our students" (Posamentier & Krulik, 2012, p. 6). It would seem that mathematics is a subject which many of the population feel that it is okay to "fail". Researchers have argued that negative comments from parents, such as, "Well I was never any good at maths" reinforce the social reproduction of attitudes towards mathematics, while also being personally disempowering and harmful to the self-esteem of the student and parent (Cotton, 2001; Orton, 1994).

When students are younger they focus on whether they enjoy mathematics or not, the joy of the task was its own reward. Increasingly, students lose interest in mathematics for enjoyment and instead base their subject choices on perceived utility or importance (Boaler & Greeno, 2000; Meyer et al., 2006).

The research suggests an on-going reciprocal interaction among mathematics self-efficacy expectations and mathematics anxiety, mathematics achievement, and mathematics related majors and career choices (Middleton & Jansen, 2011; Yailagh et al., 2009). Figure 2.2 demonstrates that interaction.

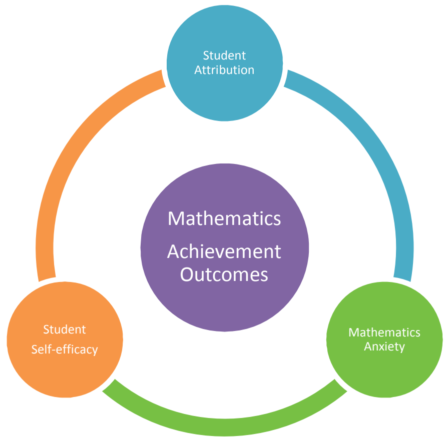

Figure 2.2 Attribution, Efficacy, Anxiety and Mathematical Achievement Outcomes

Self-efficacy has an inverse relationship with mathematics anxiety. Mathematics anxiety has been defined as the "state of nervousness and discomfort brought upon by the presentation of mathematical problems" (Hoffman, 2010, p. 276) or "a person's negative affective reaction to situations involving numbers, math, and mathematics calculations” (Ashcraft & Moore, 2009, p. 197). Low efficacy expectations and high mathematics anxiety share similar origins, including lower ability perception regardless of actual ability (Ashcraft & Moore, 2009), prior unsuccessful experience (Ma & Xu, 2004) and situational factors (Hong & Karstensson, 2002). However, mathematical self-efficacy has been shown to moderate the influence of anxiety on desired mathematical achievement (Jain & Dowson, 2009; Shores & Shannon, 2007).

Hoffman’s (2010) research results implied that high self-efficacy was a necessary requirement in overcoming the effects of mathematical anxiety. In the article “I think I can, but I am afraid to try” (Hoffman, 2010), the author explores the role of self-efficacy beliefs and mathematics anxiety in mathematical problem solving efficiency in pre-service teachers. The sources of mathematics anxiety are summarised as being associated with lower ability perceptions, prior unsuccessful experience, mal-adaptive attributions, lack of study and test preparation, and situational affective factors. Students learn to translate their emotional and physiological states as being indicative of competence. For example, a student who feels stressed, anxious or unwell when going into the mathematics classroom may attribute these states as reflective of personal competence in mathematics (Bandura, 1997). High anxiety can undermine self-efficacy, conversely a reduction in negative emotional states improves self-efficacy. In Hoffmans’s research, seventy pre-service teachers from two universities volunteered to participate in the study, which involved solving eight different multiplication problems without the use of a calculator. Students rated their confidence in solving the problems prior to completing the problems. The results confirmed the author’s hypothesis that higher levels of self-efficacy were related to enhanced problem solving efficiency, without increasing problem solving time. However, as problems became more complex the mitigating effect of self-belief diminished and anxiety increased. This is reflected in the literature that reports that in Western cultures, there is a decline in student self-efficacy as they progress through senior school, and mathematics becomes more complex (Hoffman, 2010; Jain & Dowson, 2009).

The inter-relationship of attribution, efficacy and anxiety is similarly reflected in Jain and Dowson’s (2009) research. In that research, mathematics anxiety was explored as a function of multidimensional self-regulation and self-efficacy. Suinn and Edwards (1982) are quoted in the research as suggesting that “about half of all variance in mathematics achievement can be explained by factors other than intellectual ones” (Jain & Dowson, 2009, p. 240). The hypothesis for the study was that multidimensional self-regulation leads to enhanced self-efficacy and, subsequently, reduced mathematical anxiety. In the study, “self-regulation” was defined as the “propensity to set goals, plan strategies, and evaluate and modify on-going behaviour" (Jain & Dowson, 2009, p. 241). The study used a questionnaire and a mathematics anxiety scale to survey 232 eighth grade students in India. The study found that the Indian students' self-regulation was consistent with that reported in Western cultures and additionally, both self-regulation and self-efficacy were positively and statistically significantly related to each other, but negatively related to mathematics anxiety.

To explore the relationship between mathematics anxiety and mathematical achievement over time, Ma and Xu (2004) used data from the Longitudinal Study of American Youth. The authors cite consistent research results that demonstrate the negative relationship between anxiety and achievement. When investigating causal relationships, the authors found that across all year levels, prior low mathematics achievement appeared to cause later high mathematics anxiety, particularly for boys. The reverse relationship was not apparent: prior high mathematics anxiety was poorly related to later low mathematics achievement. Mathematics achievement was more consistent than mathematics anxiety across time.

Skaalvik and Skaalvik (2009) investigated the relationship between mathematics students' self-efficacy beliefs and mathematical achievement and potential mediators to the connection. The authors found that student self-perceptions strongly predicted subsequent achievement outcomes, beyond expected achievement outcomes based on prior attainment. These results mirror the research previously cited and emphasise the importance of understanding and fostering student mathematical self-perceptions. Of particular interest in the study are the results of a mediator on the self-efficacy/attainment association. The authors found no evidence to suggest that this correlation was mediated through the students' interest in mathematics or through students' goal orientation or their self-esteem.

To be motivated towards positive mathematical achievement outcomes students need to value mathematics and ultimately enjoy the mathematical learning process. As Posamentier and Krulik (2012) argue, mathematics classrooms should "demonstrate the power and beauty of mathematics" (p. 3).

2.6 Motivation and NCEA

It has been argued that assessments reflect students' motivation and test taking skills rather than what students know or can do (Nuthall, 2007). In a 2006 study, The Impact of NCEA on Student Motivation (Meyer et al., 2006), 569 Year 11-Year 13 students from 20 demographically representative schools throughout New Zealand were surveyed to investigate the relationship between NCEA and student motivation. The strongest predictors of high academic achievement and higher grades were a high motivation orientation towards *Doing My Best* and a low motivation orientation to *Doing Just Enough.* The results demonstrated a negative relationship between the motivation to do just enough and the number of credits achieved. This means that students whose motivation is to do the minimum requirement to pass may fail to meet their "just pass" goal, not because of a lack of ability but because of their motivation orientation.

While the flexibility of NCEA has positive effects on student motivation, elements of this flexibility were shown to be a disincentive for students. Examples of this include: the ability for students to opt out of Achievement Standards they didn't like, students choosing not to complete assessments where they expected to Not Achieve, students being able to avoid subjects and standards seen as challenging, and students having the option of not sitting any external examinations.

A follow up study in 2009 (Meyer, McClure, Weir, et al., 2009) showed that motivation patterns were generally stable across two years for most students. *Doing My Best* significantly predicted more total credits, internally assessed standards with Excellence, and externally assessed standards at all levels—Achieved, Merit and Excellence. *Doing Just Enough* was associated with lower achievement across two years and significantly predicted higher total unit standard credits. These motivation orientations also accounted for subsequent achievement over and above predictions made based on previous achievement alone. There were significant relationships between the motivation dimensions and these interpersonal influences: students high on *Doing Just Enough* reported that their teachers did not take a personal interest in their achievement, whereas students high on *Doing My Best* reported that teachers showed interest in them and in their work.

In a longitudinal study, following 1,522 high school students in their final three years of secondary school, Hodis and colleagues posed the question "Is it possible to predict students' time related evolution in achievement by making use of a brief self-report measure assessing students' patterns of motivation in the specific context of NCEA?" (Hodis et al., 2011, p. 314). Using the Survey of NCEA Goals from The Impact of NCEA on Student Motivation research (Meyer et al., 2006), students self-reported their approach to assessments. The study illustrated that sub-groups of students could be identified who were most at risk for low achievement outcomes. These students had negative motivation patterns towards assessment and low numbers of total credits passed in Year 11. The authors suggest that with intervention, motivation orientations can be changed and achievement outcomes enhanced. In response to Meyer and colleagues' findings, merit and excellence endorsements were introduced in late 2008. Specifically intended to motivate students beyond "doing just enough", these certificates are awarded to students who achieve a significant number of credits at merit or excellence level (Hipkins, 2010). The results from Hipkin's research on NCEA suggest that teachers and principals perceive that the gains in motivation of high achievers by certificate endorsement has been achieved at the expense of the motivation of students with higher learning needs. However, as nearly half of the teachers responding were uncertain of the impact of endorsement certificates, the results are not conclusive (Hipkins, 2010).

The segmentation of NCEA assessment into the four achievement levels of excellence, merit, achieved and not achieved has the potential to negatively impact teaching and learning (Rawlins, 2008). The classification of criteria for each grade may promote teaching and learning to a certain level. When students aim for specific grade criteria, there is the potential for students to achieve lower achievement outcomes than they are capable of achieving (Meyer et al., 2006).

There is little research on how student perceptions of qualifications impact their motivation and academic achievements. However, research has shown that students perceive there to be a discrepancy between the number of credits available and the perceived difficulty level to obtain Achievement Standards across different subjects (Meyer et al., 2006).

The NCEA assessment system influences student motivation. Students with negative motivation orientations have lower achievement outcomes (Hodis et al., 2011; Meyer et al., 2006; Meyer, McClure, Walley, et al., 2009; Meyer, McClure, Weir, et al., 2009). The research undertaken on the impact of NCEA and student motivation prompted questions as to whether these subject general results and conclusions would be transferrable to NCEA mathematics students.

2.7 Summary

The Literature Review supports the assertion that student academic success can be seen as influenced by learning motivation and assessment systems. Students pay attention, persist, learn more and enjoy learning, when they are interested in the subject being taught. In order to enhance achievement outcomes, it is critical that student motivational orientations are understood (Meyer, McClure, Walley, et al., 2009).

A response to the research question for this study "What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?" has been partly explained within the literature on learning motivation, mathematics and NCEA. However, at the time of writing, no literature that specifically explored all three elements together was located. This led to the conclusion that the proposed research was timely, valuable and justified.

Chapter Three

Research Design

3.1 Introduction

The evidence explored in the Literature Review provided the direction for the research process of the study. Theories of attribution and self-efficacy directed the theoretical framework of constructivism and ethnomethodology, and the research that had been completed in the field of NCEA and motivation guided the research method. This chapter outlines the design and methods used in the study in the following sections:

- Methodology - theoretical perspective, methodological approach, method, methodological tool and data analysis.
- The Research Project Process – setting, participants, ethical considerations, mathematics department, pilot study, data collection, data analysis process and presentation of findings.
- Validity and reliability.

Together these components provide a comprehensive picture of the research process pathway.

3.2 Methodology

The study is based on Constructivist Theory which proposes that learners actively construct ways of knowing (Sharma, 2006). The over-arching methodological approach that guided the methods used in the study was ethnomethodology. Ethnomethodology is a study of the methods that individuals use to make sense of their social world and accomplish their daily actions (O'Leary, 2004).

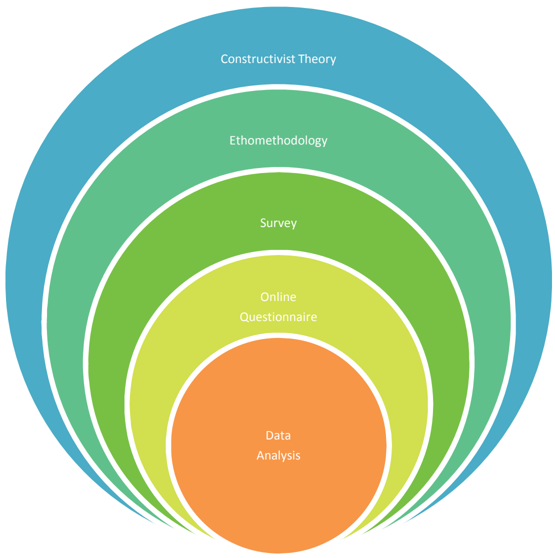

Figure 3.1 The Research Methodology

Survey method was utilised to obtain data from a large number of individual students and the methodological tool used was an online questionnaire. The data gathered and analysed are primarily quantitative. The research methodology is represented in Figure 3.1.

3.2.1 Theoretical Perspective: Constructivist Theory

The objective of the research was to explore how senior mathematical students' make sense of their mathematical experience through the NCEA qualifications system, and understand what factors motivate these students in their mathematical studies and to what students attribute mathematical success. Students are seen to actively construct mathematical meaning as they interact and engage in interpretation of their mathematical experience.

The theoretical perspective for a research study provides "an overarching framework, organising observations/interpretations of related phenomena into a coherent whole, terminology, and research methodology" (Niss, 2007, p. 97). Tolich and Davidson (1999b, p. 17) suggest that "theory without research is mere speculation; research without theory is mere data collection".

The study is based on Constructivist Theory. The fundamental constructivist principles are that:

- Learners actively construct ways of knowing.
- Reality is not fixed but constructed.
- Meaning is socially, culturally and historically situated (Sharma, 2006).

Within constructivism, learners invent concepts, models and schemes to make sense of their experiences, and test and modify these templates following new experiences (Mutch, 2005). The research project investigated student motivation, with a specific focus on attribution and self–efficacy. Attribution Theory proposes that the perceived understanding that students have about the causes of academic outcomes influences their future behaviour (Weiner, 1985). Self-efficacy is the belief that students have in their own capabilities (Usher & Pajares, 2009). It is the confidence that students have in their ability to achieve certain outcomes. Attribution and self-efficacy theories are both centred on the students' individual sense making of their reality. The objective of this research was embedded within the constructivist belief that students build an understanding of mathematics out of their experiences of functioning in the mathematics classroom (Newby, 2010).

3.2.2 Methodological Approach: Ethnomethodology

In this study, I researched the motivations that students attribute to their mathematical learning. I wanted to investigate how motivations affect their mathematical success. The methodological approach used for the research was ethnomethodology. Check and Schutt argue that "Ethnomethodology focusses on the way participants construct the world in which they live – how they create reality – rather than describing the educational world itself" (2012, p. 310). Ethnomethodology pursues an understanding on *how* reality is constructed. It does not seek to provide a description of reality. Rather than describing the educational world, ethnomethodology focuses on the way students create and sustain a sense of reality. This project seeks to investigate how student motivations create and *sustain their mathematical reality*. In relation to this research, understanding student self-efficacy motivations and the effect that they have on students' mathematical reality (construction of reality) is of more significance than mathematical attainment (factual reality).

3.2.3 Method: Survey

Survey research involves the collection of information from a sample of individuals through their responses to questions. I chose survey research because of the versatility, efficiency and generalisability of survey methodology. The versatility allowed for students to be questioned on a wide range of areas related to their mathematical learning. The efficiency of survey research as a method enabled a sample of nearly 100 students to respond in a limited time frame, at a relatively low cost. To understand student motivations, I needed to access student thought processes. Motivations cannot be observed or measured without student participation. The survey method provided a vehicle for students to directly voice their opinion. While other research methods could have been utilised to achieve the study objectives of understanding the student perspective, for example, interviews or focus groups, the survey method enabled a large sample of students to respond. The research sought to develop a representative understanding of mathematics students' motivations and, according to Check and Schutt (2012) "survey research is often the only means available for developing a representative picture of the attitudes and characteristics of a population" (p. 160). Survey methodology provided a structure that combined the individual with the collective. The data collected from student responses explored how motivational beliefs created a unique mathematical reality, while the large sample of student responses facilitated potential generalisability.

3.2.4 Methodological Tool: Online Questionnaire

The survey method employed was an online questionnaire through the Survey Monkey website. A questionnaire is defined as "structured format that generates a response by asking individuals specific questions and with the researcher not involved" (Newby, 2010, p. 284).

The advantages of a questionnaire include the following:

- Obtaining data in a structured way.
- Tailored exactly to the needs of the researcher.
- The ease with which questionnaires can be constructed to meet research objectives.
- Access to a large number of participants.

There are some potential disadvantages to using a questionnaire as a methodological tool. These include:

- Lack of opportunity to explore participant responses further.
- Participant non-response.

A questionnaire can be administered via mail, telephone, in person or electronically. The advantages of a web based questionnaire are flexibility, low cost, minimisation of data entry errors and immediacy of results. Check and Schutt (2012) argue that web based questionnaires are perceived to be "shorter, more interesting and more attractive" (p. 176) to respondents. These are desirable qualities, especially for the teenage participants included in the research. Web based questionnaires are dependent on participant access to the internet.

The potential obstacles to using a questionnaire and specifically, an online questionnaire, were overcome by using a computer laboratory setting for the research, providing the opportunity for students to complete the questionnaire either during scheduled class time or at a suitable time for them, prior to a closing date, and the inclusion of three open ended questions for students to justify their responses.

"Survey Monkey" is a web tool that allows users to create their own surveys using question format templates. Survey Monkey operates encrypted security which protects the privacy of participants and the research data. SSL encryption (Secure Sockets Layer) enables the following:

- The ability to send encrypted URLs to participants. The url link to the questionnaire and the survey pages are secured by Verisign during transmission from the Survey Monkey account to participants and then back into account.

- The ability to download collected data over a secure channel.
- The ability to comply with the data confidentiality requirements related to Massey University ethics approval.

The questionnaire combined several types of questions: multiple choice, Likert scale and open response. A mix of structured and unstructured questions provided different opportunities to explore student motivations and enabled the researcher to capitalise on the advantages and minimise the disadvantages of each question type.

The Likert scale questions in the questionnaire offered four responses, for example, in Question 5 the options are "not true, partly true, mostly true and definitely true". As argued by Hambleton (2012) an even number of responses lessens the possible 'go for the middle as the easy option' effect of Likert scale questions and forces a decision from the participant.

The research project questionnaire contained 13 questions (Appendix B), which are summarised in Table 3.1:

Table 3.1 Question Summary

Question Number	Question Content
1	Gender
2	Ethnicity
3	Age
4	NCEA Level 3 Mathematical subjects chosen in 2013: Statistics and/or Calculus.
5	Justification for response to Question 4.
6	Contains 15 statements about learning mathematics that the participants are asked to respond to on a four stage Likert Scale: not true, partly true, mostly true and definitely true.
7	Students were asked to reflect on times when they have achieved their highest grades in mathematics, and to rate seven possible influences on their grades on a four stage Likert Scale: no influence, little influence, some influence and big influence.
8	Students were asked to reflect on times when they have achieved their lowest grades in mathematics and to rate seven possible influences on their grades on a four stage Likert Scale: no influence, little influence, some influence and big influence.
Questions 9 – 12 related to the recently completed Achievement Standard "Investigate Time Series".	
9	Multi-choice selection based on the student's perception of their knowledge and skills to pass the achievement standard.
10	Multi-choice selection based on student's perception of how "easy" it will be to pass the achievement standard.
11	Justification for response to Question 10.
12	Multi-choice selection based on the grade that the student thought they were going to get for the achievement standard.
13	Justification for response to Question 12.

The ethnicity options available to students in Question 3 are the same as those used in the Survey of NCEA Goals, and are similar to the Statistics New Zealand Census data. The categories used do not allow for the reality that many students identify with multiple ethnicities. However, for this study, the gender and ethnicity questions are for the purpose of comparison of the sample to the New Zealand Year 13 secondary school population, rather than being the focus of the research.

I followed the advice of Check and Schutt (2012, p. 163), "if another researcher has already designed a set of questions to measure a key concept, and evidence from previous surveys indicates that this measure is reliable and valid, then by all means, use that instrument." The questionnaire constructed for this research project includes elements from Sections 1 and 2 of Meyer, McClure, Weir, Walkey and McKenzie's Survey of NCEA Goals, which assesses student motivation orientations (2009).

The Survey of NCEA Goals was modified to make it applicable for this research project. In the original survey the questions were related to NCEA generally and were aimed at a sample of Year 10 and 11 students. The questions were changed to have a NCEA *mathematics* focus and were targeted to NCEA Level 3 students (mostly Year 13).

Section 2 of Meyer and colleagues' survey corresponds to Question 6 of the online questionnaire used in the study. Question 6 asks students to respond to 15 statements about their mathematics learning. Table 3.2 demonstrates which statements were the same as the original Survey of NCEA Goals, which statements were adapted or excluded and which statements had been added. Reasons have been provided for the choices made.

Table 3.2 Questionnaire Alterations from Survey of NCEA Goals

Included in the study.
I expect to get Excellence or at least merit.
I will work for the number of credits I need, no more.
I will strive for Merit or Excellence even when I don't need this to achieve my goals.
I do best in classes where students can work together.
In class, I would rather work by myself.
Reason for inclusion.
The statements above are directly applicable to the research question, and are essential to establishing a student's motivation orientation.
Adapted statements.
My mathematics teacher is interested in me.
I learn more when students are encouraged to help each other.
I do best when I know I can count on the teacher for help when I need it.
Reasoning for adaption.
The statements above are directly applicable to the research question. They have been altered to reflect the singular mathematics focus rather than a general NCEA focus.
Excluded from study.
If I get just NCEA Level 1 or possibly NCEA Level 2 before I leave school, I'll be satisfied and have no plans to finish Level 3.
In general, I get along well with my teachers.
I get involved when we do group work in class.
I prefer credits for life skills and vocational job-related skills rather than credits related to further academic study.
I want to take credits that allow me to try for Merit or Excellence, rather than just Achieved.
Once I have my 80 credits, I'll be satisfied.
I aim at getting a good education, not just completing tasks to get credits in NCEA.
It matters to me that I can work for the NCEA Certificate endorsed for Merit or Excellence.
Reasoning for exclusion.
The statements above are not applicable to the research question. The participants in the study are already studying an academic course of study at NCEA Level 3. The subject endorsement certificate is now an accepted inclusion in the NCEA assessment system (since 2008) and unit standards (where students could only attain a maximum grade of achieved) is no longer used.

New statements.
I think mathematics is an important subject.
I need to pass my Achievement Standards for tertiary options.
I enjoy mathematics.
My family/whanau value mathematics as a subject.
I know that my mathematics teacher understands the new Achievement Standards.
Having Level 3 Statistics and Modelling will assist me in my career choices.
My friends think that mathematics is important.
Reasoning for new statements.
The statements above are applicable to the research question. The statements reflect the value placed on mathematics by the student and influential others, the remodelled NCEA Level 3 Achievement Standards, and explanations for students' choice of Statistics and Modelling as a course of study.

Section 3 of The Survey of NCEA Goals corresponds to Questions 7 and 8 of the online questionnaire. The questions ask students to reflect on times when they have achieved their highest and lowest grades in mathematical Achievement Standards and rate the possible influences on these results. I kept the influences the same as the original because the statements reflected the evidence found in the literature and the focus of the study. The influences included: ability, effort, assessment difficulty, luck, whanau/family, teacher and friends.

3.2.5 Data Analysis

The data collected from the questionnaire were evaluated according to whether the data were qualitative or quantitative. The study primarily had a quantitative focus in the form of responses to questions/statements being 'measured' on a Likert scale (Bergsten, 2008).

- Questions 1 to 4 of the questionnaire collected demographic and NCEA mathematics course selection data, to determine a sense of whether these students were representative of New Zealand Year 13 student population.
- Question 6 asked students about their experience of NCEA Statistics and Modelling through 15 statements, which the students rated *not true*, *partly true*, *mostly true* and *definitely true*.
- Questions 7 and 8 asked students to reflect on times when they had achieved their highest and lowest grades in mathematics and to rate possible influences as either *no influence, little influence, some influence* and *big influence.*

- Question 9 asked the students to think of the knowledge and skills that they needed to pass the Investigate Time Series achievement standard and select one of the following categories, *I have*: the knowledge and skills to pass well, just enough knowledge and skills to pass and not enough knowledge and skills to pass.
- Question 10 asked the students to think of what was required overall to pass the Investigate Time Series achievement standard and then select whether passing the achievement standard would be: very easy, quite easy, just manageable, quite difficult or far too difficult.
- Question 12 asked the students to predict their grade for the Investigate Time Series achievement standard.

The quantitative analysis of the questions above was presented in numerical form, using tables and a variety of graphs.

Within the questionnaire, there were opportunities provided for participants to elaborate on their quantitative choice. Question 5 asked students why they were studying NCEA Level 3 Statistics and Modelling, and Questions 11 and 13 asked for students to provide one or two key reasons for their responses to Questions 10 and 12. The responses from Questions 5, 11 and 13 were subject to qualitative, textual analysis (Check & Schutt, 2012). The data were codified into themes via an Excel spreadsheet. The codes were based on my own interpretation of how the students' comments related to particular themes. Examples of the students' comments, via direct quotations, were used to substantiate the coding selection.

Descriptive statistics were used to explore patterns in the data and to investigate the relationships between variables. The data were analysed according to the objectives of the research question:

i) Making Sense of NCEA – Student Perceptions of NCEA Level 3 Statistics and Modelling.
ii) Attributions and Motivations.

From the data analysis, conclusions were made and the implications of the findings to teaching and learning, and recommendations for future research were put forward.

3.3 The Research Project Process

Figure 3.2 illustrates the process undertaken in the research project. This is described in greater detail in the sub-sections below.

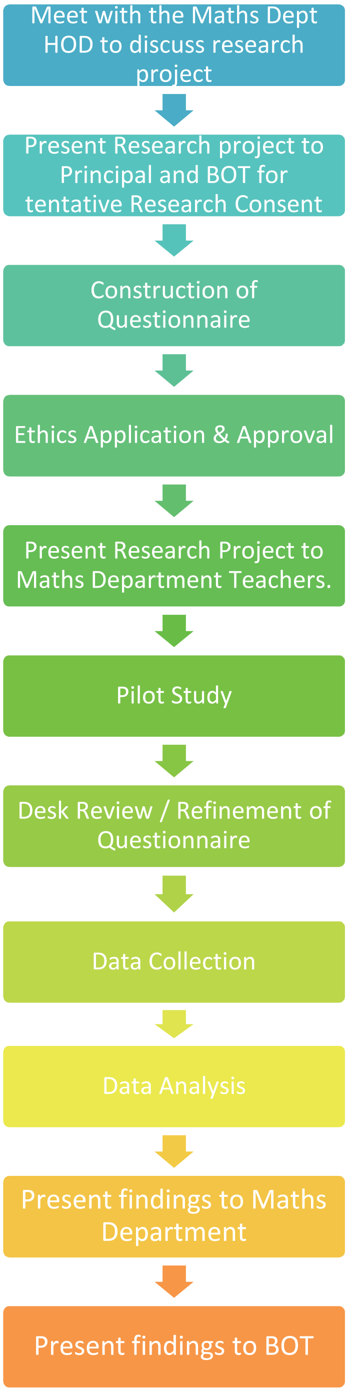

Figure 3.2 The Research Project Process

3.3.1 The Research Setting

The research setting was a co-educational, urban, decile 8, state school in the North Island of New Zealand, enrolling students in Year 9 to Year 13. The College had a predicted roll in 2013 of 1930, with an additional 72 international fee-paying students enrolled. The ethnic mix of student body is European 80%, Maori 17% and other 3%.

I initially met with the Head of the Mathematics Department (HOD) at the College to discuss the research project. The Mathematics HOD was supportive of the research from the outset. He could see the direct value of the research to their school and how a greater understanding of student motivation and subsequent implications on mathematical attainment would be of benefit to the Mathematics Department. From a statistical learning perspective, the Mathematics Department could see the value of statistics students being involved in a "real life" statistical project.

Following discussions with the Mathematics Department at the College, the research project was presented to, and approved by, the Principal and the Board of Trustees (subject to approval from the Massey University Ethics Committee).

3.3.2 Participants in the Research

All students, 16 years old and over, enrolled in a full year NCEA Statistics and Modelling Level 3 Achievement Standards programme in 2013 were invited to participate in the study. This particular cohort of students has experienced the latest roll out of changes to NCEA Mathematics over the last three years. The statistics programme at the College consisted of five streamed classes, three A Stream classes and two B Stream classes.

The HOD volunteered that the students could complete the online questionnaire during scheduled class time, if they wanted to. The NCEA Level 3 Statistics and Modelling Achievement Standard lessons are taught in a computer laboratory, due to the high level of computer analysis, graphing and research required within the curriculum. For the research project, logistically, this meant that each student choosing to participate would have access to a computer to complete the online questionnaire during scheduled class time. When students had completed the survey they returned to classwork that had to be completed, which was also computer based.

3.3.3 Ethical Considerations

The research project has been designed and conducted according to the Massey University Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants (Massey University, 2013). The major ethical principles of this code included:

- respect for persons
- minimisation of harm
- informed and voluntary consent
- respect for privacy and confidentiality
- avoidance of deception
- avoidance of conflict of interest
- social and cultural sensitivity
- justice.

Ethical approval was obtained prior to data collection from the Human Ethics Committee, Massey University.

Within the study, there were several ethical issues to be considered:

- Would students who chose not to participate in the online survey be disadvantaged? Students were invited to participate, either in scheduled class time or up to a closing date for the survey. If students did not want to complete the online survey they had scheduled computer based classwork for completion, and then would not be obvious within the class.
- The risk of being able to identify individual teachers was minimised by the number of responses; there were five classroom teachers and 98 student participants.
- The College anonymity has been maximised by the use of non-identifying information during the research and in reports.
- Given that the students were all 16 years of age or older, parental consent was not required. However, a copy of my Information Sheet (Appendix A) was emailed by the school to parents of students participating in the study. The Information Sheet and the questionnaire clearly stated that by completing the survey online, participants were consenting to the conditions of the study.

3.3.4 The Mathematics Department

Once consent had been given by the Board of Trustees, the Principal and the HOD, the research project was presented to the teachers responsible for teaching NCEA Level 3 Statistics and Modelling at the College. The background of the study was discussed, as well as the logistics of data collection. The teachers were supportive of the research and posed no issues relevant to the conduct of the project.

3.3.5 Pilot Study

The questionnaire was trialled with eight NCEA Level 3 Statistics and Modelling students from other high schools in the area. I currently tutor senior mathematics at a private tutoring education centre and invited the NCEA Level 3 students to complete the questionnaire following a tutoring session. From this Pilot Study, two questions were altered to eliminate a double negative, and the introduction to one of the questions was simplified to make it easier for participants to understand.

3.3.6 Data Collection

The five NCEA Level 3 Statistics and Modelling Achievement Standards classes involved in the project were timetabled consecutively on a Friday. I visited the College during the first Friday of the second term in 2013. The students had completed the Internal Assessment for the Achievement Standard 91580 “Investigate Time Series Data” on the last Friday of Term 1, 2013.

The procedure for data collection described was used with all classes. I introduced myself and the research project. All students were given an Information Sheet, which we discussed together. I then asked the students if they had any questions or queries. Following this, the students were invited to participate in the online questionnaire. While students were completing the questionnaire, I was available to answer any questions about the research. The questionnaire took approximately 15 minutes to complete. When the students had all finished, I thanked them for their time and contribution and advised that I would be returning to the College to present the research project findings at the end of the year. All of the students attending the Statistics and Modelling Achievement class that day chose to complete the survey.

3.3.7 Data Analysis Process

The data collected from the questionnaire were mostly quantitative data (ten out of thirteen questions), with a further three questions which provided qualitative responses from the students.

This section provides further detail into the data analysis process.

- Questions 1, 2 and 3 of the questionnaire collected demographic information about the sample. This included gender, ethnicity and age. Data analysis included a comparison of the sample with the general population of New Zealand Year 13 secondary school students.
- Question 6 asked students about their experience of NCEA Statistics and Modelling through 15 statements. The data collected from Question 6, were analysed according to the following themes: attitudes towards mathematics, achievement expectations, tertiary requirements, mathematics teacher and learning environment.
- Questions 7 and 8 asked students to reflect on times when they had achieved their highest and lowest grades in mathematics and to rate possible influences. The data collected from Question 7 and Question 8 were analysed collectively, as in the influences on highest grades and the influences on lowest grades. The individual influences were additionally analysed according to their perceived impact on high grades and low grades, for example, the influence of ability when receiving highest grades was compared to the influence of ability when attaining lowest grades.

Questions 5, 11 and 13 asked students to provide a reasoning or explanation for their quantitative choice in previous questions. The students' individual comments for each question were analysed and codified according to the nature of the reasoning. Using an Excel spreadsheet, the number of comments within each reasoning type was added together and summarised in tabular form in descending order. Examples of students' direct quotes were provided for Questions 5, 11 and 13 to provide clarification of the coding choices that were made.

Descriptive statistics were used to explore patterns in the data and to investigate the relationships between variables. The themes that became evident in the data were categorised as either contributing towards:

i. An understanding of students' perceptions of NCEA
ii. Motivations and Attributions.

The factors that motivated the students in their mathematical studies and the factors to which they attributed their mathematical success were further characterised as being either externally or internally driven motivators.

3.3.8 Presentation of Findings

The findings of the research project have potential implications for the teaching and learning of mathematics. Following the completion of the study, I presented the conclusions and recommendations from the research to the students, the teachers of the mathematics department and the Board of Trustees of the College that granted permission for the study to be undertaken.

3.4 Validity and Reliability

3.4.1 Validity

Validity in questionnaires refers to whether the questionnaire measures what it says it will and the degree of transferability of the research findings (Check & Schutt, 2012). Cohen, Manion and Morrison argue that "validity is the touchstone of all types of education research" (2011, p. 179). Figure 3.3 below demonstrates the areas of validity relevant to the research project.

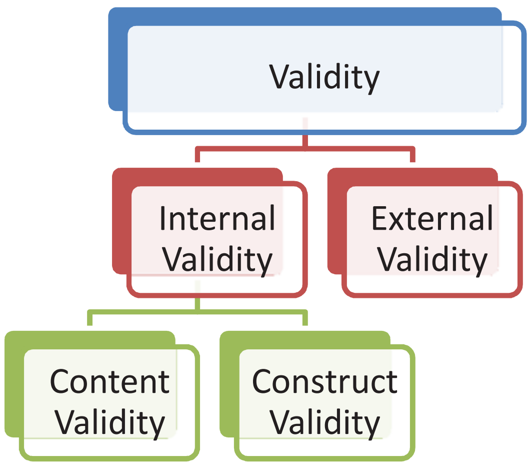

Figure 3.3 Research Validity

In this study, the questionnaire is internally valid if it does indeed measure the motivations of students enrolled in NCEA Level 3 Statistics and Modelling Achievement Standards. Internal validity has two key components relevant to the research project: content validity and construct validity. Content validity concerns the degree of "overlap between the content that a questionnaire measures and the domain of content that is of interest" (Hambleton, 2012, p. 245). If too little of the domain is measured, critics argue that the questionnaire is not representative of the research objective, conversely if too much is measured, critics argue that more is being measured than intended. Within a questionnaire, "construct validity is an analysis of the meaning of test scores in terms of psychological concepts" (Burns, 2000, p. 352). "Motivation", "attributions" and "self-efficacy" are constructs which explain aspects of human behaviour. Evidence from earlier research on student motivation and NCEA (Hipkins, 2010; Meyer et al., 2006; Meyer, McClure, Weir, et al., 2009), as well as the expertise of Massey University, thesis supervisors, and the HOD of the College, have impacted the content and nature of the questionnaire used for this study. The questions have been selected to reflect a collective understanding of "motivation", "attributions" and "self-efficacy". The questionnaire was assessed for content validity and construct validity by Massey University supervisors and cultural advisors and by the HOD of the College.

External validity refers to the degree to which results can be generalised to a wider population (Cohen et al., 2011). Can the findings from this study be generalised to the population of students enrolled in NCEA Level 3 Statistics and Modelling Achievement Standards? The findings are limited to the college involved in the study. The group of students have experienced the changes to NCEA over the last three years, and this may have an impact on how they perceive mathematics, compared to later groups of students who have not had similar experiences. Is this urban, decile 8 student sample representative of all New Zealand NCEA Level 3 Statistics and Modelling Achievement Standards students? Some researchers claim that "the only generalisation is: that there is no generalisation" (Lincoln & Cuba, 1985, cited in Coe, 2012, p. 48). At best, research in one context could be applicable only as a "working hypothesis" for another situation.

3.4.2 Reliability

Reliability refers to the consistency, accuracy and comprehensiveness of the research (Cohen et al., 2011). Internal reliability has been integrated within the questionnaire by asking students the same question twice but in a rephrased format the second time. Reliability of findings has further been reinforced by providing students with opportunities to explain or make further comment on their quantitative response.

Validity and reliability are also affected by the researcher's assumptions, identity and viewpoint. I am an experienced high school mathematics teacher, having taught mathematics for over 12 years in both a classroom setting and a private tutoring education centre. I was teaching mathematics during the initial implementation of NCEA in 2002 and have been involved with the subsequent modifications to NCEA as a teacher and as a postgraduate student. Through this time, I have seen teachers and students accommodating and assimilating the changes in NCEA, often with limited professional development and support. For the current cohort of students, the resources available through the Ministry of Education website are limited, often with only one example of an assessment (Ministry of Education, 2013). This knowledge and background experience with NCEA provides me with an awareness of the student experience and a desire to know the effects of NCEA mathematics on student motivation.

Coe (2012) argues that the core function of validity and reliability is justification of inference quality. Coe describes two types of inference, these are interpretation claims and transfer claims. Interpretation claims are descriptive of the sample. According to Coe, "if a particular researcher conducts a study with a particular group of participants in a particular context on a particular occasion, then the claims that can be made about the interpretation of what was observed must be validated" (p. 48).

Generalisability of the sample to a population and transferability of a theoretical hypothesis are categorised as transfer claims. There is a danger for the researcher to overgeneralise beyond what the evidence can support, or conversely to subjectively specialise the research findings. This can result in a reduction of inference quality of the findings, and questions about the validity and reliability of the research.

The research project selected a purposeful or non-probability sample for data collection, rather than a random sample. The objective is to describe the motivations of a sample of NCEA Level 3 Statistics and Modelling students from an urban based college in rich detail, to make sense of the interpretations and constructions the students make and to analyse them in ways that promote insightful and deep understanding (Coe, 2012). Given that the participation rate for the study was 100%, the findings from the research foster interpretation claims. However, given the study was with a particular cohort of NCEA Level 3 Statistics and Modelling students, at a particular urban school, after a particular internal assessment, transfer claims to the general population can only be made cautiously.

3.6 Summary

The Research Design Chapter has discussed how the research process for this study was developed. The research question, the research objectives and the literature review were presented as the rationale for the methodology selections.

The study is grounded in Constructivist Theory, whereby students actively construct ways of knowing. The research objectives were to explore how students make sense of their mathematical experience through the NCEA qualifications system and understand what factors motivated these students in their mathematical studies and to what the students attributed their mathematical success. Ethnomethodolgy was, therefore, chosen as the methodological approach. The survey method was selected because it enabled a sample of 98 students to be questioned on a wide range of areas related to their mathematical learning. The research tool used was an online questionnaire and the advantages and disadvantages of an online questionnaire were examined. The data analysis methods were discussed with reference to whether the question elicited quantitative or qualitative data.

The individual steps taken within the Research Process were discussed. These stages included the research setting, the participants, ethical considerations, the mathematics department of the host school, the pilot study, data collection, the data analysis process and presentation of the research findings.

In questionnaires, validity refers to whether the questionnaire measures what it says it will and the degree of transferability of the research findings. Reliability refers to the dependability, precision and completeness of the research. Validity and reliability were discussed with reference to this study.

The Research Design Chapter provided the methodology behind the research process. Chapter Four presents the data that resulted from that design.

Chapter Four

Findings

4.1 Introduction

Chapter Four presents the results from the research process outlined in Chapter Three. The participation rate was one hundred percent, with 98 students completing the online questionnaire. The findings from each question are presented in numerical, graphical or tabular form.

The demographic features of the sample were established in the first four questions of the questionnaire, concerning gender, ethnicity, age and mathematical course selection. The students' general experience of NCEA Level 3 Statistics and Modelling was explored in Question 5 through to Question 8. The students' reasons for enrolling in the NCEA Level 3 Statistics and Modelling course were established through the results in Question 5. Question 6 investigated students' perceptions of mathematics, their achievement expectations, tertiary requirements, their thoughts about their mathematics teacher, and their preferred learning environment. The possible influences on students' highest and lowest mathematical grades were examined in Questions 7 and 8.

The students in the sample had recently completed an internal assessment for the achievement standard Investigate Time Series. The remaining questions concerned the students' experience of this achievement standard. Questions 9 to 11 asked the students to consider and rate their knowledge and skills and the overall requirements necessary to pass the achievement standard. Questions 12 and 13 asked the students to predict their grade for the achievement standard and provide an explanation for their choice.

Examples of the students' comments have been provided for Questions 5, 11 and 13. The students' quotes have been presented for two reasons. The students' comments provide a depth to the results beyond the coded, categorised tabular summary. All student quotes are provided as written in the survey. Occasionally, quotes have been altered slightly grammatically, for example, capitals, spelling and full stops, for ease to the reader.

4.2 Presentation of findings.

4.2.1 Questions 1 – 4: Demographics

The first four questions provide the demographic background of the students: gender, ethnicity, age and mathematical options. The data that have been collected have been used to compare the sample with the general population of New Zealand Year 13 secondary school students.

There were 98 respondents to the questionnaire, 46 (47%) were female and 52 (53%) were male. Comparatively, the national data for the total number Year 13 students, in 2012, was 52% female students and 48% male students (New Zealand Qualifications Authority, 2013).

In Question 2, the students were asked to select which ethnicity best describes them. Table 4.1 summarises the responses to the survey with the available comparative ethnicity data for the roll of the school and the New Zealand Year 13 population from the NZQA website. To align with the demographic information obtainable through NZQA, in the sample response data, the category 'Other European' (2%) has been combined with the 'Other' category (2%).

Table 4.1 Ethnicity

Ethnicity Selection	Sample Response	School Roll	National Roll Year 13
NZ European/Pakeha	80%	80%	56%
NZ Asian/Asian	10%		12%
Maori	5%	17%	16%
Other	4%	3%	7%
Pacific Peoples	1%		9%
Total	**100%**	**100%**	**100%**

The NZ European/Pakeha was the group most strongly associated with by the students that participated in the study, at 80%, followed by NZ Asian/Asian at 10%. The student population of the college comprises of European 80%, Maori 17% and other 3%. Compared with the population of the college and the national roll of Year 13 students, there is proportionally a lower number of Maori students taking NCEA Level 3 Statistics and Modelling and a higher number of NZ Asian/Asian students. Specific demographic data on the ethnicity of NCEA Level 3 Statistics and Modelling students nationally were not available.

As expected, the majority of students who participated in the study were 17 years old (80%). The remaining students were either 16 or 18, with both categories at 10%.

Over three quarters of the students (76%) were studying only NCEA Level 3 Statistics and Modelling, 13% were taking both Level 3 mathematics options in 2013 and 11% had taken Level 3 Calculus in 2012. None of the students were planning to take Level 3 Calculus in 2014. These data suggest that students planning to take both Level 3 mathematics options, will either take them both in the same year or take NCEA Level 3 Calculus as a first option with Level 3 Statistics and Modelling the following year. The college offers students the option to take either a Statistics or a Calculus pathway from NCEA Level 2. Each respective course at Year 12, leads students towards NCEA Level 3 Statistics and Modelling or Calculus at Year 13. High achieving mathematics students are advised to accelerate through the Calculus strand, usually a year early. Non-accelerate students who desire to enrol in both mathematics courses at NCEA Level 3, are similarly advised to enrol in the Calculus pathway in Year 12. The underlying assumption from the Mathematics Department, teachers and students is that students who have been through the Calculus pathway, will still be able to attain NCEA Level 3 Statistics and Modelling, whereas, it is perceived to be a more difficult task to master NCEA Level 3 Calculus from the Statistics pathway.

4.2.2 Questions 5 - 8: General Experience of NCEA Level 3 Statistics and Modelling

Questions 5 to 8 related to the students' general experience of NCEA Level 3 Statistics and Modelling. Question 5 asked students why they were taking NCEA Level 3 Statistics and Modelling. Student comments were individually analysed and the responses were categorised and collated. The results are summarised in Table 4.2. The comments students provided often cited more than one reason, which is why the total percentage in the Table 4.2 exceeds 100%.

Table 4.2 Student Response to Question 5

Response to Question 5	Percentage of students (N=98)
Tertiary	48%
Career	12%
Enjoy Maths	12%
Easier than Calculus	11%
Calculus & Stats	9%
Enjoy Statistics	8%
No other options available in timetable	7%
Maths is important	6%
Didn't qualify for Calculus	6%
Credits	6%
Good at Maths	4%
Excellence Credits	3%
Life	2%
Stats is easy	2%
Interest	2%
Repeating Statistics	2%
Good Statistics teachers	1%
Total	**143%**

The most cited reason for taking Level 3 Statistics and Modelling was tertiary study requirements (48%), followed by career choices and enjoyment of maths (both 12%), Level 3 Statistics and Modelling was considered an easier mathematics course than Level 3 Calculus (11%) and enrolling in both NCEA Level 3 mathematics options (9%).

Examples of the commonly expressed students' reasons from these categories are provided below:

- Tertiary study requirements.

  If I want to study commerce at university, statistics and modelling would be more useful compared to calculus.

  As it is a course entry requirement for my tertiary education.

- Career choices.

  Calculus seemed too difficult and statistics had more applicable occupations for me.

  I am taking it as it will be a skill that I will need for the future career that I am planning to do, which is primary teaching.

- Enjoyment of maths.

  Because I like maths.

  Interesting subject with real life applications. I enjoy learning mathematics.

- Level 3 Statistics and Modelling being an easier mathematics option than Level 3 Calculus.

  Because I wanted to keep a math based subject and I thought calculus would be too hard.

  Because it makes more sense and is easier for me to follow than calculus and I don't really like algebra.

- Taking both Level 3 mathematics options.

  Recommended to take level 3 Calculus in 2012 then level 3 Statistics in 2013 through ALA Programme (ALA Programme is the Advanced Learner "A" stream accelerated mathematical programme).

  Completed Level 3 Calculus in 2012 but retaking it. Taking Statistics and Modelling this year as I wanted to have a complete understanding of all Mathematics.

Question 6 asked students to rate fifteen different statements that related to their experience of NCEA Level 3 Statistics and Modelling. Figure 4.1 summarises the students' responses to Question 6:

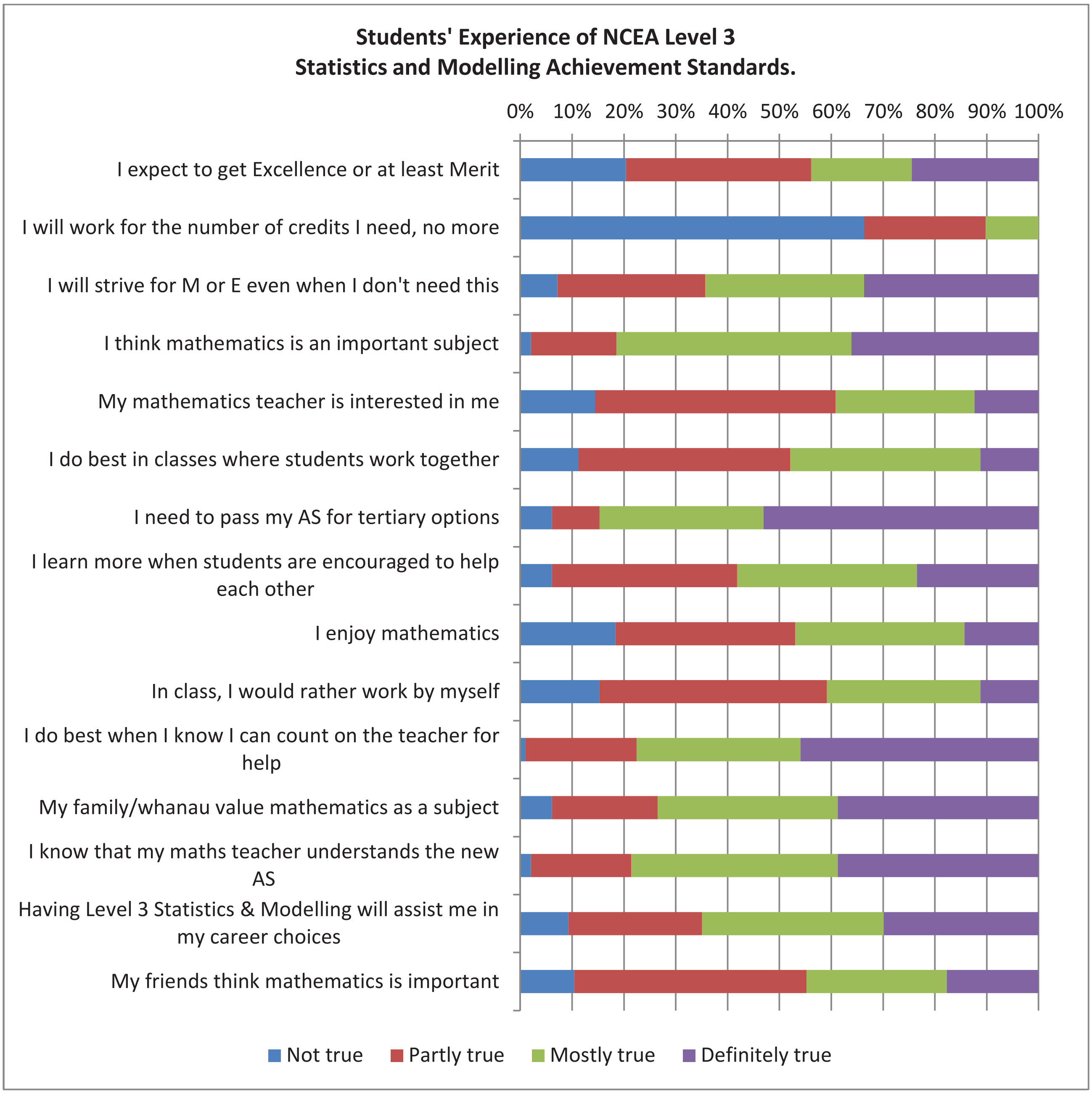

Figure 4.1 Students' Experience of NCEA Level 3 Statistics and Modelling

To analyse the responses to Question 6, the statements were collated under five sub-categories: attitudes towards mathematics, achievement expectations, tertiary requirements, mathematics teacher, and learning environment. The categories were established according to the nature of the statement that the students were responding to.

Attitudes Towards Mathematics

Table 4.3 Attitudes Towards Mathematics

Statement	Student Response			
	Not true	Partly true	Mostly true	Definitely true
I enjoy mathematics	18%	35%	33%	14%
I think mathematics is an important subject	2%	17%	45%	36%
My family / whanau value mathematics as a subject	6%	20%	35%	39%
My friends think mathematics is important	10%	45%	27%	18%

While 98% of the students consider mathematics to be an important subject, only 47% of the students would say they "mostly" or "definitely" enjoy mathematics as a subject. Students' responses indicate that nearly three quarters of their families/whanau value mathematics (74% in mostly or definitely true) compared with less than half (45% in mostly or definitely true) of their friends.

Achievement Expectations

Table 4.4 Achievement Expectations

Statement	Student Response			
	Not true	*Partly true*	*Mostly true*	*Definitely true*
I expect to get Excellence or at least Merit	20%	36%	19%	25%
I will work for the number of credits I need, no more	66%	24%	10%	0%
I will strive for Merit or Excellence, even when I don't need it	7%	29%	31%	34%

Only 20% of the students who participated did not think they would get excellence or merit, with 25% thinking that they would definitely get excellence or merit. None of the students selected "definitely true" for working to the number of credits, with 67% selecting not true. This is reinforced by the number of students (64%) of students who strive for merit and excellence even when it is not required.

Tertiary Requirements

Table 4.5 Tertiary Requirements

Statement	Student Response			
	Not true	*Partly true*	*Mostly true*	*Definitely true*
I need to pass my Achievement Standards for tertiary options	6%	9%	32%	53%
Having Level 3 Statistics and Modelling will assist me in my career choices	9%	26%	35%	30%

Eighty-five percent of the students who participated selected that they needed NCEA Level 3 Statistics and Modelling credits for their tertiary options, with 65% of students believing that the credits would assist them in their career choices.

Mathematics Teacher

Table 4.6 Mathematics Teacher

Statement	Student Response			
	Not true	*Partly true*	*Mostly true*	*Definitely true*
My mathematics teacher is interested in me	15%	46%	27%	12%
I do best when I know I can count on the teacher for help when I need it	1%	21%	32%	46%
I know that my mathematics teacher understands the new Achievement Standards	2%	19%	40%	39%

When considering their mathematics teacher's interest in them, 46% of the students selected "partly true", and 14% selected "not true". Less than half of the students thought that their teacher was mostly or definitely interested in them. Seventy-eight percent of the students thought that they did best when they could count on the teacher for help.

Seventy-nine percent of students thought that their teachers "mostly" or "definitely" understood the new NCEA Level 3 Achievement Standards.

Learning Environment

Table 4.7 Learning Environment

Statement	Student Response			
	Not true	*Partly true*	*Mostly true*	*Definitely true*
I do best in classes where students work together	11%	41%	37%	11%
I learn more when students are encouraged to help each other	6%	35%	35%	24%
In class, I would rather work by myself	15%	44%	30%	11%

The results from the questions relating to learning environments are mixed. Eighty-nine percent of students thought there was some truth in doing their best in classes where students work together, and 94% selected that they learn more when students were encouraged to help each other. Conversely, 85% of students selected that there was some truth that in class they would rather work alone.

Questions 7 and 8 asked students to reflect on times when they had achieved their highest and lowest grades in mathematics and rate the possible influences on these results as being either *no influence, little influence, some influence* or *big influence*. The influences included ability, effort, assessment difficulty, luck, family/whanau, teacher, and friends.

Question 7 related to influences on the students' highest grades in mathematics. The results from Question 7 are presented below in Table 4.8 and Figure 4.2:

Table 4.8 Possible Influences on Highest Grades in Mathematics

Possible Influence	Student Response			
	No influence	*Little influence*	*Some influence*	*Big influence*
My ability	0%	3%	61%	36%
My effort	0%	7%	37%	56%
The assessment was easy	4%	33%	42%	21%
Good luck	37%	36%	19%	8%
My family/whanau	39%	30%	25%	7%
The teacher	2%	15%	42%	41%
My friends	27%	38%	34%	2%

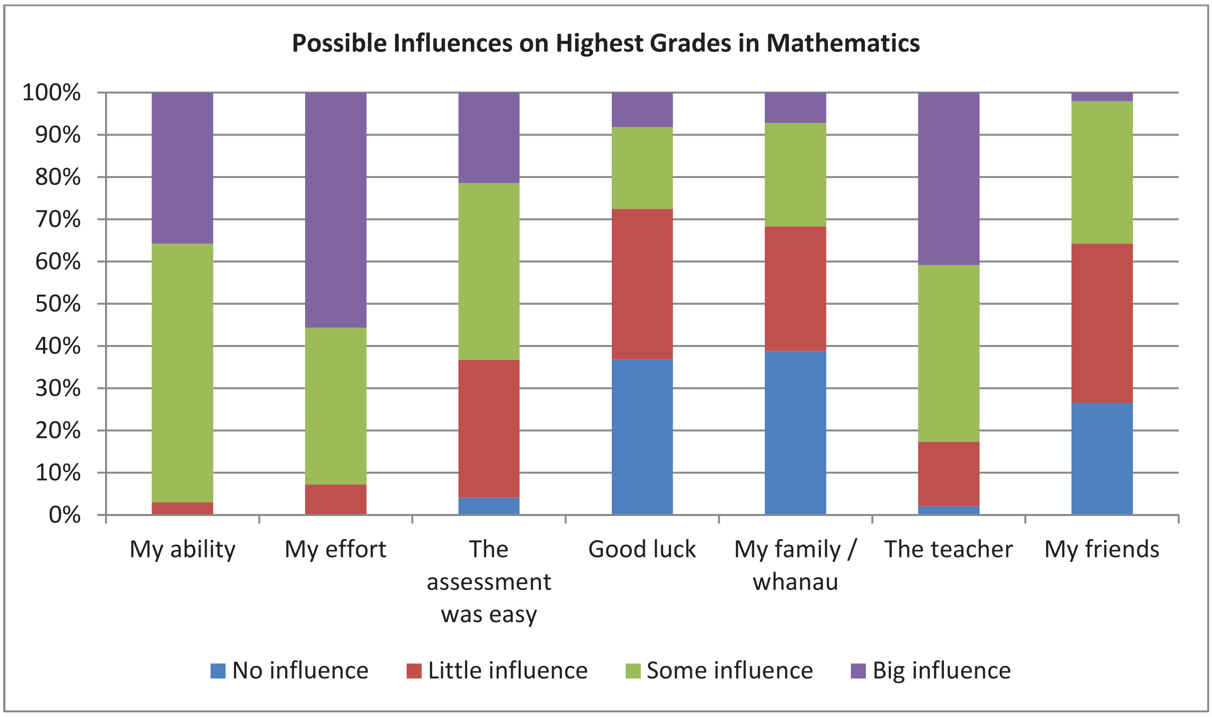

Figure 4.2 Possible Influences on Highest Grades in Mathematics

Students rated their ability, effort and the teacher as having the greatest influence on their highest grades in mathematics. Students perceived that good luck, family and friends had the lowest influence on their highest mathematical grades.

Question 8 related to influences on the students' worst grades in mathematics. The results from Question 8 are presented Table 4.9 and graphically in Figure 4.3:

Table 4.9 Possible Influences on Lowest Grades in Mathematics

Possible Influence	Student Response			
	No influence	*Little influence*	*Some influence*	*Big influence*
My ability	7%	30%	41%	22%
My effort	6%	13%	33%	48%
The assessment was difficult	2%	5%	35%	58%
Bad luck	39%	33%	18%	10%
My family/whanau	59%	34%	7%	0%
The teacher	20%	45%	24%	11%
My friends	48%	38%	10%	4%

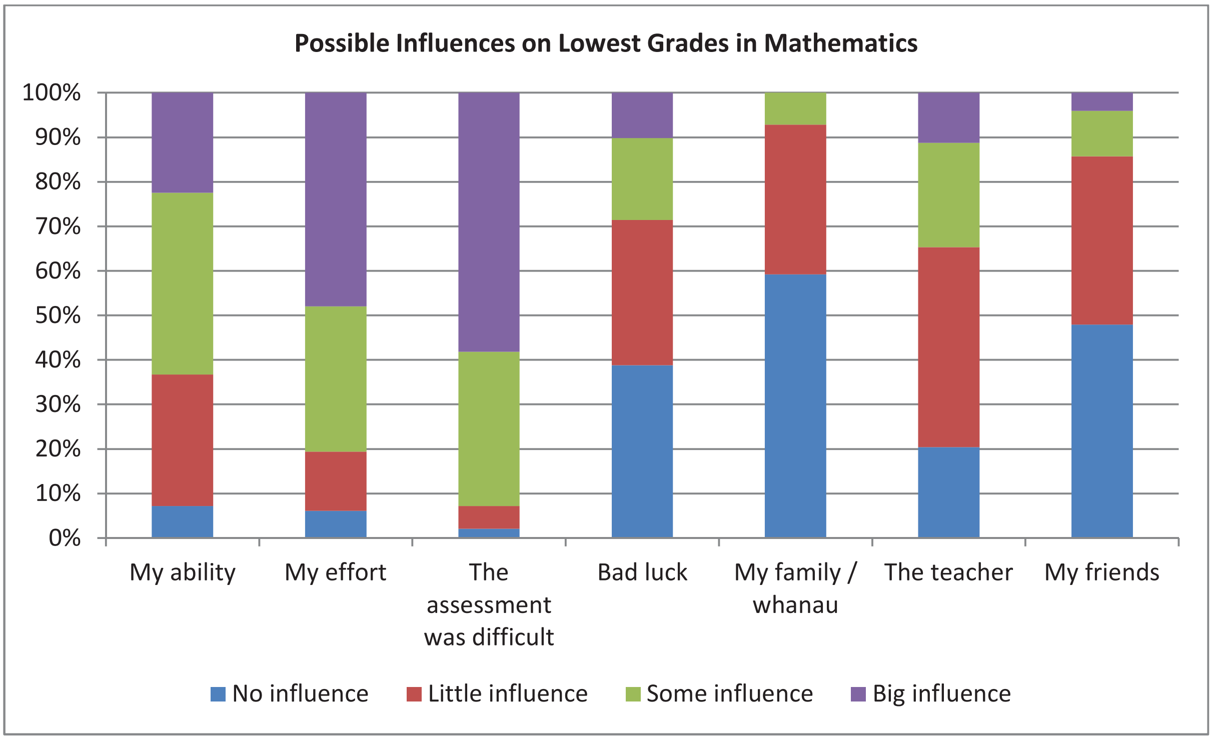

Figure 4.3 Possible Influences on Lowest Grades in Mathematics

Students rated their ability and effort, and the level of difficulty of the assessment as having the greatest influence on their worst grades in mathematics. Students perceived that family and friends had the least influence on their lowest mathematical grades.

4.2.3 Questions 9 – 13: Experience of Achievement Standard 91580 Investigate Time Series Data.

Questions 9 to 13 relate to the students' experience of Achievement Standard 91580 Investigate Time Series Data. The participants had recently completed the internal assessment for the achievement standard. The questions related to the students' perceptions of the knowledge and skills that they had to pass the Achievement Standard, the relative ease with which they thought they would pass the Achievement Standard and the grade that they were expecting. Questions 11 and 13 provided the students with opportunities to explain their selection choices.

Question 9 asked the students to think about the knowledge and skills required to pass the Investigate Time Series Achievement Standard and select the response that best applied to them, from *I have the knowledge and skills to pass well, I have just enough knowledge and skills to pass* and *I have not enough knowledge and skills yet to pass*.

Figure 4.4 summarises students' responses to Question 9:

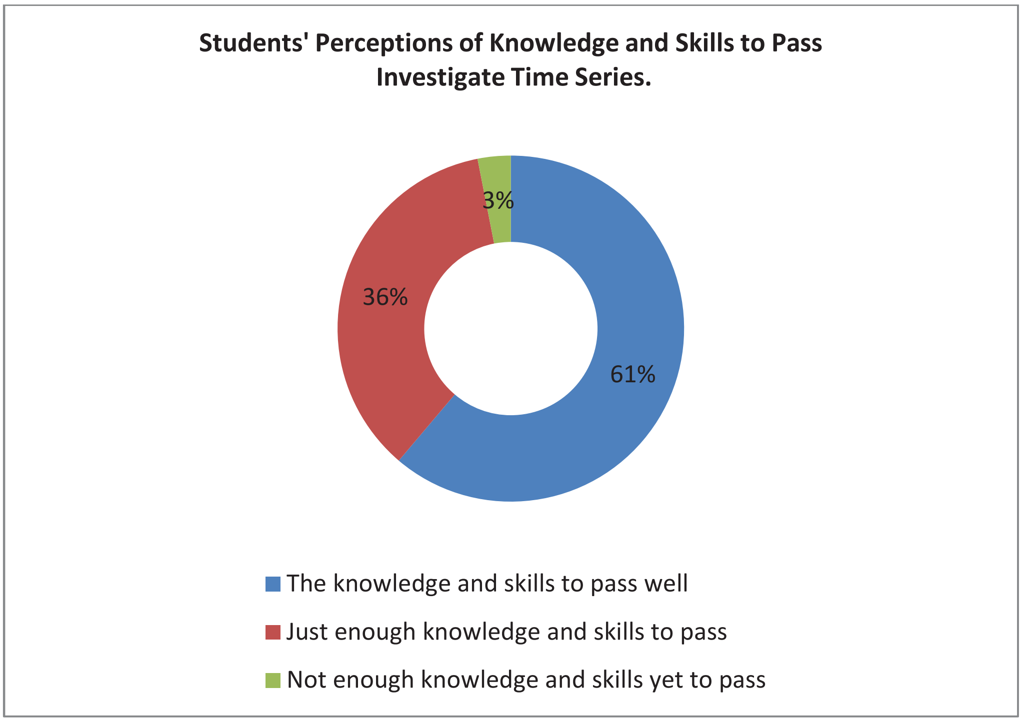

Figure 4.4 Students' Perceptions of Knowledge and Skills to Pass Investigate Time Series

97% of the students responded that they had the knowledge and skills to pass the assessment. This includes the 61% of the students responding that they had "the knowledge and skills to pass well".

Question 10 asked students to think about what was required overall to pass the Investigate Times Series achievement standard and then select the relative ease with which they thought they would be able to pass, from *very easy for me, quite easy for me, just manageable for me, quite difficult for me* and *far too difficult for me*.

The students' responses to Question 10 are represented graphically in Figure 4.5:

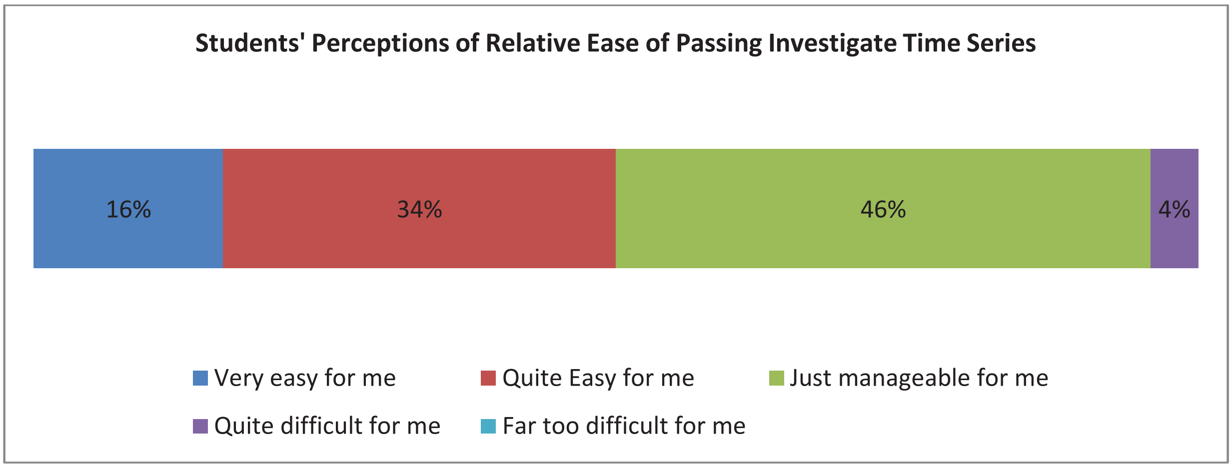

Figure 4.5 Students' Perceptions of Relative Ease of Passing Investigate Time Series

The majority of students (96%) thought that passing the achievement standard was manageable or easy. Forty-six percent of students thought that it was *just manageable*, 34% of students thought it was *quite easy* and 16% of students thought the assessment was *very easy*. None of the students in the sample thought that the Investigate Time Series assessment was far too difficult for them.

Question 11 asked students to provide one or two key reasons for their response to Question 10 and explain as fully as possible. Ninety-six students (98%) provided reasons for their selection in Question 10. The comments provided often contained more than one reason. The students' comments were individually analysed and the responses were categorised and collated. The results are summarised Table 4.10:

Table 4.10 Student Response to Question 11

Response to Question 11	Percentage of students (N=96)
Good understanding of topic	29%
Assessment Schedule & Exemplars	21%
Lack of effort	11%
Taught well	10%
Good effort	9%
Subject was commonsense	8%
Worry/not confident	6%
Statistics is a relatively easy subject	5%
Good at statistics	5%
Weak understanding of topic	4%
Friends distract me	4%
Absent a lot	4%
Not good at writing	3%
Good at writing	2%
Always A or NA for me	2%
NCEA marking schedules problematic	2%
ESOL	2%
Computer based	2%
Difficulty of Assessment	1%
Ease of Assessment	1%
Moderate ability	1%
Teacher confused by standard	1%
Inconsistency between stats classes, confusion	1%
Usually mess up	1%
Aim for excellence	1%
Did Level 2 Time Series	1%
Time Constraints	1%
Total	**142%**

When explaining why they had chosen their response to Question 10, the student comment occurring most frequently was “a good understanding of the topic” (29%), followed by the “assessment schedule and exemplars” (21%), “lack of effort” (11%) and the “topic being taught well” (10%). Examples of the students’ responses in these categories are provided below:

- Good understanding of the topic.

  I was good at the topic, understood it and felt I could complete it with ease.

  I felt that I had enough information to answer all of the questions to the best of my ability and I didn't feel that i didn't know anything.

- Assessment schedule and exemplars.

  I understand the basic steps in completing the internal. Also by looking at the marking schedule I can see what I am meant to be doing.

  I think I have done enough to pass well, I followed the assessment schedule and did everything which was on the task. I used a lot of my own time at home to finish this assessment and believe I did enough to pass with a good mark.

- Lack of effort.

  I could have put in more effort than I did in class time.

  Well. I understand what to do, but I'm not the best at putting it all together in a report/essay so I feel as though I could have done better if I put more effort in.

- Taught well.

  My teacher has provided me with all of the knowledge that I need for this assessment, as well as having access to some exemplars allows me to be more confident with the work that I produce. However I am not completely confident because with the NCEA marking schedules there is often something that comes up that you would not expect to see when actually writing the report.

  The main reason is because my teacher is very competent with making sure we understand and learn all areas that will be covered in an assessment and helps us if we don't. Another reason would be due to my own work ethic and desire to do the best I can.

Question 12 asked the students to predict the grade that they thought they were going to achieve for the Investigate Time Series achievement standard. Ninety-seven percent of the students expected to pass the Achievement Standard, with the majority of students expecting to achieve Merit (44%) or Achieve (42%). This finding is presented in graphically in Figure 4.6:

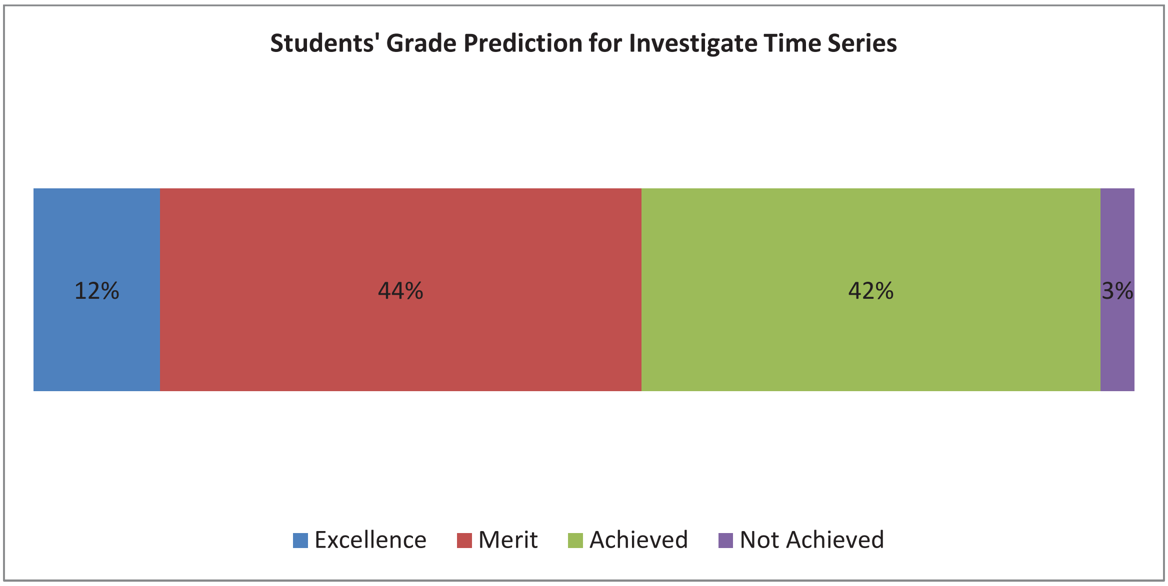

Figure 4.6 Students' Grade Prediction for Investigate Time Series

Question 13 asked the students to provide an explanation for their grade prediction. Ninety-two students (94%) responded to Question 13. The comments that the students provided often encompassed several reasons for their expected grade. Student comments were individually analysed and the responses were categorised and collated. The results from Question 13 are summarised in Table 4.11:

Table 4.11 Student Response to Question 13

Response to Question 13	Percentage of students (N=92)
Covered the required criteria	37%
Don't know if I covered everything	26%
Put in time and effort	14%
Don't want to be too optimistic	10%
Exemplars	10%
Lack of effort	5%
Grades in previous AS	3%
Absent a lot	3%
Don't understand stats	3%
Always A or NA for me	2%
Assessment went well	2%
Distracted by peers	2%
ESOL	2%
Slow at typing	2%
Boring	2%
I know I got Merit	1%
Not good at writing	1%
Good research	1%
Inconsistency between teachers	1%
Didn't sit assessment	1%
Wasn't difficult	1%
Do well at maths	1%
Extra-curricula activities take time & energy	1%
Not enough teacher coaching	1%
New AS are difficult	1%
Total	**136%**

The most commonly cited reason (37% of students) for the students' grade expectation was "covered the required criteria", followed by "don't know if I covered everything" (26%), "put in the time and effort" (14%), "don't want to be optimistic" and "exemplars" (both 10%). Examples of the students' responses in each of these categories are provided below:

- Covered the required criteria.

  I think I fulfilled the standards for an excellence because I followed what my teacher said was needed. In every period given for our internal I worked hard to make my analysis reach high standard.

Because I feel I did enough work to get a merit grade. Also I looked at the marking schedule to make sure I was on the right track. In every period I worked hard to make sure I reached my personal goals.

- Don't know if I covered everything.

Despite the simplicity I believe that there may be something that I didn't think of that will stop me from getting the excellence result.

I'm unsure of how to answer the above question, as despite the fact I followed a procedure I believed would prove successful, I still have some doubt in my ability, and worry that I could have missed things out or not completed the task in enough depth to achieve a good grade, which I was hoping to do. So I think I could potentially get any of the above results, I'm not sure at all.

- Put in time and effort.

I put quite a lot of work into what I did and making sure that I had covered all the ideas needed to get excellence.

I think I may only achieve this assessment, because I put a lot of effort in an assessment at the start of the year and did not achieve, I put a large amount of effort into this assessment and I believe I did enough to pass.

- Don't want to be too optimistic.

I chose merit because I don't want to be over confident and be a pessimist. I also think merit is a good grade, and hope for this or an excellence, I would be very disappointed with an achieved or not achieved.

I cannot answer the above question, as I don't feel confident in the mark I will get, as I don't know how it will be marked or assessed. I have made a stupid mistake that will take my grade down. Also I have a really weird phobia, that if I say or think what grade I am going to get, I never get it and that is extremely disappointing for me. So I avoid speculating as to what my result would be.

- Exemplars.

  We have done many practice examples, and that I feel I have enough skills to pass it.

  I used a merit exemplar to structure my work so I should have the same grade.

4.3 Summary

Chapter Four has presented the findings from the research process for each question in the online questionnaire. Question 1 through to Question 4 provided the demographic background of the student sample, for comparison with the general New Zealand population of Year 13 secondary school students. Question 5 through to Question 8 explored the students' general experience of NCEA Level 3 Statistics and Modelling.

The students in the sample had recently completed an internal assessment for the Achievement Standard Investigate Time Series. Question 9 though to Question 13 related to the students' experience with the achievement standard and their predicted achievement outcomes.

The purpose of the Findings Chapter was to summarise the findings from the online questionnaire in numerical, graphical or tabular form. The next chapter, Data Analysis, utilises the results from Chapter Four to explore patterns in the data and to investigate the relationships between variables.

Chapter Five

Data Analysis

5.1 Introduction

The research question for this study is as follows:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The objective of the research was to explore how senior mathematical students make sense of their mathematical experience through the NCEA qualifications system, and understand what factors motivate students in their mathematical studies and to what students attribute mathematical success. This chapter will discuss the findings from the study in two sections:

i. Making Sense of NCEA – Student Perceptions of NCEA Level 3 Statistics and Modelling.
ii. Motivations and Attributions.

Students' perceptions of NCEA are discussed under the following headings: credit parity, remodelling of Achievement Standards, literacy requirements within the assessment of Mathematics and Statistics Achievement Standards, use of ICT in teaching and assessing of the Achievement Standard, influence of assessment on grades, and criterion based assessment. Motivations and attributions are categorised according to whether they are externally or internally driven. The external category includes tertiary study requirements and career options, the teacher, peer group, whanau/family, learning environment and luck. The internally driven motivators and attributes that are discussed are enjoyment of mathematics, ability and effort. The summary at the end of the chapter will encapsulate general themes.

5.2 Making Sense of NCEA - Student Perceptions of NCEA Level 3 Statistics and Modelling

The majority of principals and teachers still perceive assessment to be the primary driver of the secondary school curriculum (Hipkins, 2010). Assessment has the capacity to arouse student motivation and interest, however, this outcome is not always achieved. The impact of assessment on teaching and learning has been referred to as "washback" (Mizutani, Rubie-Davies, Hattie, & Philp, 2011). NCEA was originally introduced to promote positive washback. For example, Fancy (2001) argues that one of the intended positive washback effects of NCEA was to motivate students of all abilities to strive for higher levels of achievement by providing criterion-based Achievement Standards with well-defined goals. NCEA mathematics has recently been remodelled to align the Achievement Standards to the new New Zealand Curriculum (Ministry of Education, 2007) and to address some of the issues raised by principals and teachers concerning credit parity and duplication. The section below seeks to understand the washback effect of NCEA Level 3 Statistics and Modelling, by exploring the students' perceptions of credit parity and the Achievement Standard remodelling.

5.2.1 Credit Parity

In Meyer at al.'s (Meyer et al., 2006) "The Impact of NCEA on Student Motivation Study" students expressed perceptions that Achievement Standards differed in level of difficulty and time required both across and within subjects. In response to credit parity and duplication concerns from students and teachers, NCEA has recently been remodelled to review and align standards with the new New Zealand Curriculum (New Zealand Qualifications Authority, 2013).

Of the 98 NCEA Level 3 Statistics and Modelling students who responded in this study in 2013, none planned to enrol in NCEA Level 3 Calculus in 2014. Some of the students (13%) were currently studying Calculus as well as Statistics and some students (11%) had taken Calculus in 2012. Student subject selections were guided by the Advanced Learners "A" (ALA) Programme at the College. This is an accelerated learner programme where students generally do NCEA Level 3 Calculus when in Year 12 and then NCEA Level 3 Statistics in year 13.

The perception for the students is that statistics is an easier mathematical option, and that was their motivation for choosing to study NCEA Level 3 Statistics and Modelling in 2013. When questioned (through Question 5) about their reasons for taking statistics, 19% of the students cited reasons related to the relative easiness of statistics ('Easier than calculus', 11%, 'Didn't qualify for calculus', 6%, 'stats is easy', 2%). In Question 11, 5% of students cited "statistics is a relatively easy subject" as the reasoning behind their ability to pass the Achievement Standard.

The quotes below provide examples of the students' responses:

> *Because I thought it was an easier option than taking calculus.*
>
> *Easier than calculus/couldn't make it into calculus even if I wanted to.*
>
> *Easiest maths subject in year 13 and any maths is good for your future. So yeah, couldn't find anything else.*

As reflected in the research, the students in this study do not perceive that parity exists between an NCEA Level 3 Statistics and Modelling Achievement Standard course and a NCEA Level 3 Calculus course. The students voiced that statistics was an easier mathematics option.

5.2.2 Remodelling of Achievement Standards

From 2011 to 2013 the students in the study have been the first cohort to go through the remodelled Achievement Standards at each level of NCEA. The section below investigates student perceptions of the remodelled NCEA Level 3 Statistics and Modelling Achievement Standards, specifically the Achievement Standard 'Investigate Time Series' in the following areas: literacy component, ICT, the influence of assessment on grades and criterion based assessment.

5.2.2.1 Literacy Component

The reforms to NCEA Level 3 Statistics and Modelling Achievement Standards have necessitated changes in how the Achievement Standards are taught and how the students are expected to present an assessment. The assessments now require a greater proportion of reasoning and explanation, including independent research and investigation. The students refer to this as "writing". Mathematics teachers have expressed their concern at the high level of literacy required in order to be successful at NCEA Mathematics (Alison, 2005).

In Question 11, five students cited "writing" as their reasoning behind their ability to pass the Investigate Time Series Achievement Standard. There were three negative and two positive comments.

Examples of the students' responses are as follows:

> *These standards have been designed to form investigations and investigate a question you form yourself from a set of data so there is not a lot of number work, there is a lot of writing and explaining it doesn't seem like a mathematical subject, I find it easy in most contexts to explain myself.*
>
> *I am not good at writing long essays etc.*

The significant increase in the literacy component, of what is thought of as a primarily numeric subject, has the potential to penalise students who are not primarily English speakers. Two students commented in both Question 11 and Question 13 about their struggles to complete the explanation component of the assessment.

For example, students offered the following responses:

> *My English is not good enough to understand and write a lot of words.*

> *Even though I did do enough work in class and I was prepared, English is my second language.*

To achieve a merit grade, a student needs to be able to demonstrate the ability to investigate time series data, *with justification.* To achieve the Excellence criteria a student must investigate time series data, with *statistical insight*. Both the Merit and Excellence standards involve a degree of non-numerical explanation and reasoning not previously required in a statistics assessment. Evidence of the ability to integrate statistical and contextual knowledge, reflect on the process and evaluate the adequacy of statistical models is a valid inclusion in the statistical curriculum. However, students need to be prepared for the additional literacy component prior to selecting statistics. While statistics may be an easier option from a 'numerical perspective', the literacy component required for success is far greater than that required in the calculus syllabus.

5.2.2.2 ICT

Research into the use of ICT in the mathematics classroom generally reports an increase in student motivation, greater engagement and improved self-esteem (Chambers & Timlin, 2013; Knights, 2009). NCEA Level 3 Statistics and Modelling classes in the college in which the study was undertaken, now takes place exclusively in a computer laboratory because of the ICT requirements. The college uses the software INZight for statistical analysis, Microsoft Word and Excel for written reports and the Internet for research into topics.

In Question 11, two students commented on the computer laboratory as a reason behind their ability to pass the achievement standard, one positive and one negative:

> *I also find it is difficult to listen in a computer lab classroom, which affects what I learn in the classroom.*

> *Because most of the work is done on computers it makes it a lot easier to complete work.*

In response to Question 13, two students cited not their ability to write explanations or the use of software, rather their ability to type as their reason for not getting excellence:

> *Because I'm pretty slow at typing I was not able to get everything done that I wanted so I don't think I'll quite get an excellence.*

> *I don't think I used enough detail to gain excellence as I am a slow typer and ran out of time.*

There is definitely potential for the use of ICT to motivate the students enrolled in NCEA Level 3 Statistics and Modelling (Calder, 2009). There are nevertheless some factors which need to be taken into account. At present, the computer laboratories are set up for teaching typically computer based subjects. The students' screens are perpendicular to the projector screen and the white board. The teacher does most of the instruction and demonstrations at the front of the classroom. Students who have not had learning experiences in this type of environment may encounter potential obstacles to learning.

5.2.2.3 Influence of Assessment on Grades

In Weiner's Attribution Theory, task difficulty is an external, stable, uncontrollable attribute for achievement outcomes (Weiner, 1985). If a student attributes the easiness of the task to their good results, they are accrediting their success not to their own effort or ability, or even anything that they can control. Subsequently, there has been no increase in the student's efficacious beliefs and future behaviour is unlikely to be changed (Shores & Shannon, 2007; Yailagh et al., 2009). If a student credits the difficulty of the assessment on their lowest mathematical grades, they are again taking no control of the situation. These students are unlikely to put more effort into future assessments as they do not assign any value to the level of effort they contribute. The self-efficacy beliefs of students are likely to remain unchanged, despite a "failure". However, future behaviours remain unchanged as well. It is worth remembering that attributions are *perceived* causes of outcomes. They may not be the actual causes.

Questions 7 and 8 asked students to reflect on times when they had achieved their highest and lowest grades in mathematics.

Figure 5.1 demonstrates the students' responses to the influence of the assessment.

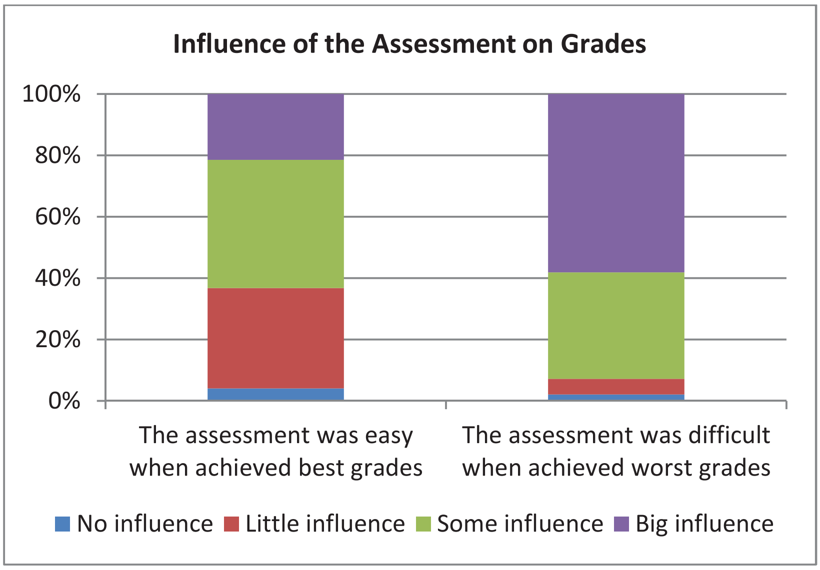

Figure 5.1 Influence of the Assessment on Grades

When students achieved their highest grades in mathematics, 62% of students thought that the "easiness" of the assessment had some or a big influence. However, 91% of the students believed that the difficulty of the assessment had some or a big influence on the times when they had achieved their worst grades in a mathematics. Two percent of the students thought the assessment had no influence over their best grades and 4% of the students thought the assessment had no bearing on their worse grades.

In both cases of highest grades and lowest grades in mathematics, the students credited the assessment with having an influence. According to research findings, students at this age differentiate ability and task difficulty according to the success rates of others. An assessment where fewer students succeed is considered "difficult" (Schunk et al., 2014). Interestingly, it is the difficulty of the assessment that students responded to as having the largest impact. These results raise questions around how assessment is presented to students and the moderation processes between Achievement Standards. Despite all the good intentions of the development of NCEA, assessment is still seen as an isolated entity rather than an integral part of the learning process (Mizutani et al., 2011).

5.2.2.4 Criterion Based Assessment

The introduction of NCEA was a move away from traditional high stakes, external examinations to a standards-based assessment system. The intention of the criterion referenced system was to strengthen connections between student learning behaviours and achievement outcomes, measuring how a student performs against a particular learning outcome rather than comparing how a student performs in relation to other students (Meyer et al., 2006; Meyer, McClure, Weir, et al., 2009; Rawlins et al., 2005). Critics of standards-based assessment in the literature cite the following disadvantages: atomisation of learning, validity and reliability, alignment between Achievement Standards and assessment, and alignment of credit parity between Achievement Standards (Rawlins et al., 2005).

The New Zealand Curriculum advocates that education should make links within and across learning areas (Ministry of Education, 2007). However, when compared to teachers of NCEA Level 3 English, Geography and Physical Education, Statistics teachers were the most concerned that NCEA's assessment process encouraged students learning in discrete components (Stewart, Gray, & Pilcher, 2007).

In this study, the students often made reference to the NCEA assessment schedule, the criteria for achieving each grade and the exemplars. When asked to provide reasoning behind the ease with which the students expected to pass the Achievement Standard, the assessment was mentioned by 25% of the students. This included assessment schedule and exemplars (21%), NCEA marking schedules problematic (2%) and the difficulty and ease of assessment (both 1%).

The following quotes are examples of the students' responses:

> *I think I have done enough to pass well, I followed the assessment schedule and did everything which was on the task. I used a lot of my own time at home to finish this assessment and believe I did enough to pass with a good mark.*

> *My teacher has provided me with all of the knowledge that I need for this assessment, as well as having access to some exemplars allows me to be more confident with the work that I produce. However I am not completely confident because with the NCEA marking schedules there is often something that comes up that you would not expect to see when actually writing the report.*

> *It is hard to know what to expect with the assessment and I could do it but it wasn't easy. It was a challenge I had to step up to.*

The exam was easy, except your grade was dependent on your research and literary skills which could of affected some students grades.

When asked to provide an explanation for their predicted grade, in Question 13, 76% of the students' comments were associated with the NCEA assessment criterion. The 76% came from the following categories of students' comments explaining their forecasted grade: I covered the required criteria (37%), I don't know if criteria covered (26%), use of exemplars (10%), assessment went well (2%) and the new Achievement Standards are difficult (1%).

For example, students explained:

I felt I wrote enough and went in depth enough to cover all of the Achieved/Merit and some Excellence requirements.

I felt as though I did the standard correctly by following exemplar sheets and the marking schedule. In saying this, I do not believe I did well enough to get a higher mark than achieved as I was not 100% sure on what I was doing throughout the standard.

In the exemplar that was given to us, I had annotated the key reasons for merit. I felt that I covered those areas and also added extra detail.

I thought the assessment went well, and I provided a comprehensive report thoroughly answering the context.

Because the new standards are pretty hard.

Interestingly, instead of solely referring to the required criteria, eight of the students who responded to Question 11 reasoned that the Investigate Time Series Achievement Standard was "common-sense".

For example, two of the students pointed out:

I understood the topic very well and had plenty of practice writing reports for practice investigations. Most of the "new ideas" we approached in class felt like common sense.

Passing comes quite naturally to me, as most of the skills needed to pass don't really need to be learned, and are mostly common sense. It is the jump from merit to excellence which is difficult, as more study is needed.

The students were aware that there was a set of criteria required for the Investigate Time Series Achievement Standard and that there were differentiated measures to attain Achieved, Merit or

Excellence. Over half of the students commented that this enabled them to attain positive results. The students were aware that achievement was measured in discrete units. Given the link between assessment and learning, further research is required to investigate whether the students of NCEA Level 3 Statistics and Modelling perceive learning of statistics to be in discrete units as well.

5.3 Motivations and Attributions

The section below considers the factors that students in the study reported as motivating their mathematical achievement and the factors which influenced their mathematical success. The discussion has been divided into two categories: externally driven and internally driven.

5.3.1 Externally Driven

External motivators are those that occur outside of the control of the individual. With reference to motivational orientations, extrinsically motivated students are driven to succeed by factors outside of themselves, for example, tertiary entrance or parental pressure (Sternberg, 2010). Weiner's theories on attribution (1985) emphasise the function of perceived control over outcomes. Attribution Theory included the concept of "locus dimension", which had been previously been proposed by Rotter (1966). The locus of control refers to whether an individual perceives an outcome to be internally or externally control. External control students believe that outcomes are outside of their control and are due to such factors as luck, other people or assessment difficulty (Schunk et al., 2014). The responses from the students in this study in relation to externally driven motivations and attributions have been categorised under the following subheadings: tertiary study requirements and career options, the teacher, peer group, whanau/family, learning environment and luck.

Tertiary Study Requirements and Career Options

For many of the students in the study, mathematical success is a means to an end. NCEA Level 3 Statistics and Modelling is perceived to be important for tertiary study, career options and life choices. These three categories were cited by 62% of the students in Question 5 as the reason they has chosen Statistics. In Question 6, only 6% of students responded to the statement "I need to pass my Achievement Standards for tertiary options" with "not true". Similarly, all but 9% felt that in some way having Level 3 Statistics and Modelling would assist them in their career. However, the sample indicated a discrepancy between students' perceptions of tertiary study requirements and career choices. Eighty-five percent of the students believed that they needed NCEA Level 3 Statistics and Modelling for tertiary study, whereas, only 65% believed in would assist them in their career choices.

This is reflective of the research demonstrating that as students progress through their schooling career, mathematics becomes viewed as increasingly utilitarian for the future, rather than an option for pleasure (Meyer et al., 2006). In this sample, more students believed in the functional value of NCEA Level 3 Statistics and Modelling concerning further academic study rather than vocationally.

The Teacher

The teacher matters. The relationship that the teacher establishes with students has the propensity to mediate and alter students' self-efficacy beliefs (Martin & Dowson, 2009; Meyer, McClure, Walley, et al., 2009; Moe, 2011a, 2011b). The evidence from the research conclusively shows that effective teachers put conscious effort into developing inclusive partnerships with their students (Anthony & Walshaw, 2007) and effective teaching and learning depends on the relationship between the teacher and the student (Ministry of Education, 2009).

When providing reasons for taking Level 3 Statistics and Modelling in 2013 in Question 5, one student commented on the influence of the teacher:

> *I'm interested in it. I'm good at maths and writing - thought it would be a good fit. We have excellent Stats teachers so I thought I might be able to do it at Scholarship level/get good marks which would help me. I might need Stats later on in whatever tertiary course I do. I'm kind of geeky like that - I enjoy grappling with data and stuff.*

In Question 6, only one student thought that the statement "I do best when I know I can count on the teacher for help when I need it" was "not true". From the students' responses, however, they were not convinced of the teacher's interest in them, as only 12% of students responded that that was "definitely true".

In response to Question 7, where students were asked to reflect on times where they have achieved their highest grades, 83% of responses indicated that the teacher had "some influence" or a "big influence" on the result. Conversely, when asked to reflect on times when they had achieved their worst grades in mathematics only 35% of students responded "some influence" or a "big influence".

This is shown in Figure 5.2:

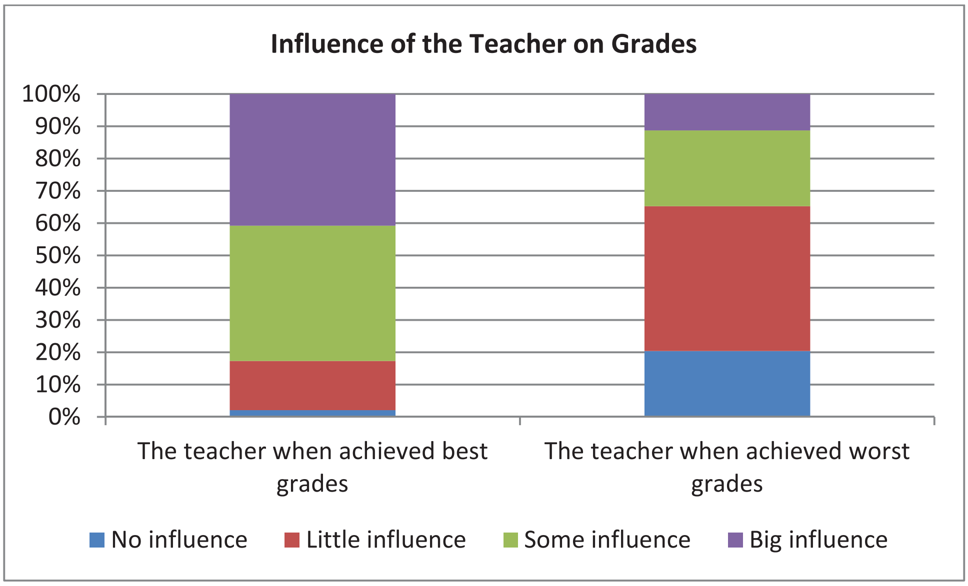

Figure 5.2 Influence of the Teacher on Grades

The students perceived their teachers as having a significant impact on their highest mathematical achievements. However, the students were not accrediting the teacher to the same degree for their lowest mathematical grades. This is encouraging for the statistics teachers and information that teachers should be aware of: 'Students are accrediting you for their good results and not their bad'.

When providing a justification for their perceived ability to pass the Investigate Time Series Achievement Standard, 10% of the students commented that the topic had been taught well. However, the role of the teacher was rarely commented on in relation to reasoning behind the actual grade the students expected to achieve.

The only two comments from students had negative teacher connotations:

> *My first internal this year I only got achieved. I feel that I would have had to done a bit more work to get the merit mark and the teacher could have expanded on some things, and maybe talked a bit more about how to increase your grade.*

> *Unsure of what was actually required due to inconsistency among teachers.*

In relation to the new NCEA Level 3 Statistics and Modelling Achievement Standards, all bar two students felt that their teacher understood the new Achievement Standards to some degree in response to Question 6.

In Question 11, one student commented:

> *I found during the time we were learning this topic in class, the teacher was not completely sure on the concepts of this new standard.*

And another felt that there inconsistencies between the statistics classes:

> *Inconsistency with what each teacher was telling their class, I found that friends in other classes had been told different things from their teacher than I had so now I'm unsure if what I wrote was correct.*

Given the importance of the relationship between the teacher and student, and the research that has consistently shown the impact of the teacher and student connection on motivation, it is significant that 61% of the students responded to the statement “my mathematics teacher is interested in me” with “not true” or “partly true”. Professional development for secondary mathematics teachers has been dominated by NCEA and the new Achievement Standards as they have been remodelled. The Ministry of Education’s (2009) document, *Ka Hikitia – Managing for Success, the Maori Education Strategy 2008-2012*, emphasises the teacher and student partnership as core to effective teaching and learning. I would suggest that student mathematical attainment could be increased, if the focus of professional development for mathematics teachers was on the teacher and student relationship and strategies to strengthen this connection.

Peer Group

Peer modelling can have an effect on student motivation. If a student’s friends value school and actively engage in academic achievement, this can positively influence a student’s motivation and attainment. The opposite is found when peers voice negative attitudes (Ladd, Herald-Brown, & Kochel, 2009). Through vicarious experiences, students compare their success, or otherwise, based on the perceived competence and similarities of others (Martin & Dowson, 2009; Middleton & Jansen, 2011).

In this study, none of the students who participated cited peer group as a reason why they had chosen statistics. When the students were presented with the statement “My friends think mathematics is important” in Question 6, the majority of students (45%) selected “partly true”. Figure 5.3 shows the students’ responses to peer influences on their highest and lowest grades in Question 7.

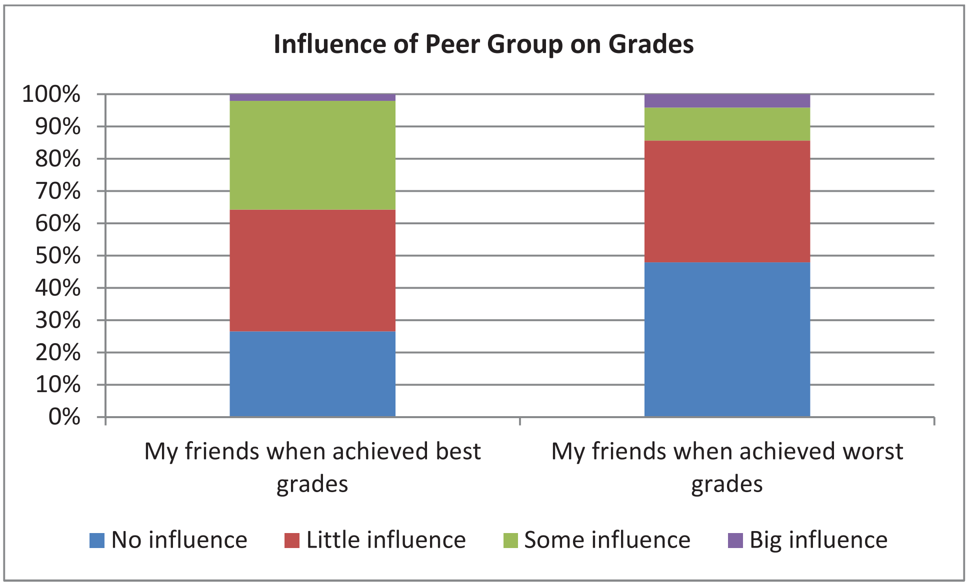

Figure 5.3 Influence of Peer Group on Grades

Of the students who responded 63% selected that friends had no or little influence on their highest grades. This increased to 84% for no or little influence on worst grades. In Question 11, only 4% of students provided the distraction of friends as a reason for their ability to pass the Investigate Time Series Achievement Standard.

The following quotes provide examples of the students' responses:

> *Because I sit with my friends we get distracted often and this affects our learning abilities then I stress a lot when it comes to the test and try hard but worry about it when I finish.*

> *Because I sit with my friends I do not put as much effort into learning the subject as I should. Though when it comes to the test I try very hard and get worried that I have not learned enough over the subject. I then swear to myself that I will try for the next internal, though the same things seem to happen every time.*

In Question 13, only two students commented that peer distraction had been the reason they selected their expected grade for the Achievement Standard and one of those comments was a copy and paste from a previous question.

The influence of the peer group on mathematical success was not perceived as significant for the sample of students participating in this study.

Family/Whanau

Research is increasingly showing that the extent to which families encourage school involvement in their children is predictive of motivation (Pomerantz, Grolnick, & Price, 2005; Pomerantz & Moorman, 2010). There are many variables involved within the context of parental influence on student motivation, for example, parenting style, socio-economic status, mother's beliefs about their parenting efficacy, father's involvement in the student's academic life, parental presence in the school (Schunk et al., 2014). These variables have not been specifically referred to in this study and warrant further research in relation to the effect they may have on senior mathematics students.

None of the students who participated in the survey cited their family/whanau as the reason they had chosen to study Level 3 Statistics and Modelling. However, in Question 6, 74% of the students selected "true" or "definitely true" to the statement "My family/whanau value mathematics as a subject". The family value of mathematics received the highest score in the "definitely true" (39%) compared to the individual value (36%) or peer group (18%).

When students reflected on times when they had achieved their highest or lowest grades, the influence of family was inconsequential. Figure 5.4 demonstrates the students' responses to Question 7 and 8 relative to the influence of family.

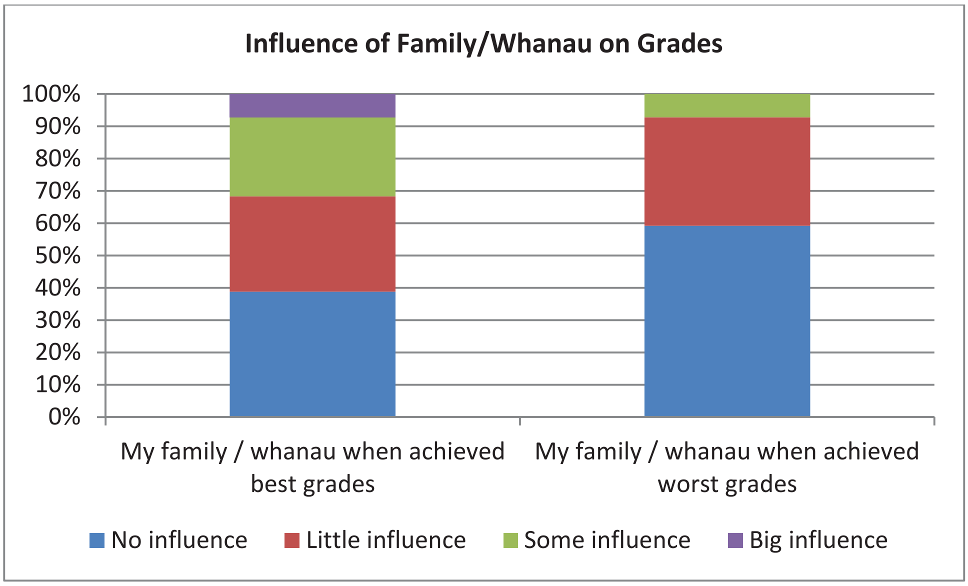

Figure 5.4 Influence of Family/Whanau on Grades

Sixty-seven percent of students believed that family and whanau had little or no influence over their highest grades, and 91% of students believed that their family and whanau had little or no influence over their lowest grades. No students believed that their family had a big influence over their lowest grades.

The students in this study are not attributing their family with having a significant influence over their mathematical success, although the family value of mathematics may have been a contributing factor to their initial selection of statistics as a subject choice. As shown by Schunk (2014), parental involvement declines throughout students' schooling, and by Year 13 parental participation in a student's academic career is at a minimum. Or perhaps, as argued by Harris (1998), the importance of the family's role has been overstated.

Learning Environment

The learning environment has been advocated by some researchers as a factor in student motivation (Martin & Dowson, 2009; Moe, 2011a; Schunk et al., 2014). However, the research also indicates that effects on motivation are variable and dependent on how the task is structured and how members of the groups are rewarded (Slavin, 1995, 2012).

Figure 5.5 represents students' responses to learning environment based statements in Question 6.

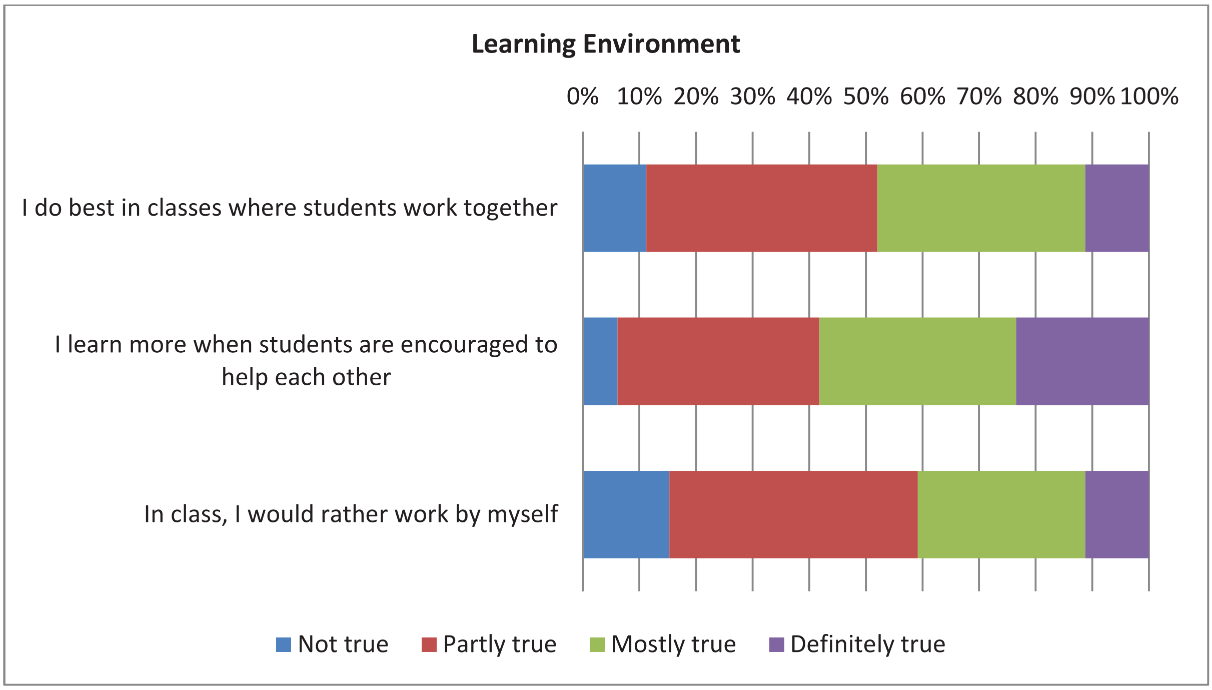

Figure 5.5 Learning Environment

Of the students who responded, 89% thought that there was partial, most or definite truth in the statement regarding working their best in a class where students work together. Ninety-four percent of students found a similar level of truth in the statement about learning more in classes where students are encouraged to help each other. The students' responses reflect the research, where learning is usually effective and students often perform better in groups than alone (Schunk et al., 2014).

However, 85% of students believed that they found partial, most or definite truth in the statement concerning preference to working alone in class. As mentioned above, in the section on peer influence on motivation, comments concerning peer group in class are associated with distraction rather than advancement of learning.

The students in the sample have not responded conclusively about a preference for working with others or working alone. These results appear to support Slavin's research (1995, 2012). The effectiveness of collaborative learning as a motivator is variable. If students have not been exposed to appropriate cooperative learning tasks, the advantages may not be obvious.

Luck

Luck was included in Weiner's original attribution theory, as an external, unstable, uncontrollable attribute (Weiner, 1985). In 1986, Weiner changed 'luck' to 'chance', to reflect a focus on circumstantial opportunities rather than a stable character trait, for example, 'She is such a lucky person' (Weiner, 1986). Luck was not mentioned by the students in the study as their explanation behind their expected grade in Question 13, even though the concept of luck had been already been introduced in Question 6. When asked to rate the relative influence of good luck on their best grades in mathematics, 37% of students said that luck had no influence. Similarly, 39% of students responded that bad luck had no influence on their worst grades. Figure 5.6 demonstrates this:

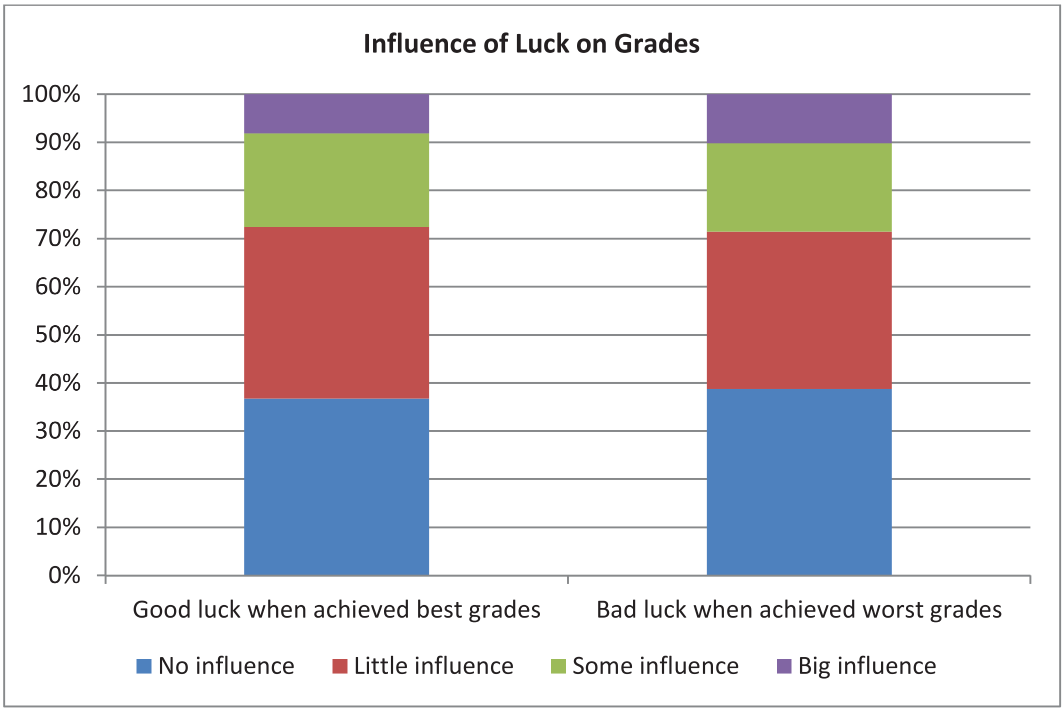

Figure 5.6 Influence of Luck on Grades

The graphs for both highest and lowest mathematical grades are very similar. Twenty-eight percent of students thought that luck had a big or some influence on their highest mathematical achievements and 29% of students believed that luck had some or a big influence on their worst grades. From the data collected, the reality in a class of thirty is that only three students believe that luck had a big influence on their mathematical achievements. Further information on these three individual students would perhaps suggest a motivation orientation pattern and prior mathematical experience which highlights that mathematical attainment is external, unstable and uncontrollable.

5.3.2 Internally Driven

Intrinsic motivation is the motivation to engage in an activity for its own sake. Research has shown that intrinsically motivated students achieve higher levels of success than extrinsically motivated students (Schunk et al., 2014). Internal control students believe that their grades are determined by their own behaviours and depended on ability, skill or effort (Rotter, 1966). Perceived control over outcomes has been associated with higher academic attainment (for example, Hipkins, 2010; Lepper, Corpus, & Iyengar, 2005; Meyer, McClure, Walley, et al., 2009; Meyer, McClure, Weir, et al., 2009; Posamentier & Krulik, 2012; Rotter, 1966; Shores & Shannon, 2007; Weiner, 1985). In the following discussion, student responses from the research questionnaire have been categorised according to enjoyment of mathematics, ability and effort.

Enjoyment of Mathematics

Mathematics students begin their mathematical journey enthusiastic, successful and with curiosity and joy (Boaler & Greeno, 2000; Cotton, 2001; Orton, 1994). As students continue on their mathematical voyage through secondary school, they increasingly lose their enjoyment of mathematics and instead focus on the importance or utility of the subject (Meyer et al., 2006). As argued by Anthony and Walshaw (2007, p. 6), “many students do not succeed with mathematics; they are disaffected and continually confront obstacles to engaging with the subject.”

In the study sample, 12% of the students cited an enjoyment of mathematics as their reasoning for selecting Level 3 Statistics and Modelling in 2013, with a further 8% of students commenting that they enjoyed statistics. In Question 6, when presented with the statement “I enjoy mathematics”, 53% of students responded “not true” or “partly true” to the statement. After five years of mathematical education at secondary school, only 14% of the Level 3 Statistics and Modelling students agreed that they definitely enjoyed mathematics.

In Schunk and colleagues taxonomy of student emotions, “enjoyment” is a positive, task related emotion (Schunk et al., 2014). The negative emotion is “boredom”. When asked to explain their reasoning behind their choice of expected grade in Question 13, two students commented that statistics was boring, for example:

I could probably get a higher result if I tried harder and studied more but it's so boring.

Throughout secondary school the perceived utility of mathematics increases. In Question 5, 6% of students commented that the importance of mathematics to their future was their reasoning behind selecting Level 3 Statistics and Modelling in 2013.

The quotes below are examples of the students' comments:

Because I feel it is important to have Level 3 Maths.

I was going to do calculus but then later realised that I didn't actually need it for my future studies but still wanted to keep up a math subject.

Eighty-two percent of the students in the study selected "mostly true" or "definitely true" to the statement "I think that mathematics is an important subject".

In the overwhelming majority, the students' responses echoed the research. The students thought that mathematics was important, but, they didn't really enjoy it.

Ability

In attribution theory, ability is classified as an internal, stable entity. The control dimension of ability, depends on the student's perception of their academic ability as fixed or incremental (Dweck, 2006). Research demonstrates important connections between mindsets, motivation and achievement outcomes. Students who have a fixed mindset believe that effort will help them reach the limits of their academic ability but after that is not very productive. Failures and frustrations can lead to lower self-efficacy and students can give up or work to meet the minimum expectations. Conversely, students with an incremental mindset believe that ability can increase with learning. An "ability ceiling" does not exist for these students and they will keep working harder to improve. Failures and frustrations are viewed as challenges and can raise efficacious beliefs, therefore, students continue to apply effort and persist (Dweck, 2006; Meyer et al., 2006; Middleton & Jansen, 2011; Yailagh et al., 2009).

Of the students who participated in the study, only 4% cited being good at mathematics as the reason they had chosen to study NCEA Level 3 Statistics and Modelling in 2013.

For example, one student commented:

> *I'm interested in it. I'm good at maths and writing - thought it would be a good fit.*

However, when asked about the influences on their highest and lowest mathematical grades in Question 6, 97% of students responded that ability had some or a big influence on their best results. Comparatively, when achieving their worst grades in mathematics, this figure lowered to 63% of students who believed that their ability had some or a big influence on the grade. Interestingly, 7% of students thought that their ability had no influence on their lowest mathematical grades.

These findings are represented in Figure 5.7:

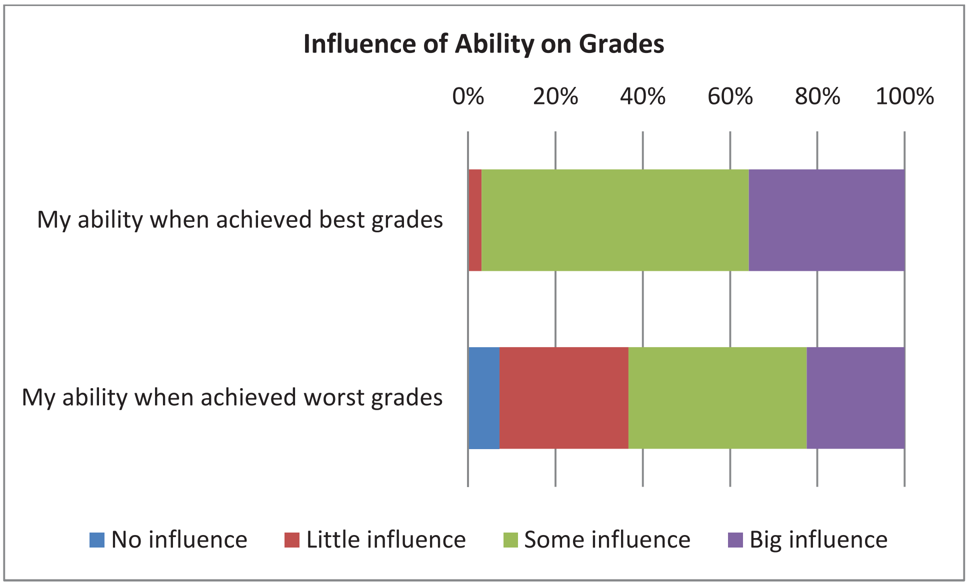

Figure 5.7 Influence of Ability on Grades

In this sample, nearly all of the students attributed their ability to their highest marks in mathematics. These same students did not attribute the same level of influence of their ability on their worst marks. Further research is recommended to explore individual student responses to the influence of ability when mathematical attainment was low.

In Question 9, students were asked about their perceived level of knowledge and skills to pass the Investigate Time Series Achievement Standard. Sixty-one percent of students selected that they had the knowledge and skills to pass well, 36% thought they had just enough knowledge and skills and 3% thought that they didn't have the knowledge and skills to pass.

Half of the students who responded to Question 10 thought that passing the Achievement Standard would be quite easy or very easy, 46% of the students believed that it was just manageable and 4%

believed that it was quite difficult. None of the students who participated thought that the Achievement Standard was far too difficult to pass.

When asked to provide key reasons as to why they had selected their relative ease of passing the Achievement Standard in Question 10, 49% of the students cited reasons relating to mathematical ability. The 49% included the following categories of student comments: good understanding of the topic (29%), statistics is a relatively easy subject (5%), good at statistics (5%), weak understanding of the topic (4%), not good at writing (3%), good at writing (2%), moderate ability (1%).

Examples of students' comments relating to mathematical ability are provided below:

> *I found that what I had learnt in class gave me enough knowledge to be able to answer what I needed for the internal and I believe that I did everything that I needed too.*

> *Passing is not particularly hard for me as I have never failed a mathematics paper.*

> *I find that maths is not my strong point and I often find the new assessment criteria vague and sometimes confusing.*

The results showed that 97% of the students responded that they had the knowledge and skills to pass, and none of the students thought that the Achievement Standard was too difficult to pass. Less than half of the students attributed these results to their ability.

In Question 12, students were asked to predict their grade for the Investigate Time Series Achievement Standard. Figure 5.8 demonstrates the students' responses:

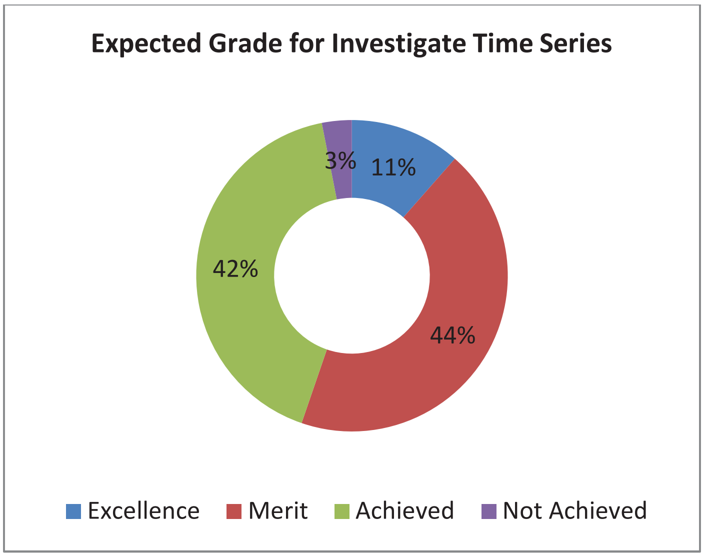

Figure 5.8 Expected Grade for Investigate Time Series

In Question 13, when the students were asked to explain their reasoning behind their choice of expected grade, the leading reason given by students was that they had covered the required criteria. The reason was not their mathematical ability. Only 8% of students cited reasons relating to ability, and 6% were negative reasons. These included the following categories: don't understand statistics (3%), slow at typing (2%), not good at writing (1%), good at research (1%), do well at maths (1%).

Of the student sample, 97% of the students expected to pass the Investigate Time Series Achievement Standard, and 55% expected to get Merit or Excellence. However, the students did not attribute their mathematical ability for attaining these grades. Rather their ability to meet the set criteria (75% of students) was the reason given.

Research consistently demonstrates that students who hold an incremental view of ability are more likely to believe that learning will raise their overall ability (Dweck, 2006; Krakovsky, 2007). It is important that students believe that their ability to learn is not constrained by factors out of their control (Schunk et al., 2014). This study questioned students about the influence of "ability" on their mathematical grades. However, the study did not question students on their perceptions of ability as being fixed or incremental. A recommendation for further research on the motivations of NCEA Level 3 Statistics and Modelling students would be to include additional questions concerning the students' discernments of mathematical ability.

Effort

Effort is categorised as an internal, unstable, controllable dimension in Weiner's Theory of Attribution (Weiner, 1985). If students fail at a task, it is better for their future expectancies and behaviours to attribute failure to a lack of effort rather than lack of ability. The lack of effort is controllable by the student and, if the behaviour is changed, the student can expect to do better at the next assessment (Schunk et al., 2014).

In the questions on Achievement Expectations in Question 6, students were asked to rate the following statements: *I will work for the number of credits I need, no more* and *I will strive for Merit or Excellence even when I don't need to*. These statements were used by Meyer and colleagues in both their 2006 and 2009 studies into the impact of NCEA on student motivation, to establish a student's motivation orientation towards either "doing my best" or "doing just enough"(Meyer et al., 2006; Meyer, McClure, Weir, et al., 2009). Figure 5.9 provides a pictorial representation of students' responses to the statement *I will work for the number of credits I need, no more*:

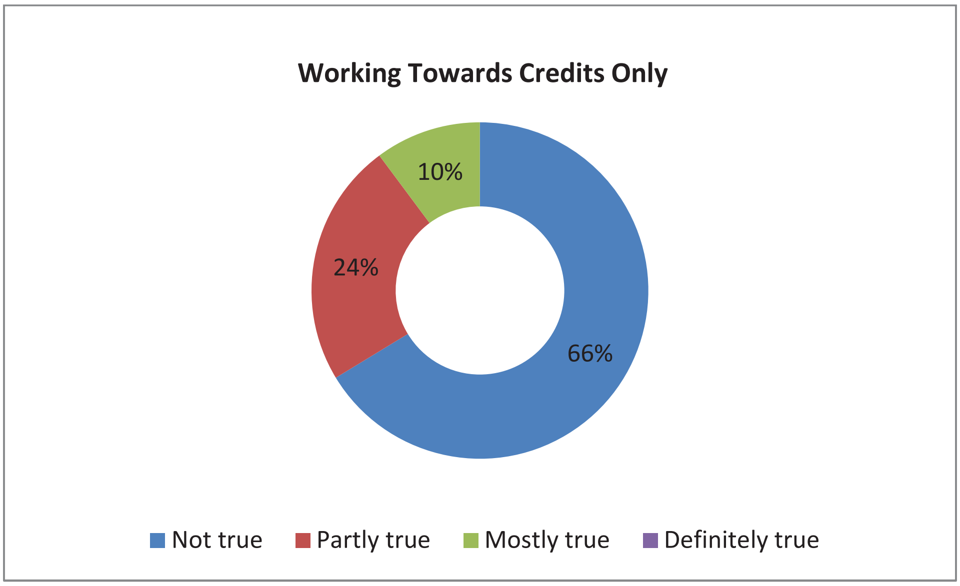

Figure 5.9 Working Towards Credits

The results in this study indicate that the students' responses are skewed towards a motivation orientation of "doing my best", with 66% of the students answering that the statement was not true. None of the students thought that this was definitely true.

Figure 5.10 demonstrates the students' response to the statement *I will strive for Merit or Excellence even when I don't need to*:

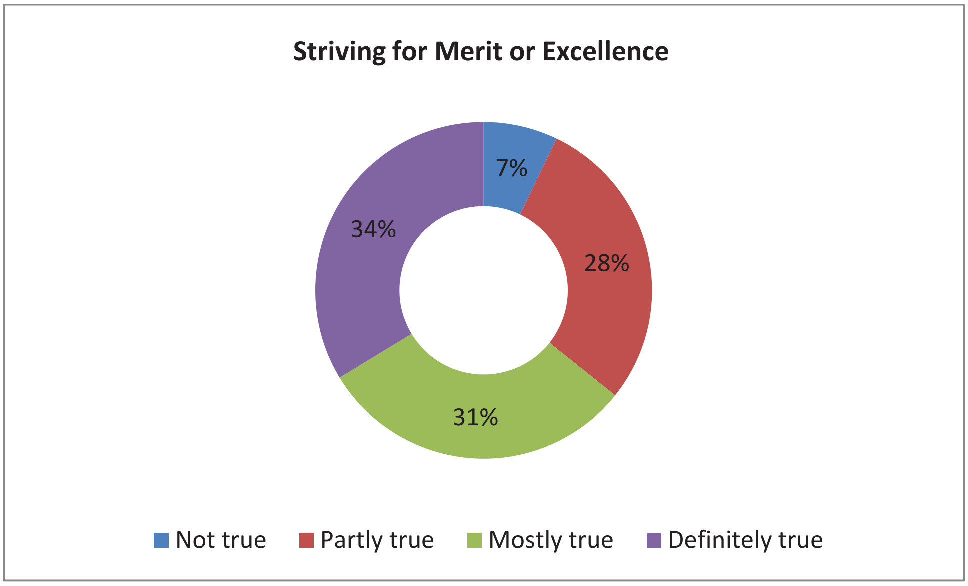

Figure 5.10 Striving for Merit or Excellence

The results above indicate that the statement is definitely true or mostly true for 65% of the students, with only 7% of students choosing that the statement was "not true". The majority of the students in the sample demonstrated motivational orientation towards "doing my best" rather than "doing just enough".

When asked to reflect on the influence of effort on their highest and lowest mathematical achievements the students' responses indicated that effort had a big influence on both scenarios. Figure 5.11 represents the findings on the influence of effort:

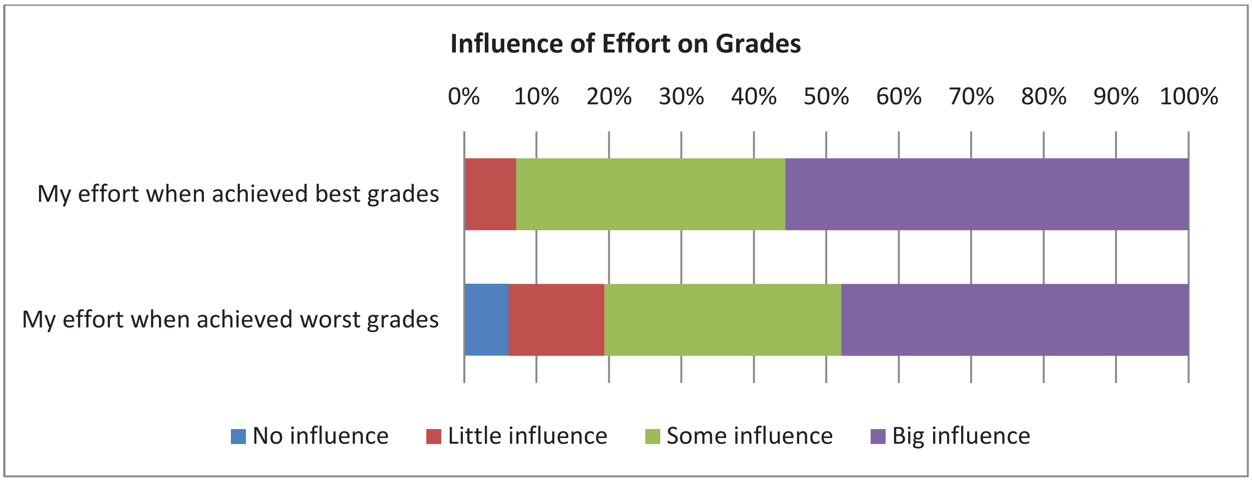

Figure 5.11 Influence of Effort on Grades

Ninety-three percent of the students thought that effort had had some or a big influence on their highest mathematical achievements. None of the students responded that effort had had no influence on their best grades in mathematics.

When it came to achieving their lowest mathematical achievements, 81% of the students responded that their effort had had some or a big influence on the result. In relation to lowest grades, 6% of the students responded that their level of effort had had no influence.

When students were asked to provide an explanation for their reasoning for the ease with which they expected to pass the Investigate Time Series Achievement Standard in Question 11, effort was cited by 20% of students. This included lack of effort (11%) and good effort (9%).

For example, students reported:

> *I could have put in more effort than I did in class time.*
>
> *I quite often doubt my work, although I always strive to get excellence. I don't think that passing is a problem. I don't aim to get achieved, so I focus my effort into getting higher grades. So for me I set the bar for passing at excellence because it motivates me to pass to the best of my ability, anything below and I believe that I have failed myself.*

Similarly, in Question 13, when the students were asked to explain why they had chosen an expected grade for the Achievement Standard, 19% of the students associated their decision with effort. The 19% included students' comments that they had put in the time and effort (14%) and those comments that reported lack of effort (5%).

Examples of students' responses concerning effort are provided below:

> *That was what I got on the first internal, although if I put more effort in I could probably get higher.*
>
> *I think I may only achieve this assessment, because I put a lot of effort in an assessment at the start of the year and did not achieve, I put a large amount of effort into this assessment and I believe I did enough to pass.*

In the studies on NCEA and motivation by Meyer and colleagues, a motivation orientation towards "doing my best" was associated with higher academic results (Meyer et al., 2006; Meyer, McClure, Weir, et al., 2009). The students in this study have demonstrated that they believe that effort is an important component of their mathematical success.

As discussed in the previous section, attribution theory is based on students' *perceived* attributions. Students who attribute low achievement to ability, and perceive ability to be fixed, are only going to invest the degree of effort necessary until they believe they have reached their ability ceiling. In Question 13, when students were asked to explain their reasoning behind their expected grade, 2% made comments referring to only having the ability to achieve or not achieve and 10% of the students made comments relating to not wanting to be optimistic.

For example, students responded:

I don't really expect any more than achieved from myself so that I don't get disappointed.

It's always either achieve or not achieved for me.

I understand what is necessary to achieve well but usually mess up somehow.

The comments above reflect what the research defines as "learned helplessness" (Dweck, 2006; Schunk et al., 2014; Yailagh et al., 2009). A sense of "helplessness" can occur when students lose hope and stop trying, by attributing their failures to lack of perceived fixed ability.

5.4 Summary

The research objectives of the study were to explore how senior mathematical students' make sense of their mathematical experience through the NCEA qualifications system, to understand what factors motivate these students in their mathematical studies and to what students attribute mathematical success. The data analysis chapter has investigated the results from the study under two subtitles:

i) Making Sense of NCEA – Student Perceptions of NCEA Level 3 Statistics and Modelling.
ii) Attributions and Motivations.

The themes that resulted from the analysis of student perceptions of NCEA Level 3 Statistics and Modelling are summarised below:

- The students in the sample believe that NCEA Level 3 Statistics and Modelling was easier than NCEA Level 3 Calculus.
- The literacy component of the new NCEA Level 3 Statistics and Modelling Achievement Standards was problematic for 4% of students.
- The ICT requirement was challenging for those students not used to being taught mathematics in a computer laboratory and for those who find typing difficult.
- The students in the sample believed that the level of difficulty of an assessment had an influence on their highest and lowest mathematical achievements.
- Students assigned a greater degree of influence of the difficulty of the assessment on their lowest grades, than the ease of the assessment on their highest grades.
- The students were very aware of the standards based criteria of the assessment.
- Students were mindful of what answers were required for the various measures of grade and practice assessments using exemplars.

A review of the factors which motivate students of NCEA Level 3 Statistics and Modelling and the student attributions of mathematical success are provided below under externally and internally driven categories:

Externally driven motivations and attributions.

- Over 90% of the students agreed that statistics was required for tertiary options or assistance in their chosen career.
- Ninety-nine percent of the students thought that the teacher's assistance enabled them to achieve their best mathematical results. However, only 12% of the students were convinced that the teacher was interested in them at an individual level.
- Students perceived that their teacher had a big influence on their highest mathematical grades. However, they did not attribute the same level of teacher influence on their lowest grades. Students rated their ability, effort and the level of difficulty of the assessment as having the greatest influence on their lowest grades in mathematics.
- The influence of peers on mathematical attainment was not significant in this sample of students.
- The students in the sample did not attribute their families as a major source of influence over their mathematical success.
- The students' responses showed mixed results in relation to the effect of the learning environment on their mathematical attainment.
- Nearly 30% of the students thought that luck had some influence over either their highest or lowest mathematical achievements.

Internally driven motivations and attributions.

- The students did not really enjoy mathematics, but recognised its importance.
- Students rated their ability and effort as having the greatest influence on their mathematical success. However, the students believed that ability and effort had more influence over their highest mathematical results than their lowest.
- Ninety-seven percent of the students expected to pass the Achievement Standard. Most reasoned that achievement was based on ability to meet the required criteria than mathematical ability.
- Over two thirds of the students were motivated to do their best, rather than 'just enough' to pass.
- Twelve percent of the students made comments that reflected a sense of "helplessness" with regards to their ability to achieve mathematical success.

Question 11 asked students to provide an explanation for their response to Question 10, which asked students about their perceived relative ease of passing the Investigate Time Series Achievement Standard. The students' comments have been categorised according to whether they were internally or externally driven factors: 45% of the comments included external reasons and 55% of the comments included internal reasons. Similarly, the students' explanation for their expected grade in Question 13 has been categorised according to externally or internally driven factors: 67% of the students cited external reasons and 33% provided internal reasons. When the students were asked about their knowledge and skill the majority cited internally driven factors. However, when asked for reasoning behind assessment grades they have cited external factors to a greater degree.

However, caution is advised. These internal and external factors are not working in isolation but are rather multi-dimensional, always changing, and hence are time and environment dependent. While it is convenient to think about intrinsic and extrinsic motivation as being located on either end of a continuum, such that the higher the intrinsic motivation the lower the extrinsic motivation, there is no automatic inverse relationship (Lepper et al., 2005). In reality, intrinsic and extrinsic motivation both operate on their own continuum, each ranging from high to low. For any given learning task or assessment, a student may be high on both scales, or low on both, or high on one and low on the other and so forth.

The summary of findings provides insight into the way that students make sense of NCEA Level 3 Statistics and Modelling and the factors that motivate them in their mathematical studies. It has also identified the factors that students attribute mathematical success.

Chapter Six

Conclusion

6.1 Introduction

The research began with the question:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The objective of the research was to explore how senior mathematical students' made sense of their mathematical experience through the NCEA qualifications system, to understand what factors motivated these students in their mathematical studies and to what students attributed their mathematical success. The Data Analysis Chapter addressed the research question for the sample of students in the study. This Conclusion Chapter will relate these results to the larger research context and summarise the significance of the findings of the study.

The Conclusion will initially provide a summary of each of the preceding chapters. The findings from Chapter Five, Data Analysis, have been repeated in the Conclusion to provide a point of reference for the remaining sections of the chapter: Limitations of the Study, Implications for Teaching and Learning, and Recommendations for Future Research.

6.2 Summary of the Chapters

Chapter One: Introduction

The Introduction Chapter provided the background and rationale for the research. Three strands of educational research were introduced: motivation to learn, engagement and desire to learn mathematics and the influence of NCEA on student motivation. A student's motivation to learn is the force behind the willingness to engage in a learning task and mediates the level of effort and persistence a student employs during the learning process. The Chapter introduced attribution theory and self-efficacy theory as two significant ideas in the understanding of how students make sense of their learning. The Attribution Theory, developed by Weiner in 1985, proposes that students' future learning behaviours are based on the perceived attributions they assign to academic attainment outcomes (Weiner, 1985, 1986). The attributions that students make can have an effect on how they perceive themselves as learners. They may also influence their self-belief. Self-efficacy theorists propose that students will persist and expend effort on learning tasks they believe they are capable of, and that they will avoid learning tasks which they believe will exceed their abilities (Bandura, 1977, 1997).

The motivation to learn mathematics is presented in the Introduction Chapter as a special case. Despite the perceived importance and utility of mathematics, only half of the student population enjoy mathematics and achieve mathematical success (Ernest, 2000). When students are younger they enjoy mathematics. Students are resilient to perceived mathematical failure and expect to succeed. However, interest in mathematics for enjoyment increasingly diminishes throughout students' school careers (Boaler & Greeno, 2000; Meyer et al., 2006).

The third component of the research focus, NCEA, was then introduced. New Zealand's standards based assessment, NCEA, was implemented in 2002. The history and structure of NCEA were discussed and reference was made to the criterion assessed grades: Not Achieved, Achieved, Merit and Excellence. Further detailed information was provided on NCEA Level 3 Statistics and Modelling, specifically the Investigate Time Series Achievement Standard.

Assessment and motivation are inextricably connected. Assessment tasks can be the measure of motivated learning behaviour. Likewise, assessment tasks can arouse certain motivational behaviour and efficacy beliefs (Brookhart, 2013; Brown & Hirschfield, 2007).

The research focus was introduced as located at the overlap between motivation to learn, mathematics and NCEA assessment. The question driving the research was as follows:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The key objectives of the research were established as being:

i) To explore and understand how senior mathematical students make sense of their mathematical experience through the NCEA qualifications system.
ii) To explore and understand the factors that motivate these students.
iii) To explore and understand the attributions that these students make for their mathematical success.

Chapter Two: Literature Review

The objective of the Literature Review was to find out what was known and what was unknown in relation to the research question. The Review investigated the literature concerning motivation to learning, motivation to learn mathematics and the impact of NCEA on motivation. These three strands were considered both individually and in combination, and relationships were made amongst each.

The research identified that students' learning motivation diminishes as they progress through their formal learning career (Hock et al., 2009; Pressley & Ghatala, 1989). Middleton and Spanias (2002) provided evidence that motivation hinges on how students attribute success and failure.

Attribution Theory was discussed in greater detail in the Literature Review Chapter. Weiner's (1985) original attribution model was presented, which included the categories of locus, stability and controllability (see Martin & Dowson, 2009). Ability was discussed as a concept that students can perceive to be either fixed or incremental. The effect that this perception may have on motivation was discussed (Pink, 2009).

Self-efficacy was found to be related to student attribution for success or failure. The Literature Review elaborated on Bandura's Self-efficacy Theory introduced in Chapter One (Bandura, 1977, 1997). The four sources of self-efficacy were identified as being mastery experience, vicarious experience, social persuasions, and emotional and physical states. The teacher and the learning environment were both found to be directly related to student self-efficacy. In the research, high self-efficacy strongly correlated with students' academic achievement (for example, Jain & Dowson, 2009; Middleton & Jansen, 2011; Skaalvik & Skaalvik, 2009; Usher & Pajares, 2009).

Research provides evidence that motivating students in their *mathematics* learning presents unique challenges (for example Boaler & Greeno, 2000; Cotton, 2001; Middleton & Jansen, 2011; Posamentier & Krulik, 2012). The relationships between mathematics, self-efficacy, anxiety and achievement were explored through the empirical research (for example, Ashcraft & Moore, 2009; Hoffman, 2010; Hong & Karstensson, 2002; Jain & Dowson, 2009; Ma & Xu, 2004; Shores & Shannon, 2007).

Meyer and associates (Meyer et al., 2006; Meyer, McClure, Walley, et al., 2009; Meyer, McClure, Weir, et al., 2009) research into the impact of NCEA on student motivation was reviewed. The authors argued that the strongest predictor of high academic achievement was a high student motivation towards "doing my best". Hodis and colleagues (2011) found similar results. Students at risk of leaving school with low achievement outcomes had negative motivation patterns. The research reviewed on the impact of NCEA on motivation was not subject specific, rather the literature concerned NCEA generally. The Literature Review identified an absence of research into the impact of NCEA mathematics assessments on the motivation to learn mathematics.

The research question for this study is integrated within the evidence from the literature concerning the areas of learning motivation, mathematics and NCEA. The lack of research incorporating all three strands led to the assertion that the proposed research was justified, valuable and timely.

Chapter Three: Research Design

The Research Design Chapter outlined the stages in the design and development of the research process.

The study was based on Constructivist Theory. In relation to this study, constructivism proposes that students actively construct mathematical meaning as they engage and interpret their mathematical experiences. The methodological approach used was ethnomethodology, which has an emphasis on how students create reality (Check & Schutt, 2012). The research focus was on student perception of reality, rather than factual attainment outcomes.

The survey method was employed to enable a large sample of students to be questioned on a wide range of areas, in a limited time frame. The methodological tool used was an online questionnaire. The advantages and disadvantages of the questionnaire were presented. The data analysis techniques that were employed in the research process were described. For the purpose of the research, the data were analysed on a quantitative and qualitative basis.

The Research Project process was explained. The process included: the setting, participants, ethical considerations, pilot study, data collection, and data analysis. The validity and reliability of the Research Design were considered, including reference to my background as a mathematics teacher.

Chapter Four: Findings

The Findings Chapter provided a summary of the students’ responses to each question in the questionnaire. The findings from each question were presented in either tabular or graphical form, depending on the nature of the question.

Questions 5, 11 and 13 were open ended questions that allowed students to provide a justification for their responses. The students’ comments were analysed according to the content and then the categories that became evident were tabulated in descending order.

A summary of the results for each question was provided. The Findings included highlighted noteworthy findings from the data. A summary of these findings are included below:

- The primary reason that students had enrolled in NCEA Level 3 Statistics and Modelling was tertiary or career related.
- Ninety-eight percent of the students believed that mathematics was an important subject, but less than half of the students agreed that they enjoyed mathematics.
- The students believed that their whanau valued mathematics (75%) to a greater degree than their peers (45%).
- None of the students in the sample were working only for the number of credits they required and no more.
- Less than half of the students thought that their teacher was interested in them individually.
- Students rated ability, effort and the teacher as having the greatest influence on their highest mathematics grades.
- Students believed that ability, effort and the level of difficulty of the assessment had the greatest impact on their lowest mathematics grades.
- Ninety-seven percent of the students believed they had the knowledge and skills to pass the Investigate Time Series Achievement Standard.
- None of the students thought that the Investigate Time Series Achievement Standard was far too difficult for them.
- A good understanding of the topic was the most mentioned reason that students cited concerning the relative ease with which they expected to pass the Investigate Times Series Achievement Standard.
- Ninety-seven percent of the students expected to pass the Investigate Time Series Achievement Standard.
- The most frequent reasoning students provided for grade prediction was ‘covered the required criteria’.

Chapter Five: Data Analysis

The Data Analysis identified the themes that emerged in the Findings Chapter, with reference to the research literature. The Chapter was divided into two sections:

i. Making Sense of NCEA – Student Perceptions of NCEA Level 3 Statistics and Modelling.
ii. Attributions and Motivations.

The students' perceptions of NCEA were organised into the following categories: credit parity, remodelling of Achievement Standards, literacy component, ICT, influence of assessment on grades and criterion based assessment. A summary of findings relating to students' perceptions of NCEA was presented in the Data Analysis Chapter. The summary points are as follows:

- The students in the sample believe that NCEA Level 3 Statistics and Modelling is easier than NCEA Level 3 Calculus.
- The literacy component of the new NCEA Level 3 Statistics and Modelling Achievement Standards was problematic for 4% of students.
- The ICT requirement was challenging for those students not used to being taught mathematics in a computer laboratory and for those who find typing difficult.
- The students in the sample believed that the level of difficulty of an assessment had an influence on their highest and lowest mathematical achievements.
- Students assigned a greater degree of influence of the difficulty of the assessment on their lowest grades, than the ease of the assessment on their highest grades.
- The students were very aware of the standards based criteria of the assessment.
- Students were mindful of what answers are required for the various measures of grade and practice assessments using exemplars.

Motivations and attributions were classified as either externally or internally driven. The themes that emerged in the external category included tertiary study requirements and career options, the teacher, peer group, whanau/family, learning environment and luck. Within the internally driven motivations and attributions the themes related to enjoyment of mathematics, ability and effort. The findings that resulted from the analysis of the students' motivations for learning mathematics and the factors to which students' attribute their mathematical success were summarised in the Data Analysis Chapter.

These were:

Externally driven motivations and attributions.

- Over 90% of the students agreed that statistics was required for tertiary options or assistance in their chosen career.
- Ninety-nine percent of the students thought that teacher's assistance enabled them to achieve their best mathematical results. However, only 12% of the students were convinced that the teacher was interested in them at an individual level.
- Students perceived that their teacher had a big influence on their highest mathematical grades. However, they did not attribute the same level of teacher influence on their lowest grades. Students rated their ability, effort and the level of difficulty of the assessment as having the greatest influence on their lowest grades in mathematics.
- The influence of peers on mathematical attainment was not significant in this sample of students.
- The students in the sample did not attribute their families as a major source of influence over their mathematical success.
- The students' responses showed mixed results in relation to the effect of the learning environment on their mathematical attainment.
- Nearly 30% of the students thought that luck had some influence over either their highest or lowest mathematical achievements.

Internally driven motivation and attributions.

- The students did not really enjoy mathematics, but recognised its importance.
- Students rated their ability and effort as having the greatest influence on their mathematical success. However, the students believed that ability and effort had more influence over their highest mathematical results than their lowest.
- Ninety-seven percent of the students expected to pass the Achievement Standard. Most reasoned that achievement was based on ability to meet the required criteria than mathematical ability.
- Over two thirds of the students were motivated to do their best, rather than 'just enough' to pass.
- Twelve percent of the students made comments that reflected a sense of "helplessness" with regards to their ability to achieve mathematical success.

6.3 Limitations of the Study

This research contributes to the literature of learning motivation, mathematics and NCEA. The perceptions that students have of NCEA Level 3 Statistics and Modelling and the motivations and attributions these students make for their mathematical success as a research focus has not previously been investigated. However, all research has limitations. The limitations of the study have been identified as concerning the generalisability of the sample, the use of a questionnaire as a methodological tool, the complex nature of motivation, and my personal background as a teacher of NCEA Level 3 Statistics and Modelling.

6.3.1. The Sample

The participants in the study were students, 16 years old and over, enrolled in a full year NCEA Statistics and Modelling Level 3 Achievement Standards programme in 2013, at an urban, decile 8 school in New Zealand. The particular cohort of students had experienced the latest roll out of changes to NCEA mathematics over the last three years. The statistics programme at the College consisted of five streamed classes, three A Stream classes and two B Stream classes. There were 98 students in the sample which represented a 100% response rate. While the sample was large and the response rate was ideal, the findings are applicable to this sample, at this school, with these teachers, and at this particular point in time. Given the participant response rate of the sample, interpretative claims can be inferred, however, caution is advised over generalising claims to the general population. The findings from the research suggest a need for comparative research nationally.

6.3.2 The Questionnaire

The advantages of the survey as a research tool are widely documented in the literature. In this study, the use of an online questionnaire enabled a large sample of students to respond in a limited time frame, at a relatively low cost. Students responded on a wide range of areas related to their mathematical learning. The research sought to develop a representative understanding of NCEA Level 3 Statistics and Modelling students' motivations.

There are potential disadvantages to using a questionnaire as a methodological tool for the research question. The first potential disadvantage that is often associated with questionnaires, is participant non-response. However, for this research, this did not become an issue. The participation rate was 100%. Another disadvantage with a questionnaire is the lack of opportunity to explore participant responses further. While there were opportunities for students to provide clarification of their responses in Questions 5, 11 and 13, the data generated are representative of the collective sample and do not track individual student motivation patterns. A greater understanding of motivation unique to each student could be gained through interviews.

6.3.3 The Complex Nature of Motivation

Motivation is complex. Larroa and Jazmin (2013, p. 34) suggest that motivation is deeply personal and unique to each student and "is likely to be linked to what makes each human being unique". According to Middleton and Jansen (2011), a student's motivational orientation is a multi-dimensional inter-relationship between classroom organisation, social setting, teacher enthusiasm, assessment, and the student's belief about their ability and the importance of mathematics. The multifaceted nature of motivation ensures that the research findings should be treated with caution and presented as emerging understandings.

6.3.4 Personal Background

Tolich and Davidson (1999a) argue that researchers need to have an awareness of, and make explicit, their own and other world views and the influence of these views over the research. This has been defined as "reflexivity" (p. 152). My experience as a secondary school mathematics teacher who has taught NCEA Level 3 Statistics and Modelling has been an advantage to the development of this research project. The history and implementation of NCEA was familiar knowledge prior to starting this study, and provided a platform from which to begin the research. When designing the questionnaire, my experience gave clarity and strength to the questions and their likely interpretation by the students. Additionally, throughout the data analysis process, my understanding of the NCEA Level 3 assessment tasks and the criteria required, enabled a depth of understanding when categorising the students' responses.

However, I am mindful of the influence that my experience with NCEA Level 3 Statistics and Modelling brings to the study. The findings are based on my individual interpretation of the data collected from the questionnaire, and another researcher may understand them differently.

6.4 Implications for Teaching and Learning

The results from the study have highlighted implications for teachers and students of NCEA Level 3 Statistics and Modelling. These include the information that students receive about NCEA Level 3 Statistics and Modelling prior to commencing the course of study, the development of motivation intervention programmes, and teaching the statistics course as a collective whole rather than discrete units of learning.

- When summing up ten recommendations for student learning and assessment, Gilmore and Smith (2008) advise to think of the students. When students choose to study statistics there needs to be a system in place whereby students are making an informed choice. Prior to confirming their commitment to a statistics course, students need to be aware of the level of non-numerical explanation and reasoning required in order to succeed (Alison, 2005). Students need to be mindful that their statistics classes will be taking place in a computer laboratory, that there is a high ICT requirement and internal assessments involve a lengthy, computer written report. International students and students who don't speak English as their first language need to be informed that while NCEA Level 3 Statistics and Modelling is a mathematics subject choice, there is a high literacy component compared to NCEA Level 3 Calculus.
- Middleton and Jansen (2011) argue that highly productive academic behaviours stem from students who are attributing successes to a combination of internal factors, namely, effort and ability, and attributing low attainment outcomes to a lack of effort. The students in the sample attributed their lowest mathematical achievement outcomes to ability, effort and the assessment. Hodis and colleagues (2011) suggest that student motivation orientations have the potential to change with intervention. More research is required into the practical utility of the literature on motivation. How can we use what we know about NCEA Level 3 Statistics and Modelling students' motivation to positively change these students' future motivational orientations? The development of motivation intervention programmes and research into their effectiveness has potential implications for the teaching and learning of NCEA Level 3 Statistics and Modelling students.
- Students in the study were aware that NCEA Level 3 Statistics and Modelling assessment is attained in discrete units. There is a danger that learning is also perceived by the students to be in discrete units rather than as a connected whole (Stewart et al., 2007). Atomisation of learning has been acknowledged as a disadvantage of a standards based assessment system like NCEA (Rawlins et al., 2005). The New Zealand Curriculum states that all subjects should be taught holistically, with connections made between and within the Achievement

Standards (Ministry of Education, 2007). Professional development around teaching to emphasise and make connections to the 'big picture' would be recommended for mathematics teachers, and especially for pre-service teachers in training.

6.5 Further Research

The research sought to investigate how students made sense of their experience of NCEA Level 3 Statistics and Modelling, and to explore the factors that motivated these students and understand the factors that students attribute to their mathematical success. The research has clearly answered the research question that provided the impetus for the study. However, in doing so, it has prompted many more questions, as any good inquiry should. To gain a greater depth of understanding of the research question, the following recommendations have been made for further research:

- The data were collected at one point in time and provide a snapshot of those students. Longitudinal research which measures the students motivations and the factors to which they attribute their NCEA Level 3 Statistics and Modelling success throughout the whole year and then correlates these data results with the students' final assessment outcomes would be valuable. In line with the comment by Nuthall (2007), "learning requires motivation, but motivation doesn't necessarily lead to learning" (p. 35), a connection between the students' motivation and their final qualifications would provide another perspective through which to understand the motivation, learning and achievement outcome relationship.
- The students in the study perceived NCEA Level 3 Statistics and Modelling to be an important qualification for their tertiary study and for career options. Further research is recommended to investigate whether the students' perception is a reality and explore how many students go on to utilise the learning from NCEA Level 3 Statistics and Modelling.
- The gender and ethnicity questions in the questionnaire were included to provide comparative demographics to the general population of New Zealand secondary school students. Compared with the population of the college and the national roll of Year 13 students, in the sample, there was proportionally a lower number of Maori students choosing to enrol in a NCEA Level 3 Statistics and Modelling course. A different dimension of understanding of motivations of NCEA Level 3 Statistics and Modelling students could be explored by researching the cohort of students according to ethnicity and gender.

- The host college was a decile 8 school in an urban area. A research project on a larger scale that included schools from all decile ratings in various locations around the New Zealand would provide a broader perspective of NCEA Level 3 Statistics and Modelling students' motivations.
- The participants in the study came from five statistics classes. The classes included two A stream classes and three B stream classes. The students were not asked to identify which stream they belonged to in the questionnaire. It is recommended that further research into the motivations of NCEA Level 3 Statistics and Modelling students would include comparative, differentiated results between the two steams, to establish whether there is a difference in motivation related to the students' streamed level.
- Critics of NCEA believe that the standards based system atomises learning into distinct units (Rawlins et al., 2005; Stewart et al., 2007). The findings from this study, show that students are very aware that NCEA Level 3 Statistics and Modelling assessments are criteria based and in discrete components. Further research linking students' perceptions of the assessment and the connection of the assessment to learning would be beneficial.
- Mathematics classes have traditionally been taught in a regular classroom. There is a need for further research into the effect that mathematics teaching within a computer laboratory is having on teaching and learning.
- The questionnaire used in the study referred to "ability". As previously discussed, a student's perception of ability as either fixed or incremental has an impact on the level of effort that the student commits to a learning task (Dweck, 2006; Krakovsky, 2007; Schunk et al., 2014). The research highlighted an additional potential discrepancy in students' perception of ability. The findings suggest that students perceive there to be a distinction between mathematical ability compared with the ability to meet the criteria expected for each grade requirement. Further research on the motivations of NCEA Level 3 Statistics and Modelling students would benefit from asking students about their ability beliefs and the tracking the relative influence of these views of ability on their motivation.
- The teacher and student relationship has been shown to have an influence on student motivation (Martin & Dowson, 2009; Moe, 2011a, 2011b; Posamentier & Krulik, 2012). In this study, less than 40% of the students felt that their teacher was interested in them as an individual. I suggest that further research and training and development focusing on mathematics teacher and student connections have the propensity to increase student mathematical attainment.

- Research has shown that a teacher's own motivation, efficacious beliefs in their teaching, and attitudes towards mathematics, have an impact on student motivation (for example, Boaler & Greeno, 2000; Cotton, 2001; Moe, 2011a, 2011b; Tschannen-Moran & Woolfolk Hoy, 2001). In order to fully respond to the research question concerning students' motivation, research is required to investigate the effect of NCEA Level 3 Statistics and Modelling teachers' motivation on students' motivation.

As with all research recommendations, there is a need to move forward cautiously. The focus of the research was learning motivation, mathematics and NCEA. The recommendations for further research are not to be considered in isolation. Rather they are to be conceived of as a collective, to enable a deeper understanding of the research question.

6.8 Concluding Thoughts

The objective of the research was to explore how senior mathematical students' made sense of their mathematical experience through the NCEA qualifications system, and understand what factors motivated these students in their mathematical studies and to what students attributed their mathematical success. The question which framed the research was:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The findings from the research have added to the established body of literature on student learning motivation, mathematics and NCEA. The focus on all three strands has established this research as distinct in the field.

The findings from the research suggest that to maximise student achievement within the standards based NCEA Level 3 Statistics and Modelling assessment system, several objectives need to be established:

- Students need to be aware of the non-numerical content and the grade criteria expectations within NCEA Level 3 Statistics and Modelling prior to committing to the course.
- Students need to be able to attribute their mathematical successes to the internal factors of ability and effort, while attributing their "mathematical failures" to effort alone.
- NCEA Level 3 Statistics and Modelling teachers need to be aware of the influence of their own motivational patterns and the importance of the teacher and student relationship on student achievement.
- NCEA Level 3 Statistics and Modelling Achievement Standards need to be taught as a collective, cohesive statistics curriculum.

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Appendices

Appendix A: Information Sheet

Driving Force?

Motivations of Senior Mathematics Students enrolled in National Certificate of Educational Achievement (NCEA) Statistics & Modelling Level III.

Researcher

My name is Jackie Webb. I am a mathematics teacher and a postgraduate student at Massey University. I am currently completing my Masters in Education, with a focus on Mathematics Education. My specific area of interest is student motivation.

Project

The research proposed is a study of mathematical students' motivation, investigating the research question:

What motivates senior mathematics students enrolled in NCEA

Statistics & Modelling Level 3 Achievement Standards?

Students involved in the research will be enrolled in National Certificate of Educational Achievement (NCEA) Level 3 Statistics and Modelling Achievement Standards in 2013. An online survey questionnaire will ask students to think about their mathematics studies, what influences the amount of effort or time they spend, what they want to achieve and what impacts these goals. The data collected from the questionnaire will be analysed and presented as the thesis component of a Masters of Education. Research will be conducted and completed within a two year timeframe, finishing in January 2014.

There are two key reasons why this research is relevant and required at this time:

- An absence of research specific to NCEA *mathematics* and motivation.
- 2011, 2012 & 2013 reforms to the NCEA Level 1, Level 2 and Level 3 Mathematics Achievement Standards and their effect on students' motivation.

A greater understanding of mathematical students' motivations has the potential to be beneficial to students, teachers, policy and practice.

Participation

All Level 3, Statistics & Modelling students (aged 16 years and over) at the College have been invited to participate in this research. Your opinion and feedback are valuable and essential to the success of the project.

Project Procedures

Your participation will include completion of an online survey through the Survey Monkey website, taking approximately 20 minutes. The survey will ask you to reflect on your involvement with NCEA Statistics and Modelling Level 3 mathematics. The survey can be completed at any time up to 5pm, Sunday 12th May 2013, by accessing the following URL address: https://www.surveymonkey.com/s/statisticsandmodelling.

Data Management

The data collected will be analysed according to the different influences and impacts students report as having an effect on their mathematical achievement. The data will be used solely for the completion of a Masters of Education thesis. A summary of the research findings will be presented to the BOT and the Mathematics Department of the College and will be made available to any participant on request.

Survey Monkey operates encrypted security which protects the privacy of participants and the research data. The data collected will be downloaded electronically from Survey Monkey onto Jackie Webb's (Research Student) personal computer for analysis. Once the research project is completed, Jackie Webb (Research Student) will download a complete set of the data and then delete the survey.

Following the conclusion of the Research Project, supervisor, Dr Tim Burgess (or an appropriate nominee) will hold all data (electronic and hard copy) prior to disposal after five years.

Participant's Rights

You are under no obligation to accept this invitation. The completion of the Survey Monkey Questionnaire implies consent.

If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time;
- ask any questions about the study at any time during participation;
- be given access to a summary of the project findings when it is concluded.

Ethics Approval

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern B, Application 13/08. If you have any concerns about the conduct of the research, please contact Dr Nathan Matthews, Chair, Massey University Human Ethics Committee: Southern B, telephone 06 350 5799 x 80877, email humanethicsouthb@massey.ac.nz.

Project Contacts

Please contact either myself or one of my supervisors, Dr Tim Burgess or Prof Margaret Walshaw, if you have any questions or feedback about the project.

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Appendix B: Online Questionnaire

This questionnaire is part of a thesis research study of mathematical students' motivation, answering the research question:

What motivates senior mathematics students enrolled in NCEA Statistics & Modelling Level 3 Achievement Standards?

The completion of this questionnaire implies consent. You have the right to decline to answer any particular question. To be eligible for participation you must be 16 years old or over.

1. What is your gender?

- Female
- Male

2. Which ethnicity best describes you? (Please choose only one.)

- Maori
- NZ European / Pakeha
- NZ Asian / Asian
- Pacific Peoples
- Other European
- Other

3. How old are you?

- 16
- 17
- 18
- 19

4. Are you studying Level 3 Statistics & Modelling and Level 3 Calculus, or only Level 3 Statistics and Modelling?

- Level 3 Statistics & Modelling only
- Level 3 Statistics & Modelling and Level 3 Calculus
- Level 3 Statistics & Modelling in 2013 with Level 3 Calculus in 2014
- Level 3 Statistics & Modelling in 2013, completed Level 3 Calculus in 2012

5. Why are you taking Level 3 Statistics and Modelling?

I am interested in what motivates you in your learning of mathematics.

Please rate each sentence listed below using this scale, and select the statement closest to your opinion;

1) this is not true
2) this is partly true
3) this is mostly true
4) this is definitely true

6. These questions relate to you and Level 3 Statistics & Modelling Achievement Standards.

	Not true	Partly true	Mostly true	Definitely true
I expect to get Excellence or at least Merit				
I will work for the number of credits I need, no more				
I will strive for Merit or Excellence even when I don't need this to achieve my goals				
I think mathematics is an important subject				
My mathematics teacher is interested in me				
I do best in classes where students work together				
I need to pass my Achievement Standards for tertiary options				
I learn more when students are encouraged to help each other				
I enjoy mathematics				
In class, I would rather work by myself				
I do best when I know I can count on the teacher for help when I need it				
My family/whanau value mathematics as a subject				
I know that my mathematics teacher understands the new Achievement Standards				
Having Level 3 Statistics & Modelling will assist me in my career choices				
My friends think mathematics is important				

What has influenced how well you do in mathematics?

Please rate each sentence listed below using this scale and select the statement closest to your opinion:

1) no influence
2) little influence
3) some influence
4) big influence

7. Reflect on times when you have achieved your highest grades in mathematical Achievement Standards. Rate the following possible influences on those results:

	No influence	Little influence	Some influence	Big influence
My ability				
My effort				
The assessment was easy				
Good luck				
My family / whanau				
The teacher				
My friends				

8. Reflect on times when you have got your worst grades in mathematical Achievement Standards. Rate the following possible influences on those results:

	No influence	Little influence	Some influence	Big influence
My ability				
My effort				
The assessment was difficult				
Bad luck				
My family / whanau				
The teacher				
My friends				

You have recently been assessed for Achievement Standard 91580, Investigate Time Series Data. The following questions relate to this achievement standard.

9. Think about the knowledge and skills required to pass Achievement Standard 91580, Investigate Time Series Data. Tick one box that best applies to you.

When I think of the knowledge and skills needed to pass this achievement standard, I have:

- The knowledge and skills to pass well
- Just enough knowledge and skills to pass
- Not enough knowledge and skills yet to pass

10. Think of what is required overall to pass Achievement Standard 91580, Investigate Time Series Data to answer this question. Tick one box that best applies to you.

I think passing this achievement standard will be:

- Very easy for me
- Quite Easy for me
- Just manageable for me
- Quite difficult for me
- Far too difficult for me

11. Give one or two key reasons for your response to Q10 above and explain these as fully as possible.

12. What result do you think you will get for Achievement Standard 91580 Investigate Time Series Data? Tick one box that best applies to you.

- Excellence
- Merit
- Achieved
- Not Achieved

13. Give one or two key reasons for your response to Q12 above and explain these as fully as possible.

Thank you for taking the time to respond to this survey. Please click 'done' to submit your answers.