MONASH University

Understanding the relations between the social climate and help seeking in secondary mathematics classes

Roy Thomas Smalley

Bachelor of Applied Science (Physics/Mathematics) (Ballarat C.A.E.)
Graduate Diploma in Education (Science/Mathematics) (Monash University)
Graduate Diploma in Computer Education (The University of Melbourne)
Master of Education by Coursework (The University of Melbourne)
Master of Education by Research (Monash University)

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Abstract

In Australia as elsewhere, student under-participation and disengagement in secondary mathematics classes are persistent problems. To address these problems, many teachers endeavour to establish learning environments that support the development of self-directed learners who enjoy mathematics, and actively participate in challenging learning experiences. At the same time, teachers try to promote students' self-regulated behaviours that enable them to consolidate their understanding and to seek help when help is needed. Despite these efforts, many students avoid seeking help from teachers and peers as they progress through secondary school.

The purpose of the current study was to examine relations between students' perceptions of social climate in secondary mathematics classes and their help-seeking goals and intentions, in an effort to understand the factors that promote and hinder academic help-seeking. In addition to social climate, students' academic and social self-efficacy, and self-theories of intelligence were examined. Participants included 551 Grade 7-12 students (432 male and 162 female) in 47 classes from eight secondary schools and two vocational institutes, in three Australian states. The measurement model for social climate was reduced to four factors (Task Orientation, Cooperation, Investigation, and Teacher Support) and a mediated structural equation model, informed by theory and previous empirical studies, was assessed using the Mplus statistical program.

Findings indicated that Task Orientation had the strongest direct and indirect effects on students' academic help-seeking behaviours. Cooperation had direct positive effects on instrumental help-seeking and indirect negative effects on help-seeking avoidance and expedient help-seeking. Investigation had a direct positive effect on help-seeking avoidance and a small indirect positive effect on instrumental help-seeking.

Teacher Support had a direct positive effect on expedient help-seeking. Moreover, students' academic and social self-efficacy and self-theories of intelligence meditated the relations between the social climate of the mathematics classroom and students' help-seeking goals and intentions in interesting ways.

The present study makes distinctive contributions to the learning environments and academic help-seeking research fields, since few studies have explored the relations between multiple dimensions of classroom social climate and students' help-seeking behaviours. The findings suggest practical ways educators can plan and put into practice strategies for promoting adaptive help-seeking behaviours and reducing non-adaptive help-seeking behaviours in secondary mathematics classes.

Declaration

This thesis is an original work of my research and contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signature: ……………………

Print Name: Roy Smalley

Date: 6th September 2020

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Glossary

Acronym	Definition
AAMT	Australian Association of Mathematics Teachers
ABS	Australian Bureau of Statistics
ACARA	Australian Curriculum Assessment and Reporting Authority
AQF	Australian Qualifications Framework
CGEA	Certificates in General Education for Adults
COAG	Council of Australian Governments
DEECD	Department of Education and Early Childhood Development (Victorian Government)
DEEWR	Department of Education, Employment and Workplace Relations (Australian Government) – formerly DEST
DEST	Department of Education, Science and Training
DET	Department of Education and Training
DFAT	Department of Foreign Affairs and Trade
RTO	Registered Training Organisation
SSCE	Senior Secondary Certificate of Education
TAFE	Technical and Further Education
VCAA	Victorian Curriculum and Assessment Authority
VCAL	Victorian Certificate of Applied Learning
VCE	Victorian Certificate of Education
VET	Vocational Education and Training

CHAPTER 1: INTRODUCTION TO STUDY

Mathematics is of fundamental importance for citizens of the 21st century (Council of Australian Governments [COAG], 2008). While many students recognise the importance of mathematics for their future, they also perceive it as being a difficult subject, with a heavy workload, that requires a significant commitment in terms of time and effort (McPhan, Morony, Pegg, Cooksey, & Lynch, 2008). Consequently, close to 50 percent of senior secondary students enrol in an elementary mathematics course and 20 percent decide to opt out of mathematics (Sullivan, 2011; Kennedy, Lyons, & Quinn, 2014).

With the implementation of the Australian Curriculum, one of the cross-curriculum priorities for teachers is to help students develop personal and social capabilities for handling challenging learning situations constructively and making learning more effective (Australian Curriculum Assessment and Reporting Authority [ACARA], 2015c). In particular, Mathematics teachers are encouraged to help students develop self-regulatory skills so that students become confident learners who actively participate in challenging and engaging experiences (ACARA, 2015a). This is also the consensus view adopted by teachers in the *Standards for Excellence in Teaching Mathematics in Australian Schools* (Australian Association of Mathematics Teachers [AAMT], 2006). For example, teachers are expected to be able to establish learning environments that support the development of “self-directed learners who enjoy mathematics” (AAMT, 2006).

Mathematics is a challenging subject where students are continually required to engage in increasingly abstract concepts as they progress through school. For this reason, the development of cognitive, motivational, and behavioural self-regulation skills is an essential component of a mathematical disposition (De Corte, Mason, Depaepe, & Verschaffel, 2011). Help-seeking is an important self-regulated behaviour, enabling students to deal with academic challenge in the mathematics classroom (Newman, 2002a; Wolters, Pintrich, & Karabenick, 2005).

Help-Seeking: A Self-Regulated Behavioural Strategy

In the general helping literature, helping interactions are recognised as involving a complex social dynamic marked by an inherent tension between two basic psychological needs of the help-seeker; the need for self-reliance and for belongingness (Nadler, 2015). The tension between the need to belong and the need for independence is influenced by personal, interpersonal, and group-level factors, thereby determining an individual's receptivity to help. For adolescents, help-seeking behaviour can be grouped according to the type, need, or problem to be solved as follows: specific health issues (generally called health-seeking behaviour); normative development needs, such as school completion; and psychosocial needs that go beyond normal development needs of young people, such as homelessness (Barker, 2007).

Help-seeking in a school context (academic help-seeking), occurs when the student perceives a need for help which is then matched with a request for assistance (Newman, 2006). Contemporary studies of academic help seeking are based on goal orientation theory (Karabenick, 2006; Karabenick & Dembo, 2011) and generally distinguish between three types of help-seeking: Insturmental, Expedient and Avoidant. Instrumental help-seeking, also known as adaptive help-seeking, is commonly associated with students' learning goals that are focused on increasing understanding of concepts through asking for hints rather than answers (Karabenick, 2011; Newman, 2006). Expedient help-seeking, also known as executive help-seeking, is conceptualised as a less adaptive behaviour where students seek help when there is no need. This strategy is commonly associated with work-avoidance goals and performance-oriented classrooms where students are concerned with ability comparisons (Karabenick, 2011). Avoidant help-seeking is a non-adaptive strategy where students avoid seeking help when it is necessary and it is commonly associated with performance-avoidance goals (Newman, 2006).

Other epistemic and motivational beliefs may also influence a student's self-regulated behaviour in mathematics classes (De Corte, et al., 2011). For example, an individual's self-theory of intelligence (now commonly referred to as Mindset) may be especially significant "in the areas of maths and science that really ask the student to enter a new conceptual world" (Dweck, 1999, p. 12). Dweck (1999) asserts that a student's self-theories of intelligence influences their willingness and capacity to expend effort on difficult tasks. Dweck's model proposes that a student's self-theory of intelligence (entity/incremental) influences their goal orientation (performance/learning), which is then moderated by competency beliefs, resulting in specific types of self-regulated behaviours (i.e., learned helplessness and mastery-oriented behaviours) (Dweck & Leggett, 1988). Based on this model, students who view intelligence as being fixed at birth ('entity theorists') will give up when confronted by unforeseen obstacles, because they believe 'intelligent' people should be able to succeed without the appearance of effort (Dweck, 1999). These students tend to believe that 'intelligent' people don't make mistakes and will therefore ignore their own mistakes rather than try to correct them (Dweck, 2007). Hence, 'entity theorists' are more likely to avoid seeking help rather than engage in instrumental help-seeking. In contrast, students who view intelligence as being malleable ('incremental theorists') seek tasks which offer real 'learning focused' challenges and are instrumental help-seekers (Mangels, Butterfield, Lamb, Good, & Dweck, 2006). A number of studies have investigated how students' self-theories of intelligence relate to how they approach study and learning (deep, surface or strategic; Yorke, 2004, 2006; Yorke & Knight, 2004) and the development of self-efficacy (Usher, 2009; Usher & Pajares, 2008). While students' self-theories are relatively stable over time, they can change from entity to incremental beliefs during intervention and experimental studies (Dweck & Molden, 2005). Students' perceptions of implicit messages communicated in learning environments by a teacher's instructional practices are also influential. For instance, Good, Rattan, and Dweck (2012) found females were able to maintain a higher sense of belonging in mathematics classrooms that predominantly communicated an incremental view of intelligence.

Another area of significant research is the extent that a student's sense of self-efficacy influences their decisions to participate in potentially enriching environments and activities. Self-efficacy refers to an individual's judgement of their capability to perform tasks in specific contexts at a designated level (Bandura, 1997). Academic efficacy is a measure of a student's belief in their general ability to perform and learn in academic settings (e.g., Bong, 2004; Fast, et al., 2010). In studies of mathematics classrooms, academic self-efficacy has been associated with the adaptive use of self-regulation strategies such as help-seeking (Ryan, Patrick, & Shim, 2005; Schunk & Richardson, 2011). As students do not learn in isolation, but are members of different social groupings (e.g., class, year level, school), social self-efficacy is also important. Social self-efficacy is an individual's judgment of their capabilities to "interact effectively with others in order to realize their goals" (Patrick, Anderman, & Ryan, 2002, p. 93). Patrick and colleagues have found student-peer and student-teacher social self-efficacy is correlated with academic self-efficacy (Patrick, Hicks, & Ryan, 1997), self-regulation of learning (Ryan & Patrick, 2001), and help-seeking behaviour (Ryan, et al., 2005).

Problem Statement

In the school learning environment, academic help-seeking is viewed as a self-regulated behaviour that requires a transaction between the individual and the social environment in order to be effective. Adaptive help-seeking is viewed as being important for student success and yet mathematics students increasingly avoid asking for help as they progress through secondary school (Marchand & Skinner, 2007; Ryan, Pintrich, & Midgley, 2001). Contemporary research on academic help-seeking behaviour has been somewhat limited in focus, as it has predominantly investigated students' perceptions of the extent to which their teacher's practice emphasises learning or performance goals.

Help-seeking behaviour in secondary school is likely to be complex due to the inherent tension between two basic psychological needs of the adolescent student, the need for independence and for belongingness (Nadler, 2015). Newman (2002b) has argued that students' academic help-seeking competencies and motivational resources are developed through their socializing experiences. While the motivation to seek help is seen to reside in the individual, the decision to follow through may be influenced by the students' subjective perceptions of the contextual social norms of the class, rather than any objective measures of social support (Barker, 2007). Few studies have focused on how students' help-seeking competencies and motivational beliefs are influenced by the psychosocial aspects of different learning environments (Karabenick & Zusho, 2015; Newman, 2002b). Psychosocial learning environments research, with its long tradition of focusing on the relationship and personal development dimensions of social learning environments (or social climate) that influence student behaviour, offers a new approach to the study of academic help-seeking.

This study will focus on the relationship between secondary students' perceptions of the mathematics classroom learning environment, their motivational beliefs (self-theory of intelligence and self-efficacy), and help-seeking behaviour. This study marks the first time all three research areas involving psychosocial learning environments, academic help-seeking, and personal beliefs related to learning secondary school mathematics have been brought together in the same study. This study also marks the first time that students' academic help-seeking behaviours have been investigated in an Australian secondary mathematics context.

The Australian Education Context

The education system in Australia has a high level of complexity (see Gurr, 2020). The Australian education system consists of four sub-sectors: primary school (Foundation to Grade 6), secondary school (Grades 7-10), senior secondary school (Grades 11-12), and tertiary education (University and Vocational Education and Training [VET]) (Department of Foreign Affairs and Trade [DFAT], 2017). Each state and territory government determine its policies relating to the organisation of the school and VET sectors, including curriculum development and implementation of national curriculum guidelines (Department of Education and Training [DET], 2015). It is compulsory for children to attend school from age six until they have completed Grade 10 (about 15 years old). Furthermore, young people who are less than 17 years old are required to be engaged in full time education, training or employment (DFAT, 2017). The Australian academic school year begins in late January and continues until mid-December, depending on the jurisdiction and school type. Compared to other countries, the Australian school sector is highly privatised (DFAT, 2017). From 2014 to 2018, approximately 65% of students attended a government school, 21% a Catholic school, and 14% an independent school (Australian Bureau of Statistics [ABS], 2018).

Retention in secondary schools, from Grade 7 to 12, is about 88% for females and 81% for males (Gurr, 2020). The current study includes participants from state and catholic schools in Victoria and from independent schools in Tasmania and Western Australia.

The State and Territory governments also administer the VET system, consisting of private registered training organisations (RTOs) and government funded Technical and Further Education (TAFE) institutes. The learning culture of the typical TAFE program is focused on delivering specific vocational training for motivated and engaged students over 15 years old. TAFE also has a long history of providing general education courses to meet the learning needs of educationally disadvantaged students (Volkoff, Keating, Walstab, & Marr, 2006). For example, Victorian TAFEs provide early school leavers with the opportunity to reengage with education by completing the Certificates in General Education for Adults (CGEA), the Victorian Certificate of Applied Learning (VCAL), and the Victorian Certificate of Education (VCE). These certificates provide students with the prerequisite numeracy and mathematics skills and knowledge needed to pursue further education and training. The current study includes CGEA, VCAL, and VCE participants from two Victorian TAFEs.

The first national curriculum (*Australian Curriculum*) for the compulsory school years, was implemented in three phases from 2013 to 2016 (ACARA, 2020). The F-10 *Australian Curriculum: Mathematics* was one of the first learning areas to be implemented by all states and territories during phase 1 (2013). While the *Australian Curriculum* is the mandated curriculum, the State and Territory Education Authorities are able to customise it to meet their individual needs, for example, by supplementing additional content in order to support the aspirations of different cohorts of students in Grades 9 and 10 (Stephens, 2014). The State and Territory Authorities continue to be responsible for developing and implementing the curriculum for the various senior secondary certificates. A senior secondary *Australian Curriculum* has been developed for four learning areas, including mathematics. However, the State and Territory Authorities have control over the degree to which they integrate the Australian Curriculum into their senior secondary courses (ACARA, 2020). Australian senior secondary certificates serve a dual purpose: to certify the successful completion of secondary school, and as a basis of selection for university and further education courses (Stephens, 2014). The current study includes secondary mathematics students from Grade 7 to 12 in Victoria and Western Australia, and Tasmanian students from a composite Grade 11/12 class.

Secondary Mathematics Curricula

The *Australian Curriculum: Mathematics* for Foundation to Grade 10 (F-10) was developed in consultation with key stakeholders at the state and local level. It is a consensus document, which was mostly consistent with previous state curricula and so major changes were not expected in terms of the effect on teachers' daily practice (Stephens, 2014).

The teaching and learning of mathematics is based on a spiral curriculum. That is, students from Foundation to Grade 10 cover concepts from all key content areas with increasing depth throughout their schooling. In the mathematics curriculum, the knowledge, skills and processes that teachers are expected to teach are detailed in three content strands: Measurement and Geometry, Number and Algebra, and Statistics and Probability (ACARA, 2015b). In addition, there are four proficiency strands (Understanding, Fluency, Problem Solving, and Reasoning), which are focused on developing students' ability to work and think mathematically (Stephens, 2014).

While some concerns remain regarding the overall rationale for the AC (Reid, 2019), researchers have suggested that there are clear benefits with the AC for the teaching and learning of mathematics during the compulsory years (F-10). One important consideration was how the national curriculum addressed equity issues, such as streaming, by providing all students with the opportunity to experience the full mathematics curriculum until the end of Grade 10 (Anderson, White, & Wong, 2012). Sullivan (2012) asserted that the four proficiency strands would provide teachers and students with a clearer framework for what was meant by ‘working mathematically’. Anderson (2014) noted that there was a greater emphasis on problem solving than previous curriculum documents and suggested that this may encourage teachers to provide students with more opportunities to engage with authentic problem solving. Furthermore, the content strands were developed to promote a more coherent and integrated treatment of related content and to enable teachers to focus on content to a greater depth (Stephens, 2014; Sullivan, 2012).

In Australia, as elsewhere, senior secondary students (Grades 11 and 12: 16 to 18 years old) can opt to study different mathematics subjects or opt out of studying mathematics altogether. Across the various states, the variety of senior secondary mathematics courses can broadly be classified into a hierarchical set of subjects consisting of four categories: advanced, intermediate, elementary, and vocational mathematics (Barrington & Brown, 2014; National Curriculum Board, 2008).

About 10 % of Grade 12 students choose to study a challenging mathematics subject (Barrington & Evans, 2016). Higher-level mathematics (Advanced or AC level D) courses are designed to meet the needs of students who have a strong interest in mathematics and intend to study a STEM course at university (James, 2019; National Curriculum Board, 2008; Sikora & Pitt, 2019). These subjects commonly include topics such as vector calculus, complex numbers, kinematics and mechanics (Sullivan, 2011). In most jurisdictions, students completing a higher-level subject must also have completed or be enrolled in an intermediate level mathematics course. About 20% of Grade 12 students who were not studying advanced mathematics are enrolled in an intermediate level mathematics subject. Intermediate mathematics subjects are the most common prerequisite (after English) for a range of courses at university (Jaremus, Gore, Fray, & Prieto-Rodriguez, 2019; Murphy, 2019). These subjects commonly focus on topics such as calculus, graphs and relationships, and statistics and probability distributions (Sullivan, 2011).

About 52% of Grade 12 students study an ‘elementary’ level mathematics subject (Barrington & Evans, 2016). The term ‘elementary’ can be misleading as subjects in this category cover substantive content needed to prepare students for a wide range of vocations (National Curriculum Board, 2008; Sullivan, 2011). Therefore, the classifications of these subjects have been further refined to take into account the differing requirements of a range of university and further education vocational courses. General mathematics (AC level B) courses provide students with the assumed skills and knowledge to study a wide range of university vocational courses, such as teaching, nursing, business, and information technology. The content of general mathematics courses varies greatly, but typically include a range of non-calculus topics such as business or financial mathematics, networks and applied geometry, data analysis, and matrices (Sullivan, 2011). Students doing general mathematics courses, such as Further Mathematics in Victoria, tend to be less confident and have a less positive view of their classroom experience compared to students in higher-level courses (Helme & Lamb, 2007; Helme & Teese, 2011).

Vocational mathematics (AC level A) captures the diversity of numeracy and mathematics options designed for students pursuing vocational pathways, which do not require a higher education qualification (National Curriculum Board, 2008). Specific examples of such subjects are Mathematical Life Skills (New South Wales), Workplace Maths (Tasmania), and Foundation Mathematics (Victoria). In Victoria, students completing the VCAL and CGEA qualifications are required to complete at least one 'numeracy' unit (Victorian Curriculum and Assessment Authority [VCAA], 2011b). The Numeracy Skills units for both these qualifications are designed to build students' critical awareness of how mathematics is integrated into a range of real-world social contexts, including the workplace (VCAA, 2011a, 2013).

Research Questions

The objective of the current study was to investigate the relations between student's perception of classroom's social climate, personal beliefs, and their help seeking behaviour in secondary mathematics classes. This study will focus on the following research questions:

1. What is the relationship between students' perceptions of the social learning environment (social climate) and their intention to use help-seeking strategies?
2. To what extent does students' academic and social self-efficacy mediate the influence of the social climate on their intention to use help-seeking strategies?
    a. What is the relationship between students' perceptions of the social climate and their academic and social self-efficacy?
    b. What is the relationship between students' academic and social self-efficacy and their help-seeking strategies?
3. To what extent does students' self-theories of intelligence mediate the influence of the social climate on their intention to use help-seeking strategies?
    a. What is the relationship between students' perceptions of the social climate and their self-theories of intelligence?

    b. What is the relationship between students’ self-theories of intelligence and their help-seeking strategies?

4. What empirical model best explains the relationship between students’ perceptions of the social climate and their intention to use help-seeking strategies?
    a. What direct and indirect relations exist in this empirical model between students’ perceptions of the social climate and help-seeking strategies?
    b. What relative importance do different aspects of the social learning environment have on students’ help-seeking strategies?

How the Thesis is Organised

In Chapter 2, I provide an outline of the literature relevant to this study. In particular, I detail how this study fits at the intersection of the social climate and academic help-seeking research fields and introduce the research questions. The relevant literature for this review was identified after a thorough search of the main education and mathematics education databases available through the Monash University library. Additionally, I also made extensive use of Google Scholar and Researchgate.net to find other relevant articles, conference papers, and book chapters. Some selection bias may exist as I was restricted to searching English only literature.

In Chapter 3, I explain the course of my decision making as I adapted the study in response to issues emerging while implementing the research design.

In Chapter 4, I present an analysis of the measurement model derived from the review of the empirical literature. I used Confirmatory factor analysis (CFA), Average variance extracted (AVE) and construct reliability to examine the construct validity of the scales.

In Chapter 5, I detail the development and analysis of the mediated structural model in response to the four research questions. I highlight how the study was limited to a single level analysis of the data due to limitations related to sample size and the number of clusters and explain how a bootstrapping approach was used to assess the statistical significance of the paths in the final model.

In Chapter 6, I discuss the key findings in relation to the research questions, outline the contributions and limitations of the study, and provide recommendations for future research arising from this study.

CHAPTER 2: LITERATURE REVIEW

Mathematics is challenging. A key role for secondary mathematics teachers is to establish a learning environment that maximises students' learning opportunities and empowers all students to become independent learners (Australian Association of Mathematics Teachers [AAMT], 2006). The development of self-regulation skills can assist students to cope with the academic challenges of studying mathematics at the secondary level (De Corte, Mason, Depaepe, & Verschaffel, 2011). An important set of self-regulated behaviours that enable students to deal with academic challenge is related to help-seeking (Newman, 2002a; Wolters, Pintrich, & Karabenick, 2005). Seeking help from peers and/or teachers is an effective strategy for deep learning (Hattie & Donoghue, 2016); it has been associated with gains in achievement over the school year (Schenke, Lam, Conley, & Karabenick, 2015) and subsequent behavioural and cognitive engagement in later years (Duchesne, Larose, & Feng, 2019). Yet, despite these advantages, many students increasingly avoid seeking help as they progress through secondary school (Marchand & Skinner, 2007; Ryan, Pintrich, & Midgley, 2001).

Help-seeking differs from other self-regulated behaviours in that it encompasses both personal behaviours and social behaviours (Karabenick & Berger, 2013). This means that help-seeking may be influenced by personal factors; for example, students may be more likely to seek help when they hold positive beliefs about their own competencies (cognitive and social) and more likely to avoid seeking help if they are less confident about their competencies. It also means that help-seeking may be influenced by social factors operating in the learning environment, since in order to obtain help students need to interact with their teacher or peers. Thus, how students perceive different aspects of the classroom climate will affect their intentions to seek help and their help-seeking goals, their help-seeking behaviours.

Students’ perceptions of their learning environment (sometimes referred to as classroom climate), have been studied from at least two theoretical perspectives: a goal-orientation perspective and a social perspective. From a goal-orientation perspective, goal structures have been investigated using students’ perspectives of the extent to which learning or performance goals are emphasised in the classroom (Urdan, 2010). From a social perspective, which conceptualises the classroom as a dynamic social system consisting of three dimensions (relationships, personal development, and systems change and management), students’ perceptions of the psycho-social environment have been investigated (Fraser, 2012; Moos, 1980).

Much of the contemporary research on students’ academic help-seeking behaviours has focused on a goal-orientation perspective (Karabenick, 2006). Goal-orientation theories were developed within a social-cognitive framework to specifically focus on achievement motivation and associated behaviours, in educational or other achievement settings. The two goal-orientations most commonly represented are a mastery-goal orientation (also known as learning, task-involved or task-focused goals) and a performance-goal orientation (also known as ego-involved or ability-focused goals). Students with a mastery goal-orientation prefer to engage in tasks that provide opportunities for learning and foster self-improvement (mastery-approach focus) or avoiding misunderstanding or not mastering the task (mastery-avoidance focus). In contrast, students with a performance goal-orientation prefer to engage in tasks that demonstrate their competence (performance-approach focus) or avoid appearing to have less ability in relation to others (performance-avoidance focus) (Schunk, Pintrich, & Meece, 2008). The associations between students’ academic help-seeking behaviours and their achievement goal-orientation have been well studied (Karabenick & Dembo, 2011).

A significant issue with using goal structures to represent classroom climate is the difficulty in knowing how to promote changes in teachers' practices, especially in mathematics classrooms where both understanding and performance are valued (Patrick, Kaplan, & Ryan, 2011; Patrick, Ryan, & Kaplan, 2007). On the other hand, from a social perspective, classroom climate research has shed light on what teachers can do to positively influence students' perceptions of the social climate and improve learning, engagement and/or participation. Since research has made it clearer how teachers can influence the social climate of their classrooms, students' perceptions of the learning environment were investigated from a social perspective in this study.

The aim of this study was to explain the influence of learning environment factors from a social perspective (henceforth referred to as social climate of the classroom, or social climate), as well as personal factors (namely self-efficacy and self-theories of intelligence), on students' help-seeking behaviours (avoidant, expedient, and instrumental) in secondary mathematics classes. A holistic approach was taken where social climate factors, and personal factors, and the interactions between the two, were investigated to try to understand the complex interplay of elements that influence students' help-seeking behaviours.

In the following sections, I first review findings highlighting how (i) student outcomes are influenced by help-seeking behaviours, social climate, and personal factors (self-efficacy and self-theories of intelligence), and how (ii) social climate influences students' help-seeking behaviours (goals and intentions), self-efficacy, and self-theories of intelligence in mathematics classrooms. I then review findings highlighting how (iii) personal factors influence students' help-seeking behaviours in mathematics classrooms. Lastly, I review findings that have considered a holistic approach to examining how, (iv) social climate and personal factors play out in mathematics classrooms to promote or discourage students' help-seeking behaviours.

Student Outcomes

In the following sections, I review findings highlighting the influence of help-seeking, social climate and personal factors (namely self-efficacy and self-theories of intelligence) on student outcomes more broadly and/or student outcomes in mathematics classrooms.

Help-Seeking and Student Outcomes

For millennia, western philosophers have debated whether humans are born cooperative and helpful or if these are learnt behaviours (Tomasello, 2008). The expectation that people are cooperative and helpful is so pervasive across cultures and time, that only their absence was a matter for concern (Hunt, 1990; Johnson & Johnson, 1979). In the mid twentieth century, social psychologists began to focus on what factors promote or inhibit helping behaviour among humans (Penner, Dovidio, Piliavin, & Schroeder, 2005). Early research on helping relationships initially focused on the perspective of the help-giver, then the recipients' reactions to offers of help, and finally the perspective of the help-seeker (Gergen, 1974; Shapiro, 1978).

Help-seeking is an integral part of our lives from early infancy through to old age. Much prior research on help-seeking has focused on the specific needs of adults, particularly in the areas of mental health (Gourash, 1978; Rickwood, Thomas, & Bradford, 2012) and organisational research (Lee, 1997; van der Rijt et al., 2013). In contrast, adolescents seek help to address significant issues related to their interpersonal relations, education, and health (Boldero & Fallon, 1995). Whether or not it is appropriate to seek help for a particular problem can be influenced by the type of help sought, the age or gender of the help-seeker, cultural norms, the situation, the social environment and past experiences of seeking help (Graf, Freer, & Plaizier, 1979; Nadler, 1986, 2015; Newman, 2000; Pescosolido, 1992). This study is focused on academic help-seeking.

Prior to the seminal work of Nelson-Le Gall (1981), children's academic help-seeking was traditionally viewed as an aspect of dependence, immaturity, or incompetence. Help-seeking research in an educational setting was mostly restricted to situations not involving formal teacher-student interactions, such as teacher professional support and peer-tutoring programs, as students in a formal classroom context were not considered to be in a 'specific state of need' (Nadler, 1983). Academic help-seeking is now well recognised as a self-regulated learning strategy (Wolters et al., 2005), and seeking help from peers is considered one of the most effective strategies for students' subsequent consolidation of deep learning (Hattie & Donoghue, 2016).

Consistent with much of the research on academic help-seeking, the current study has conceptualised help-seeking as being one of three types: instrumental help-seeking, expedient help-seeking and avoidant help-seeking (Karabenick, 2006). Instrumental help-seeking (or adaptive help-seeking) is focused on increasing understanding and often involves asking for hints rather than answers. Expedient help-seeking is conceptualised as a less adaptive behaviour than instrumental help-seeking, where the help-seeking goal is to minimise effort. Avoidant help-seeking is a non-adaptive strategy where students intentionally avoid seeking help when they are aware of a need to seek help.

A relationship between academic help-seeking and achievement has been found in studies with elementary and secondary students. Students' help-seeking tendencies have been found to have an impact on subsequent achievement, after controlling for previous achievement. Instrumental help-seeking has been associated with subsequent improvement in achievement (Greenberg, 2001; Ryan & Shin, 2011). Expedient help-seeking has also been found to be associated with lower achievement for students during the transition to middle school (Ryan, Patrick, & Shim, 2005; Ryan & Shim, 2012). Ryan and Shin (2011) found that avoidant help-seeking behaviours can have a relatively quick (within a 20-week time frame) negative impact on academic performance.

Karabenick (2003) examined relationships between academic help-seeking and achievement for undergraduate chemistry students in a large US college. For students who had a tendency to seek instrumental help, but not avoidant or expedient help, their preferred help source was found to influence achievement. On average, students who preferred seeking help from the teacher, rather than a peer, achieved higher grades.

Relationships between academic help-seeking and achievement has also been studied in secondary mathematics students. Luo and Zhang (2015) found that for Singaporean students (13-14 years old), subsequent achievement in mathematics was positively predicted by instrumental help-seeking and negatively predicted by expedient help-seeking. Furthermore, expedient and avoidant help-seeking were predicted by previous academic achievement. Thus, low achieving students were likely to avoid seeking help when needed or to seek help with the intention of reducing effort, which resulted in further low performance.

Social Climate and Student Outcomes

The last 20 years has seen a significant increase in interest in how the social climate of the mathematics classroom influences student outcomes (58 of the 81 studies identified for this review were undertaken post 2000). Students' perceptions of social climate have been associated with positive cognitive, affective and behavioural outcomes in mathematics and science classrooms (Fraser, 2012). In this section, I review research that has mainly focused on the social climate and students' mathematics outcomes.

One of the most challenging aspects of the educators' role is the development and maintenance of a learning environment that meets the diverse physical, social and pedagogical needs of the students in a particular context. The strongest tradition within the learning environments research field has been a focus on investigating the relationship between students' perceptions of the social climate of their classroom and various cognitive, affective and behavioural outcomes (Fraser, 1980, 2002, 2012; Randhawa & Fu, 1973; Walberg & Anderson, 1968). Much of this research has been attributed to the work of Moos and Walberg, who independently developed a number of high inference self-report measures to assess participants' perceptions of various social environments (Dorman, 2002; Fraser, 2012).

Over the last 20 years, five studies that have investigated students' attitudes towards mathematics as an affective outcome, using a similar set of social climate factors that have been operationalised as variables using the What is Happening in this Class (WIHIC) questionnaire (Fraser, McRobbie, & Fisher, 1996). A description of these factors is provided in Table 2.1.

One study involved primary students in Singapore (Goh, Young, & Fraser, 1995); three studies involved secondary students in Australia (Rawnsley & Fisher, 1998), Canada (Raaflaub & Fraser, 2002) and the USA (Hoang, 2008); and one study involved university students in Indonesia (Margianti, 2003). Each of the studies took the multilevel nature of educational contexts into account by reporting on two units of analysis: the individual student level (a between-students analysis) and the class level (a between-classes analysis using either a class form of the measures or the class mean of the individual responses).

Table 2.1

Description of Classroom Social Climate Factors

Factors	Description
Teacher Support	The extent to which the teacher helps, befriends, trusts and is interested in students
Involvement	The extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class
Student Cohesiveness	The extent to which students know, help and are supportive of one another
Investigation	The extent to which there is emphasis on the skills and processes of inquiry and their use in problem solving and investigation
Cooperation	The extent to which students cooperate rather than compete with one another on learning tasks
Task Orientation	The extent to which it is important to complete activities planned and to stay on the subject matter
Equity	The extent to which the teacher treats students equally

In general, the results from these studies suggest that, irrespective of learning context or culture, students' perceptions of a positive social climate are associated with productive attitudes towards mathematics. A more nuanced break down of these findings is summarised in Table 2.2.

Table 2.2

Relationships between Social Climate and Attitude Towards Mathematics/Inquiry

Scale	Unit of analysis	Singapore PS	Australia SS	Canada SS	USA SS	Indonesia Uni.
Teacher Support	Person	x	+ve	+ve		+ve
	Class	x	+ve			
Involvement	Person	x	+ve	+ve	+ve	+ve
	Class	x	+ve			+ve
Student Cohesiveness	Person	+ve		+ve	+ve	+ve
	Class		+ve			-ve
Investigation	Person	x	+ve	+ve	+ve	x
	Class	x	+ve			x
Cooperation	Person	x	+ve	-ve	+ve	
	Class	x	+ve			
Task Orientation	Person	+ve	+ve	+ve		+ve
	Class		+ve			
Equity	Person	x	+ve	+ve	+ve	+ve
	Class	x	+ve	+ve	+ve	+ve

Note: +ve/-ve indicates a statistically significant ($p < 0.05$) positive/negative relationship. PS indicates Primary School. SS indicates Secondary School. Uni. indicates University. Cells with an ‘x’ indicate social climate factors that were not included in the study.

In summary, these five studies indicate that students had a more positive attitude towards mathematics when classes were perceived as promoting positive peer relationships (student cohesiveness) and on-task learning-oriented work habits (task orientation). Four of these studies suggest that secondary and university students’ attitudes towards mathematics may be influenced by similar dimensions of the social climate of the mathematics class. The relationship between equity and attitudes towards mathematics is particularly noteworthy. Equity was the only social climate dimension that had a consistent effect on students' attitudes towards mathematics, across cultures and learning contexts. This affirms the value of ensuring all students have an equal opportunity to get help and encouragement during mathematics classes (Sullivan, 2011). With the exception of the Australian study, the other social climate factors (Teacher Support, Involvement, and Investigation) mostly influenced students' attitudes towards mathematics at the individual level, with few between-class effects.

While some studies have focused on a single attitude dimension, students' attitudes towards mathematics have also been viewed as being multidimensional (McLeod, 1994). Liking or enjoying mathematics was identified by Australian students as influencing their continued participation in post-compulsory secondary mathematics (McPhan et al., 2008). Usefulness (the perceived relevance of mathematics for learning and life) was another attitudinal factor that strongly influenced students' ongoing participation in mathematics (McPhan et al., 2008; Murray, 2011). Students' self-confidence in their mathematics ability influenced their level of math anxiety and enjoyment (Koch, 2018).

Findings from another five studies that investigated the relationships between social climate and students' enjoyment/liking of mathematics are summarised in Table 2.3. These studies included primary students in Singapore (Goh & Fraser, 1998), and secondary students in Indonesia (Wahyudi, 2010), Singapore (Chionh & Fraser, 2009) and the USA (Hoang, 2008; Ogbuehi & Fraser, 2007). Students were more likely to report enjoying mathematics in classrooms that were task oriented. Other social climate factors, including Teacher Support, Involvement, and Investigation, also influenced students' enjoyment of mathematics.

Table 2.3

Relationships between Social Climate and Enjoyment/Liking of Mathematics

Scale	Unit of Analysis	Singapore PS	USA SS	USA SS	Singapore SS	Indonesia SS
Teacher Support	Person	x	x		+ve	+ve
Involvement	Person	x		+ve	+ve	
Student Cohesiveness	Person	+ve	x			
Investigation	Person	x		+ve	+ve	
Cooperation	Person	x	x	+ve		-ve
Task Orientation	Person	+ve	+ve	+ve	+ve	+ve
Equity	Person	x	x		+ve	

Note: +ve/-ve indicates a statistically significant ($p < 0.05$) positive/negative relationship. Cells with an X indicate social climate factors that were not included in the study. PS indicates Primary School. SS indicates Secondary School.

Yang (2015) explored the links between junior secondary students' perceptions of the social climate and their attitudes towards mathematics (self-confidence and usefulness) in rural China. Overall, students rated the social climate of the mathematics classroom poorly and did not hold very positive attitudes towards mathematics. However, classrooms perceived as having good teacher-student relations, and which supported inquiry-based approaches, were more likely to bring about improvements in students' achievement, self-confidence, and perceptions of the usefulness of mathematics. Classes where students felt supported and were encouraged to participate (Involvement) had a positive effect on students' self-confidence in mathematics. Classrooms perceived as emphasising the importance of staying on-task and completing work (Task Orientation) were associated with improvements in students' perceptions of the usefulness of mathematics.

Two studies have investigated the association between the quality of teacher-student interpersonal behaviours and students' attitudes towards their mathematics classes in Australian secondary schools. Students who perceived their teachers as showing leadership and helping/friendly behaviours were found to have favourable attitudes towards mathematics (Fisher & Rickards, 1998; Rawnsley & Fisher, 1998). Conversely, in classrooms where teachers were perceived as showing mostly judgemental (dissatisfied, admonishing, or strict) behaviours, students had a more negative attitude towards their class (Fisher & Rickards, 1998; Rawnsley & Fisher, 1998).

In the USA, Haladyna, Shaughnessy, and Shaughnessy (1983) explored the relationship between students' perception of 'teacher quality', their attitude towards mathematics, and their motivation, in various classroom contexts. They found that student motivation (academic self-concept) was increasingly influenced by students' attitude toward mathematics as they progressed through school. By Grade 9, students' attitudes towards mathematics were mostly influenced by the perceived quality of teacher-student interactions.

A number of studies have investigated the role of students' perceptions of social climate and goal-orientation, in relation to student outcomes in mathematics. Recall, goal-orientation relates to a student's beliefs about the purpose of the learning process: whether learning is an interesting end in itself (mastery focused), or as a means for demonstrating ability (performance focused). For example, Patrick et al. (2007) found that 5th grade students' perceptions of teacher emotional support, teacher support for peer-peer interaction (Cooperation), and academic support of peers, influenced their pursuit of mastery goals. Norwich (1994) investigated the extent to which goal-orientation and social climate factors influenced girls' learning behaviour during the first two years of secondary school in the UK. They found that students' performance-approach goals and perceptions of student cohesiveness directly influenced mathematics self-efficacy, which in turn influenced students' learning intentions and subsequent learning behaviours. Gherasim, Butnaru, and Mairean (2012) explored the extent to which students' goal-orientations moderated the influence of social climate on the mathematics achievement of Grade 7 students in Romania. Girls with low performance-approach goals benefited from participating in classes with higher levels of peer support (Student Cohesiveness and Cooperation), whereas peer support had no influence on the achievement of girls with high performance-approach goals. For boys, teacher support (Teacher Support, Task Orientation, and Equity) had a positive effect on grades only for students with low performance-avoidance goals.

Dimensions of the social climate of the classroom have also been linked to other outcomes in mathematics classrooms. For example, Forgasz (1995) explored the extent to which an individualised learning environment influenced students' independent engagement with challenging tasks during Grade 7 mathematics classes in Australia. At the individual level, three dimensions of the social climate were associated with students' attitudinal beliefs about mathematics (confidence, usefulness, persistence, sex-role congruence, and attributional style). Students who perceived the teacher as caring about their personal welfare and social growth were more likely to be confident about their ability to learn and to view mathematics as useful. However, females were less likely than males to view mathematics as being useful for their future education or vocation. Male and female students were also more confident in classrooms where active participation in the learning process was encouraged, such as participating in class discussions. Students were more persistent when confronting difficulties with tasks, and more likely to perceive mathematics as useful, in classrooms that supported inquiry-based learning approaches (Investigation) for problem solving rather than relying on textbooks for answers. However, female students had less confidence in their ability to learn and perform well than their male peers. Using the class as the unit of analysis, males had more positive attitudes towards mathematics than females, in terms of perceived usefulness and confidence. Also, students' perception of opportunity for teacher-student interaction positively influenced their attitude towards the support provided by the teacher, their belief about how the teacher rated their achievement, and if they attributed success to environmental forces beyond their control.

Mathematics anxiety has also been linked to social climate factors. Anxiety related to the learning of mathematics can reduce students' cognitive engagement during mathematics, and lead to the pursuit of self-handicapping behaviours such as avoiding help (Koch, 2018). Secondary students' anxiety related to learning mathematics is lower in classrooms that use more cooperative learning approaches compared to traditional approaches (Lavasani & Khandan, 2011). Frenzel, Pekrun, and Goetz (2007) found that students reported experiencing fewer negative emotions (anxiety, anger, and boredom) in classrooms with clear and well-structured lessons, and where mathematics was held in high regard by their peers. In contrast, students were more likely to report these negative emotions in mathematics classrooms perceived as emphasising competition rather than cooperation. At the class level, the level of peer esteem for mathematics had the strongest influence on reducing students' anxiety towards mathematics. Similarly, Taylor and Fraser (2003, 2013) found that senior secondary students (Grades 9-12) were less likely to be anxious about learning mathematics in classrooms where peers were supportive and help each other (Student Cohesiveness).

Self-Efficacy and Student Outcomes

Self-efficacy theory is a core feature of Bandura's social cognitive theory of motivation (Schunk et al., 2008). Self-efficacy refers to an individual's belief in their capability to influence events so that they can achieve a desired outcome (Bandura, 1997), which can vary depending on the domain and situation (Bandura, 2012a). Self-efficacy affects an individual's self-development, learning, and career trajectories through influencing voluntary participation in potentially enriching environments and activities (Bandura, 1986; Lorsbach & Jinks, 1999).

Academic self-efficacy refers to students' beliefs in their capability to master the academic tasks that they encounter in their classrooms (Dorman, 2001). Academic self-efficacy influences students' educational outcomes through 'approach' behaviours, such as expending effort and perseverance in the face of obstacles (Bandura, 2001). For example, academic self-efficacy directly influenced the academic achievement, academic aspirations and prosocial behaviour of Italian secondary students (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996, 2001). In addition to its influence on mathematics achievement, academic self-efficacy has also been associated with the increased use of self-regulated learning strategies in mathematics classrooms (Nasser-Abu Alhija & Amasha, 2012; Schunk & Richardson, 2011). Academic self-efficacy directly influenced the intrinsic motivation and self-regulated behaviours (including effort and persistence) of Norwegian middle school (Grades 8-10) mathematics students (Skaalvik, Federici, & Klassen, 2015). Students with higher levels of academic self-efficacy are more likely to be engaged during mathematics (Liu et al., 2018), and less likely to feel anxious (Lavasani, Hejazi, & Varzaneh, 2011) or engage in self-handicapping behaviours (Ferguson & Dorman, 2002).

Consistent with Bandura's (2012b) social cognitive theory, academic self-efficacy is often a key mediator of the influence of environmental factors on students' cognitive and social outcomes. In the United Arab Emirates, college students' perceptions of their mathematics class as being personally relevant to their out-of-school experiences, positively influenced their academic self-efficacy, which subsequently had a positive influence on their enjoyment of mathematics (Afari, 2013; Aldridge, Afari, & Fraser, 2013). However, while teacher support also had a direct influence on their enjoyment of mathematics, it did not have an effect on academic self-efficacy. In the US, academic self-efficacy and enjoyment mediated the influence of social climate (sense of belonging and teacher support) on the academic effort of 7th and 8th Grade mathematics students (Sakiz, Pape, & Hoy, 2012). Students' emotional and cognitive outcomes can be influenced by ongoing reciprocal interactions between their personal efficacy beliefs and their experience of the social environment (Bandura, 1993). For younger students, positive relationships with peers and the teacher can influence the development of academic self-efficacy, which in turn influence their aspirations and self-regulated learning behaviours (Bandura, 1997). For senior secondary students, the relationship between classroom social climate and students' academic self-efficacy is likely to be more complex. For example, in Australia, students can choose to study one or more mathematics subjects associated with different fields of study. In a study of low socioeconomic schools in Victoria, Grade 12 students who only took the least demanding mathematics subject (Further Mathematics) had a more negative perception of their classroom's social climate and were less efficacious than their peers who studied an additional mathematics subject (Helme & Lamb, 2007).

Students' social competence can also influence their sense of belonging and success at school (Patrick, 1997). In an early study of the transcultural nature of social competence, Indian children (aged 8-10 years) who were more socially competent, were found to be more likely to seek help from a peer helper and use it in a constructive way to enable them to complete a task of moderate complexity (Koh's Block Design number 7), or reject it and continue with their efforts to solve the task without devaluing themselves or the helper (Tyler & Varma, 1988). That is, these socially competent children were capable of seeking help when needed, and then accepting or rejecting the given advice without affecting their self-esteem or the self-esteem of the help giver. For junior high school students in the US, students' feelings of social competence significantly reduced their perception of threat to self-worth associated with asking for help during their mathematics lessons (Ryan & Pintrich, 1997).

An important aspect of social competence is social self-efficacy. Social self-efficacy is an individual's judgment of their capability to seek out and cultivate social relationships with others in order to realize their goals (Bandura et al., 1996; Patrick, Anderman, & Ryan, 2002). Social self-efficacy has been associated with reduced feelings of depression and an increased ability to develop socially supportive relationships, which are particularly important during transitional periods of life (Bandura, 1997).

Research on students' social self-efficacy has mostly focused on social and emotional factors associated with students' well-being and sense of belonging at school. In elementary school, 5th grade students' academic self-efficacy and social self-efficacy with peers, positively influenced their interactions with peers while doing mathematics and their subsequent achievement (Patrick et al., 2007). For Israeli students, social self-efficacy at the end of 6th grade positively influenced their behavioural and emotional engagement after transitioning to middle school (Madjar & Chohat, 2017). For Italian middle school (Grades 6 and 7) students, social self-efficacy positively influenced academic aspirations (Bandura et al., 1996, 2001) and had an indirect influence on academic achievement via a lowered vulnerability to depression (Bandura et al., 1996). In Australia, academic and social self-efficacy directly influenced Grade 11 students' well-being at school, which had a positive effect on students' academic engagement and achievement in mathematics (Phan, Ngu, & Alrashidi, 2016).

Self-Theories of Intelligence and Student Outcomes

There is growing evidence that students' self-theories of intelligence play a significant role in the mathematics classroom (Bostwick, Martin, Collie, & Durksen, 2019; Dweck, 2008; Sullivan & McDonough, 2007). In Australia, as elsewhere, students may experience differences in learning opportunities and achievement in secondary mathematics depending on the social context of their families and the schools they attend (Atweh, Vale, & Walshaw, 2012). Students who experience lower participation and achievement are more likely to be female (Koch, 2019; Watt, Eccles, & Durik, 2006), working class (Education and Training Committee, 2006), live in a rural or remote community (Welch, Helme, & Lamb, 2007), or identify as an Indigenous Australian (Helme, 2007). Students' self-theories of intelligence have been shown to be one of the factors that distinguish students who achieve despite these disadvantages; that is, students who are resilient when they encounter challenges (Brooks, Brooks, & Goldstein, 2012; Dweck, 2002).

A nationwide study in Chile found that a growth mindset (i.e., an incremental view of intelligence) predicted achievement of 10th grade students irrespective of socioeconomic status; however, while this effect was stronger for low-income students, these students were also more likely to endorse a fixed mindset (i.e., an entity view of intelligence; Claro, Paunesku, & Dweck, 2016). In Australia, Tarbetsky, Collie, and Martin (2016) found that the negative relationship between Indigenous status and achievement in mathematics was mediated by the students' mindset beliefs. While Aboriginal and Torres Strait Islander participants were more likely to have a fixed-mindset, those students with a growth-mindset were as academically successful as their non-Indigenous peers. Secondary students' mindsets are also influenced by their academic growth (engagement and achievement) in mathematics one year later (Bostwick et al., 2019). Good, Rattan, and Dweck (2012) found females were able to maintain a higher sense of belonging in mathematics classrooms that predominantly communicated an incremental view of ability.

The influence of students' self-theories of intelligence on motivation and subsequent achievement has been shown to differ for students who self-identify as having an underdog versus top dog status. Davis, Burnette, Allison, and Stone (2011) explored the influence of students' self-theories of intelligence on students' academic self-efficacy while participating in a mathematics competition, where students' perceived underdog versus top dog status was manipulated. For students who perceived themselves as being an underdog, having a growth mindset was especially advantageous as these students were less likely to experience feelings of helplessness, which, in turn, had a positive influence on their self-efficacy.

As previously mentioned, students with a growth mindset are less concerned about making mistakes and therefore are more likely to engage with challenging tasks and take cognitive risks (Patrick, Mantzicopoulos, & Sears, 2012). Blackwell, Trzesniewski, and Dweck (2007) found a growth mindset at the beginning of Grade 7 was positively associated with a network of interrelated motivational variables: effort beliefs, learning goal-orientation, low helpless attributions, and effort-based learning strategies. Grade 7 students with a growth mindset made significant improvement on their subsequent Grade 8 achievement scores, while there was little change in the achievement scores of students with a fixed mindset. The same path model was subsequently tested with a different population (students in Grade 9 algebra classrooms) and was found to be consistent and invariant across genders (Jones, Wilkins, Long, & Wang, 2012).

Summary

Help-seeking behaviours, social climate, self-efficacy, and self-theories of intelligence, all have an impact on student outcomes more broadly, and in particular, on outcomes relating to mathematics classrooms.

Students' academic help-seeking behaviours have been shown to influence subsequent mathematical achievement (Karabenick, 2003; Luo & Zhang, 2015). Instrumental help-seeking is associated with achievement gain over time (Ryan & Shin, 2011), while expedient and avoidant help-seeking behaviours are associated with reduced achievement (Ryan et al., 2005; Ryan & Shim, 2012).

There has been much research on social climate and its impact on students' mathematical outcomes. In general, the results from these studies suggest that, irrespective of learning context or culture, primary and secondary mathematics students' perceptions of a positive social climate promotes engagement (Patrick et al., 2007), productive motivational beliefs (Forgasz, 1995; Gherasim et al., 2012; Haladyna et al., 1983), positive attitudes towards mathematics (Raaflaub & Fraser, 2002; Rawnsley & Fisher, 1998), and enjoyment of mathematics (Chionh & Fraser, 2009; Hoang, 2008), At the same time, a positive social climate has been linked to reduced anxiety (Taylor & Fraser, 2013) and other negative emotions (Frenzel et al., 2007) related to the learning of mathematics.

Self-efficacy also plays a significant role in the secondary mathematics classroom. Students with higher levels of academic self-efficacy are more likely to be engaged during mathematics (Nasser-Abu Alhija & Amasha, 2012; Skaalvik et al., 2015) and less likely to feel anxious or engage in self-handicapping behaviours (Ferguson & Dorman, 2002; Lavasani et al., 2011; Liu et al., 2018). Social self-efficacy is associated with reduced feelings of depression (Bandura et al., 1996), an increased ability to develop socially supportive relationships (Madjar & Chohat, 2017), and supports academic engagement and achievement in mathematics (Phan et al., 2016).

Students' self-theories of intelligence also play a significant role in the mathematics classroom. Students may experience differences in learning opportunities and achievement in secondary mathematics depending on their gender, indigenous status, the social context of their families, and the schools they attend. A growth mindset is especially advantageous for these students, as they are less likely to experience feelings of helplessness and more likely to be resilient when they encounter learning challenges (Claro et al., 2016; Good et al., 2012; Tarbetsky et al., 2016). Students' who hold a growth mindset are more likely to experience academic growth (engagement and achievement), engage with challenging tasks, and take cognitive risks (Blackwell et al., 2007; Bostwick et al., 2019; Jones et al., 2012).

Social Climate

In this section, I review findings highlighting how social climate influences students' self-regulated behaviours (including help-seeking goals and intentions) and personal factors (self-efficacy and self-theories of intelligence) in secondary mathematics classrooms.

Social Climate and Self-Regulated Behaviours (including Help-Seeking)

Self-regulated learners engage in an active, constructive process whereby they "set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment" (Wolters, et al., 2005, p. 251). Students' self-regulation strategies that support learning include perseverant effort, volition, and help-seeking (Corno, 2004; Wolters et al., 2005; Zimmerman, 2011). Empirical studies that explored the relationship between students' perceptions of the classroom's social climate and self-regulatory behaviours are reviewed in this section, with a particular focus on help-seeking behaviours.

In the mathematics classroom it is common for some students to actively engage in avoidance behaviours as a self-regulatory strategy to maintain a sense of self-worth, especially when they consider a task to be important but their expectancies for success are low (Urdan, Ryan, Anderman, & Gheen, 2002). Students' avoidance behaviours encompass self-handicapping strategies, which include procrastination, help-seeking avoidance, disruptive behaviours, withdrawing effort, and avoiding risk-taking (Ferguson & Dorman, 2002; Urdan & Midgley, 2001). Students' self-handicapping behaviours are thought to represent an early stage of the cycle of academic withdrawal and disengagement with school (Urdan & Midgley, 2001).

In secondary mathematics classes, teachers and students recognise that effort and persistence are key self-regulated behaviours, which are directly related to achievement (Sullivan, McDonough, & Harrison, 2004). While effort and persistence are mostly viewed as individual traits, they can also be influenced by the cultural norms of the classroom (Jackson, Mackenzie, & Hobfoll, 2000; Sullivan, Tobias, & McDonough, 2006). Studies exploring the extent to which students' effort and persistence are influenced by the social environment have mostly focused on the quality of the teacher-student interactions.

Federici, Caspersen, and Wendelborg (2016) found that secondary students' perceptions of teacher emotional support had a direct effect on students' motivation and theeir perceived relevance of schoolwork, which in turn had a direct effect on persistence. Skaalvik and colleagues explored the extent to which 8th-10th Grade students' perceptions of teacher support (emotional or instrumental) influenced effort and persistence. In mathematics classrooms, Skaalvik et al. (2015) found that teacher emotional support had a direct positive influence on students' effort and persistence, and a further indirect positive effect via self-efficacy and intrinsic motivation. In a separate study with 9th and10th Grade mathematics students, Federici and Skaalvik (2014) found that students' perceptions of emotional and instrumental teacher support had an indirect effect on effort via intrinsic motivation, and instrumental support had a direct effect. Skaalvik and Skaalvik (2013) found that middle school students' perceptions of teachers as being emotionally supportive had an overall positive influence on students' effort. However, after controlling for the positive effects of academic self-concept and intrinsic motivation, this total effect had two components: a strong positive indirect effect and a weaker negative direct effect. The authors suggest that one plausible reason for this apparent suppression effect is that students who lack motivation may interpret emotional support as a teacher's acceptance of their lack of effort (Skaalvik & Skaalvik, 2013). These passive non-participants are also likely to exhibit other self-handicapping behaviours such as expedient help-seeking, in order to reduce their effort and get the work done quickly or avoiding seeking help when help is needed.

In addition to promoting self-regulated effort, students' perceptions of teacher support have been found to reduce some self-handicapping behaviours common in secondary mathematics classrooms. In a cross-national study of secondary mathematics classes (Grades 8, 10, and 12), Dorman, Adams, and Ferguson (2002) explored the relationship between self-handicapping, academic self-efficacy, and the social environment. At the individual level of analysis, after controlling for academic self-efficacy, students were less likely to self-handicap in classrooms perceived as having good teacher support, equity, and clear work and learning objectives (Dorman et al., 2002). In a separate analysis of the Canadian cohort (Grades 8 & 10), task orientation had a significant negative effect on self-handicapping, with or without control for academic self-efficacy (Ferguson & Dorman, 2003). Similarly, Ryan and Patrick (2001) found that 8th Grade mathematics students who perceived the teacher as supportive were less likely to be disruptive during class; that is, they were more likely to follow the teacher's directions and less likely to disrupt their peers. In addition, classrooms perceived as promoting mutual respect and harmony among peers had a significant positive influence on students' self-regulated learning behaviours, such as monitoring and regulating their efforts to understand the class work. Turner et al. (2002) found that 6th Grade elementary students who perceived their mathematics classrooms as emphasising enjoyment and understanding, reported using fewer avoidance strategies, such as avoiding help and self-handicapping.

In studies that focus more specifically on help-seeking behaviours, social climate has been investigated most prominently in terms of teacher support, cooperation, and student cohesiveness. Student's perceptions of teacher support in mathematics classes have been found to influence student's help-seeking behaviours (Arbreton, 1993; Cheema & Kitsantas, 2016; Federici & Skaalvik, 2014). For example, Kiefer and Shim (2016) found 6th Grade students' perceptions of teacher support (academic and emotional) predicted subsequent instrumental help-seeking (positively) and expedient help-seeking from peers (negatively), but not help-seeking avoidance. Similarly, students' who perceived higher levels of teacher support for seeking help during 5th Grade mathematics classes were more likely to seek instrumental help and less likely to avoid seeking help when needed (Arbreton, 1998).

Studies of secondary mathematics classrooms have found similar relationships between teacher support and students' help-seeking goals and intentions. Grade seven students' who perceived their mathematics teacher as providing emotional support were more likely to seek instrumental help from peers, and expedient help-seeking was reduced (Ryan & Shim, 2012). Students' perceptions of teacher emotional support were found to have a direct positive effect on academic help-seeking behaviours of mathematics students in Grades 8-10 in Norway (Federici & Skaalvik, 2014; Skaalvik et al., 2015).

Schenke et al. (2015) examined the relationship between secondary students' perceptions of the classroom climate (goal structure and emotional support) and the types of help (instrumental and expedient) they sought from teachers and peers over the school year. Consistent with previous research, students who perceived their teacher as being emotionally supportive were more likely to seek help from the teacher, but teacher support was not associated with the types of help sought. Additionally, the relative difficulty of the mathematics class influenced the choice of helper, but not the type of help, over the school year. Students in elementary subjects sought more help from the teacher, and students in advanced subjects sought more help from peers than students in intermediate subjects.

While most help-seeking studies assume that students' help-seeking behaviours are influenced by their teacher's practices, a few studies have explored the inverse relationship; that students' help-seeking goals and intentions influence their perceptions of teacher support. Ryan et al. (2005) found that 5th Grade students identified as being help-avoiders, perceived lower levels of teacher emotional support than instrumental help-seekers, and lower levels of teacher academic support than expedient and instrumental help-seekers.

In secondary classrooms, peers are a more easily accessible source of help. Social climate researchers have explored peer relations from two perspectives, classrooms perceived to promote cooperative learning approaches (Johnson & Johnson, 1979) and student cohesiveness (Schmuck, 1966). Nelson-Le Gall (1992) hypothesised that the perceived costs of help-seeking would be reduced in classrooms where teachers relinquished some control and encouraged the use of cooperative learning strategies, so that interactive learning by students became the norm, and there would be a corresponding increase in help-seeking and help-giving behaviours by students. Webb (1992) found general support for this hypothesis but noted that a successful outcome, in terms of test performance, depended on the internal dynamics of small groups and students' ability levels. For example, lower and middle ability students benefited from receiving explanations (instrumental help), whereas high ability students did not need to overtly participate in group interactions in order to be successful.

There are some inconsistencies in findings in relation to cooperative learning approaches. Lavasani and Khandan (2011) found that mathematics students who are taught using a cooperative learning (instructional) approach were less likely to avoid help-seeking and less anxious than students taught in a traditional approach. However, Wosnitza, Labitzke, Woods-McConney, and Karabenick (2015) found that teachers may have somewhat inconsistent beliefs and behaviours associated with students seeking help during group work, which may confuse students, resulting in students avoiding asking for help when faced with difficulties.

Student cohesiveness may have a positive impact on help-seeking behaviours, where classrooms provide readily accessible opportunities for students to help each other, or a negative impact, if students are overly social, concerned about making mistakes, or looking foolish in front of their friends (Taylor, 2004). Student cohesion is a measure of the degree of dispersion of friendship relations within the class. Classrooms with concentrations of liked and disliked peers are perceived as being less cohesive (Schmuck, 1966). Students' anxiety related to learning mathematics also influences avoidance behaviours (Koch, 2018), including help-seeking avoidance. Students are less anxious in mathematics classrooms perceived as fostering acceptance and friendly relations amongst students (Taylor & Fraser, 2013). Shim, Kiefer, and Wang (2013) found that middle school (Grades 6-8) students who had a positive perception of the peer climate (student cohesiveness) of their mathematics classroom, were less reluctant to seek help and less likely to seek help with the intention of avoiding effort. Rather than focus on student cohesiveness, help-seeking research has mostly examined the benefits and limitations of peer friendship on students' selection of peers nominated as helpers.

Shin (2018) found that students' help-seeking tendencies had an interaction effect with friend selection and influence, in 5th and 6th Grade classrooms in South Korean. Students tended to select as friends, peers who had similar instrumental help-seeking tendencies and were less likely to select peers who showed higher avoidant help-seeking behaviour. Over time, students became more similar to their friends in terms of avoidant help-seeking behaviour, but friendship did not have a significant influence on instrumental help-seeking behaviour. Girls and high-achieving students' help-seeking behaviours tended to become more instrumental and less avoidant over time.

Friendships have also been found to influence the help-seeking behaviour of secondary students. Zander, Chen, and Hannover (2019)) examined how 9th Grade mathematics students' friendship choices influenced their choice of helper. While students preferred seeking help from a more knowledgeable peer, they were more inclined to restrict their choice of helper to within clique boundaries, that is, in terms of the same gender, religion, or migration background. Roussel, Elliot, and Feltman (2011) found that senior students' goals for strengthening their relationship with friends had a direct influence on their intentions to seek instrumental help from peers. In contrast, when the focus of students' friendship goals was avoiding disagreements and conflicts with friends, they were more likely to have a negative attitude towards help-seeking, which in turn had a negative effect on instrumental help-seeking.

In summary, at least three social climate factors have been found to have a direct effect on secondary mathematics students' help-seeking behaviours (see Figure 2.1). Students who had positive perceptions of teacher and peer support were more likely to seek help in order to improve their understanding, and less likely to avoid seeking help when needed. Secondary students who perceived their mathematics teacher as providing emotional or academic support were more likely to be persistent and maintain their efforts to stay on task and learn new concepts (Skaalvik, et al., 2015). Although, it appears that less motivated students may interpret emotional support as their teacher's acknowledgement of their lack of effort (Skaalvik & Skaalvik, 2013). However, for students in less advanced subjects, students' perceptions of teachers support their intentions to seek instrumental help and reduce expedient help-seeking (Ryan & Shim, 2012; Schenke, et al., 2015; Skaalvik, et al., 2015). Students who perceived their teacher as supportive are also less likely to self-handicap (Ferguson & Dorman, 2003) or engage in disruptive behaviours during class (Ryan & Patrick, 2001). The relationship between teacher support and help-seeking avoidance is less clear, while some studies have found that teacher support can reduce help avoidance (Arbreton, 1998), others have found no relationship (Kiefer & Shim, 2016). Students are also less likely to engage in self-handicapping behaviours in classrooms perceived as providing clear work and learning objectives (Task Orientation) and promoting equity (Dorman, et al., 2002). Thus, other social climate factors may also influence students' decisions to avoid or seek help during mathematics.

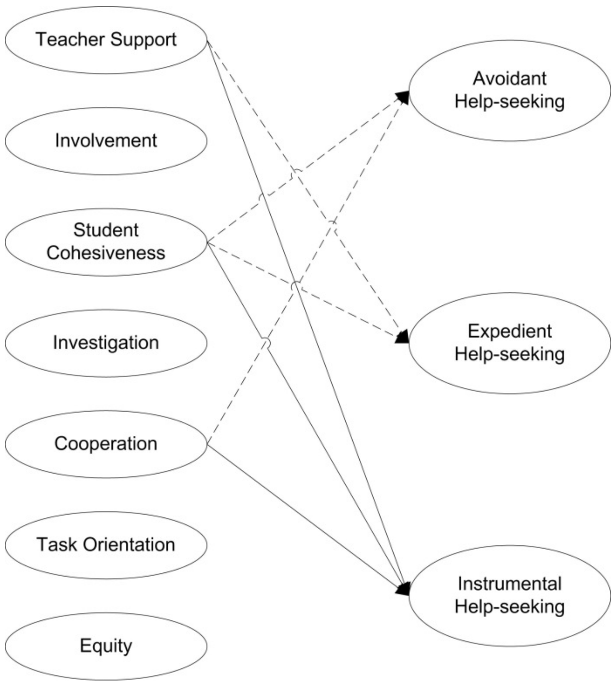

Figure 2.1 Summary model of the relationships between social climate and help-seeking factors. Note: solid line indicates a positive path and a dashed line indicates a negative path.

Student cohesiveness is one social climate factor that has been found to influence students' help-seeking behaviours. In classrooms perceived as supporting student cohesion, students are more likely to engage in Instrumental Help-Seeking, and less likely to engage in Expedient Help-Seeking or avoid seeking help when needed (Shim, et al., 2013). Students who perceived their class as providing more opportunities for participating in cooperative learning experiences, experienced more academic help, and were more likely to perceive the class as being cohesive (Johnson, Johnson, & Anderson, 1983). Students are less likely to avoid seeking help in mathematics classrooms when taught using a cooperative versus traditional learning approach (Lavasani & Khandan, 2011).

Social Climate and Self-Efficacy

The influences of social climate factors on students' academic and social self-efficacy are reviewed in this section. Recall, self-efficacy refers to an individual's belief in their capability to influence events so that they can achieve a desired outcome (Bandura, 1997), which can vary depending on the domain and situation (Bandura, 2012a). Academic self-efficacy refers to students' beliefs in their capability to master the academic task they that they encounter in their classrooms (Dorman, 2001). Academic self-efficacy is a measure of a student's belief in their general ability to perform and learn in academic settings (Bong, 2004; Fast et al., 2010). Social efficacy is an individual's judgment of their capabilities to "interact effectively with others in order to realize their goals" (Patrick, et al., 2002, p. 93).

A number of studies have focused on how aspects of the relationship dimension of the social climate influence academic self-efficacy. Students' perceptions of teacher caring and affective support have been found to have a positive influence on academic self-efficacy in primary classrooms (Fast, et al., 2010; Patrick, et al., 2007) and secondary mathematics classrooms (Sakiz, et al., 2012; Skaalvik, et al., 2015). For example, Sakiz, et al. (2012) found that teacher affective support had a direct influence on students' sense of belonging, which in turn influenced academic self-efficacy, in a study involving Grade 7 and 8 students in the USA. Peer relations have also been found to be influential in primary classrooms. For example, Patrick, et al. (2007) found that 5th Grade student perceptions of teacher promotion of peer-peer interaction and academic support from peers independently had a direct positive influence on academic self-efficacy. During the transition from primary to secondary school, students' academic self-efficacy can be influenced by the change in classroom context. For example, Friedel, Cortina, Turner, and Midgley (2010) found that students' academic self-efficacy declined when they perceived a lower emphasis on mastery goals in the Grade 7 mathematics classroom compared to their experience in Grade 6.

To date, six learning environments research studies have explored how both the social and cognitive dimensions of the secondary mathematics and science classrooms have influenced academic self-efficacy. The relationships between the social climate and students' academic self-efficacy from these studies are summarised in Table 2.4: two studies of science classrooms, one in Australia (Velayutham & Aldridge, 2013) and one in Turkey (Yerdelen & Sungur, 2019); two studies of mathematics classrooms, one in Australia (Dorman, 2001) and one in the USA (Hoang, 2008); and two cross-national studies of students in Grades 8/10/12 mathematics classrooms in Australia, Canada, and the United Kingdom (Dorman & Adams, 2004; Dorman, Adams, & Ferguson, 2003). Findings from these six studies indicate that students, who were clear about the learning objectives and had perseverant work habits (Task Orientation), had a stronger sense of academic self-efficacy. Students held stronger academic self-efficacy beliefs in mathematics classrooms where there was a shared perception that students knew what they were trying to learn, were attentive and had productive work habits. Academic self-efficacy was also strengthened in classes perceived as being inquiry-based (Investigation) and when students were actively involved (Involvement) in discussions about the problem-solving process. The influence of the other social climate factors (Student Cohesiveness, Teacher Support, Cooperation, and Equity) was inconsistent across contexts and cultures. For example, student cohesiveness had an effect on academic self-efficacy in a Science context but not for the four studies with a mathematics context.

Table 2.4

Relationships between Social Climate and Academic Self-Efficacy in Secondary Mathematics and Science Classrooms

Scale	Unit of Analysis	Maths (2001) Aust.	Maths (2003) Aust. Canada UK	Maths (2004) Aust. UK	Maths (2008) USA	Science (2013) Aust.	Science (2019) Turkey
Teacher Support	Person	-ve					
	Class						
Involvement	Person	+ve	+ve	+ve		+ve	+ve
	Class						
Student Cohesiveness	Person					+ve	+ve
	Class						
Investigation	Person	+ve	+ve	+ve	+ve	+ve	+ve
	Class						
Cooperation	Person		-ve	-ve	+ve		-ve
	Class						
Task Orientation	Person	+ve	+ve	+ve	+ve	+ve	+ve
	Class	+ve	+ve	+ve	+ve		
Equity	Person		+ve	+ve			+ve
	Class		+ve	+ve			

Note: Aust. indicates Australia.

With respect to social self-efficacy with the teacher, Ryan and Patrick (2001) found that teacher support and promotion of social interaction amongst peers facilitated students' confidence in interacting with the teacher. Whereas, when students perceived that teachers emphasised promotion of performance goals, they were less confident about their ability to relate well with the teacher.

In terms of social self-efficacy with peers, Patrick, et al. (2007) found that 5th Grade students' perceptions of how well the teacher promoted mutual respect, peer-peer interactions, and peer academic support, independently had a direct positive influence on students' social self-efficacy with peers. Whereas, a similar study of secondary mathematics students did not find the expected relationships between dimensions of the social learning environment (Teacher Support, Teacher Promotion of Social Interaction) and students reported social self-efficacy with peers (Ryan & Patrick, 2001). Secondary students' self-efficacy to relate well with peers may be the result of dimensions of the social learning environment other than positive actions taken by the teacher (Bandura, 1997; Ryan & Patrick, 2001). For example, classrooms which support peer-peer interactions may enable students to create positive relationships and build friendships, which can result in reduced feelings of isolation and higher levels of group cohesion (Johnson & Johnson, 2003).

In summary, across cultures and educational sectors, mathematics students' perceptions of social climate factors have been found to influence their social and academic self-efficacy (see Figure 2.2).

Classrooms with a social climate that provided clear guidance about the learning objectives (Task Orientation), opportunities to use inquiry-based learning approaches (Investigation), and encouraged student involvement (Involvement), had a positive influence on secondary students' academic self-efficacy across cultures and learning contexts (Dorman, et al., 2003; Hoang, 2008; Yerdelen & Sungur, 2019). Secondary students' perceptions of teacher and peer relationships had a direct effect on their social self-efficacy with the teacher (Ryan & Patrick, 2001). The opportunity to work with, and engage in discussions, with other students on mathematical tasks was found to improve elementary students' social competency when working with peers (Patrick, et al., 2007), but the no effect was found for secondary students (Ryan & Patrick, 2001).

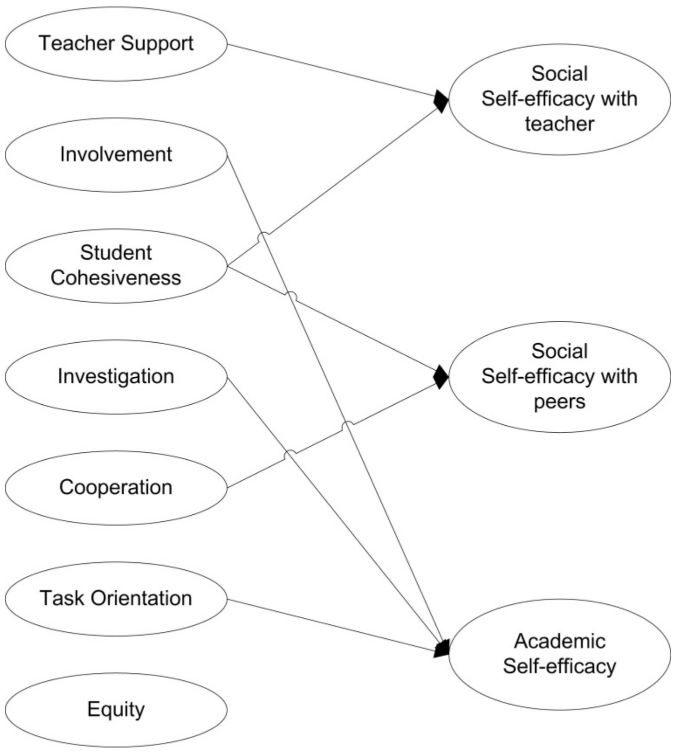

Figure 2.2 Summary model of the relationships between social climate factors and students' academic and social self-efficacy in mathematics.

Social Climate and Self-Theories of Intelligence

The social climate of mathematics classrooms also has been found to influence students' fixed and growth mindset beliefs. In general, research has shown that students' exposure to challenging environments, such as senior secondary science and mathematics, results in the adoption of an entity view of intelligence over time (Jonsson

& Beach, 2017; Lee & Seo, 2019; Shively & Ryan, 2013). Francome and Hewitt (2018) found that secondary students in mixed-attainment classrooms, which emphasised collaboration and learning from mistakes, were more likely to endorse a growth-mindset belief compared to students in ability-grouped classrooms, which were more teacher-centred and emphasised individual work. Recent research has also indicated that students' perceptions of the quality of personal relationships with peers and the teacher, positively predicted the pursuit of growth goals, which subsequently influenced students' adoption of growth-mindset beliefs (Martin, et al., 2019). Also, neuroscientists have confirmed that mathematics students experience greater stimulation and motivation, which are associated with a growth mindset, when solving questions which were modified to support more inquiry-based opportunities (Daly, Bourgaize, & Vernitski, 2019).

In summary, mathematics students' perceptions of social climate factors have been found to influence their endorsement of a growth mindset (see Figure 2.3). Students are more likely to endorse a growth mindset in classrooms where collaboration (Francome & Hewitt, 2018) and the quality of personal relationships are emphasised (Martin, et al., 2019). The opportunities to engage with challenging mathematical problems have also been shown to enhance the likelihood that students will develop a growth mindset (Daly, et al., 2019).

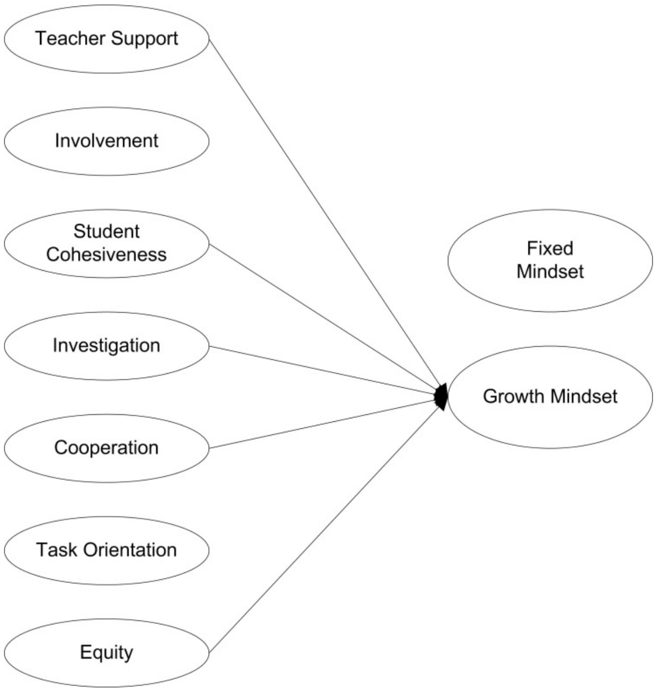

Figure 2.3 Summary model of the relationships between social climate factors and students' self-theories of intelligence in mathematics.

Help-Seeking Behaviours

In this section I review findings that have considered how self-theories of intelligence and self-efficacy influence students' help-seeking behaviours in mathematics classroom.

Self-Theories of Intelligence and Help-Seeking

Few empirical studies have explored the relationship between students' self-theories of intelligence and their help-seeking behaviours (instrumental, expedient and avoidant types) in secondary mathematics classrooms. One study explored how Taiwanese 6th Grade mathematics students' incremental and entity views of intelligence (growth and fixed mindsets) influenced their attitudes towards help avoidance and their help-seeking avoidance behaviours (Shih, 2007). Shih found that students with a growth mindset were less likely to avoid seeking help than students with a fixed mindset. In another study, Shively and Ryan (2013) explored how the self-theories of intelligence (general vs. mathematics) of College algebra students changed over a semester, and their influence on help-seeking and academic performance. Students' self-reported help-seeking was positively associated with a stronger incremental theory of intelligence but was not influenced by the domain specific self-theory of mathematics intelligence.

To date, only one study has jointly examined how the instrumental, expedient, and avoidant types of help-seeking behaviours are influenced by students' mindsets. Luo (2017) examined the relationship between self-theories of intelligence and help-seeking behaviours of secondary mathematics students in Singapore. The results are shown in Figure 2.4.

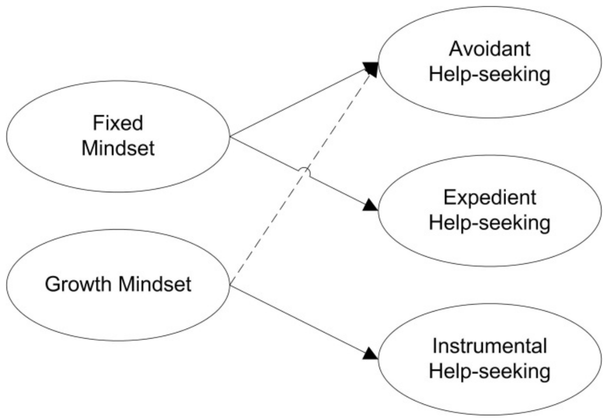

Figure 2.4 Summary model of the relationships between secondary mathematics students' self-theory of intelligence and help-seeking behaviours. Note: solid line indicates a positive path and a dashed line indicates a negative path.

Also, males and low-achieving students were more likely to endorse a fixed mindset, and report using expedient and avoidant help-seeking behaviours (Luo, 2017). Consistent with Dwecks' theoretical model, a growth mindset had a strong positive influence on instrumental help-seeking and a relatively weak negative influence on avoidant help-seeking behaviour. In contrast, a fixed mindset had a similar positive influence on students' expedient and avoidant help-seeking behaviours.

In summary, students who view intelligence as malleable, as a product of their efforts, are more likely to seek help which supports their efforts to consolidate their conceptual understanding (Luo, 2017; Shively & Ryan, 2013), and less likely to avoid seeking help (Luo, 2017; Shih, 2007). Students who view intelligence as fixed trait are more likely to avoid asking for help or seek expedient help (Luo, 2017).

Self-Efficacy and Help-Seeking

In addition to its influence on mathematics achievement, academic self-efficacy has been associated with the increased use of self-regulated learning strategies, including academic help-seeking (Nasser-Abu Alhija & Amasha, 2012; Schunk & Richardson, 2011). Academic self-efficacy with learning mathematics was positively related to adaptive help-seeking behaviours, and negatively related to avoidant help-seeking, for 6th Grade students (Ryan & Shin, 2011). A similar relationship was found between academic self-efficacy and help-seeking behaviours for post-secondary students enrolled in community college remedial mathematics courses (Meuschke, 2005). Skaalvik, et al. (2015) also found that academic self-efficacy with learning mathematics had a direct positive relationship with effort, persistence, and help-seeking behaviour of Norwegian middle school students (8-10th Grade).

Academic self-efficacy has also been associated with avoidance behaviours in mathematics classrooms. Ryan, et al. (2005) found that students who avoided seeking help during a Grade 5 mathematics class also reported lower academic efficacy than students who engaged in adaptive help-seeking behaviours. Studies investigating the relationship between academic self-efficacy and help avoidance in secondary mathematics classrooms have reported mixed results. Bong (2008) found that academic self-efficacy was the strongest mediator of the relationship between secondary students' perceptions of the home and classroom environments, and help-seeking avoidance.

Academic self-efficacy and a mastery goal-orientation were negative predictors of help-seeking avoidance. Whereas, Luo and Zhang (2015) found academic self-efficacy was a positive predictor of adaptive help-seeking but was not associated with help avoidance or expedient help-seeking behaviour of secondary mathematics students in Singapore.

Recall, help-seeking differs from other self-regulated behaviours in that it mostly involves social interactions in order to be effective; that is, students need to identify who to ask for assistance and then initiate the help-seeking process. Therefore, students who hold positive beliefs about their own social competencies (social self-efficacy) may be more likely to seek help when it is needed, and more likely to avoid seeking help if they are less confident about their competencies. Ryan, et al. (2005) found that 6th Grade students who perceived low levels of emotional support and social self-efficacy with the teacher were more likely to avoid seeking help when needed.

Few studies have jointly examined social self-efficacy and the three types of help-seeking behaviours (instrumental, expedient, and avoidant). Kiefer and Shim (2016) found that for students transitioning to middle school (6th Grade), both academic self-efficacy and social self-efficacy with peers were negatively associated with students avoiding seeking help with schoolwork from peers but did not influence instrumental or expedient help-seeking behaviours. Ng (2014) explored the relationship between social self-efficacy, with peers and the teacher, and the help-seeking goals and intentions of university Business undergraduates in Hong Kong. Both forms of social self-efficacy positively influenced instrumental help-seeking and reduced the likelihood of students' avoidance of help-seeking. In addition, social self-efficacy with the teacher had a positive influence on students' expedient help-seeking behaviour.

An overview of the results from the empirical studies reviewed in this section is presented in Figure 2.5. Only paths that have consistently been shown to have the same potential relationships between the three self-efficacy beliefs (Academic Self-Efficacy, Social Self-Efficacy with Peers, and Social Self-Efficacy with the Teacher) and the three types of help-seeking behaviour are included in the summary model.

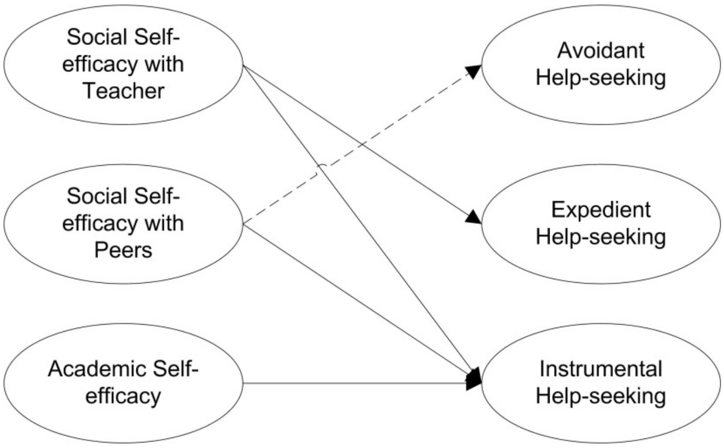

Figure 2.5 Summary model of the relationships between secondary mathematics students' self-efficacy beliefs and help-seeking behaviours. Note: Solid lines indicate a positive path and a dashed line indicates a negative path.

In summary, irrespective of learning context or culture, students who are more socially and cognitively efficacious are more likely to engage in help-seeking that is focused on the consolidation of learning (Kiefer & Shim, 2016; Luo & Zhang, 2015; Ng, 2014). The relationships between secondary students' help-seeking avoidance and their academic self-efficacy are inconsistent and may be dependent on other factors in the learning context (Bong, 2008; Luo & Zhang, 2015). Students who are comfortable communicating with their teacher are more likely to ask for help in order to improve their understanding or to enable them to complete the task quickly and progress to the next task (Ryan, et al., 2005). Students who are comfortable communicating with peers are less likely to avoid seeking help (Kiefer & Shim, 2016), and more likely to focus on seeking help that facilitates their understanding (Ng, 2014).

Social Climate, Self-Efficacy, Self-Theories of Intelligence and Help-Seeking

Few studies have examined the complex interactions between social climate and personal factors and how they play out in mathematics classrooms to promote or discourage students' help-seeking behaviours. In studies that have, teacher support is the predominant social climate variable used. Students' perceptions of teacher emotional support have been found to have an indirect effect on help-seeking, through its positive effect on intrinsic motivation and academic self-efficacy (Sakiz, 2012; Skaalvik, et al., 2015). Federici and Skaalvik (2014) found that while teacher emotional and instrumental support were strongly correlated, instrumental support was a better predictor of help-seeking, directly and indirectly via its influence on reducing math anxiety and supporting intrinsic motivation. In terms of support for autonomy, the influence of students' perceptions of teacher support (to questioning) on instrumental help-seeking was mediated by their sense of a personal relationship with the teacher (Newman & Schwager, 1993). For example, Kozanitis, Desbiens, and Chouinard (2007) found that students' perceptions of teacher reaction to questioning (both verbal and non-verbal cues) had a direct effect on academic self-efficacy, which in turn exerted a mediating effect on task value and instrumental help-seeking.

In summary, studies which have explored the complex interactions between the social climate, personal factors, and help-seeking behaviours have primarily focused on a single variable, teacher support, to represent the social climate of the classroom. In each case, the relationship between teacher support and help-seeking was entirely mediated by personal factors, including academic self-efficacy. However, as previously established, other social climate factors may also directly and indirectly, via self-efficacy and self-theories of intelligence, influence students' help-seeking behaviours.

The Current Study

The aim of this study was to explain how the social climate of the contemporary mathematics classroom interacts with personal characteristic to influence students' help-seeking behaviours. The main contribution of this study is that it considered multiple dimensions of the social climate using a well-validated contemporary parsimonious instrument (the WIHIC, Aldridge & Fraser, 2000). Significantly, the WIHIC has been used to guide teachers' efforts to improve the learning environments of their own classrooms (Aldridge, Fraser, & Ntuli, 2009; Bell & Aldridge, 2014; Fraser, 2012; Fraser & Pickett, 2010; Henderson, 2012).

In the current study I examined the interactions between seven dimensions of social climate, three self-efficacy beliefs (academic, social with peers, and social with teacher), self-theories of intelligence and three help-seeking behaviours (instrumental, expedient, and avoidant). Based on the findings to date, it was not possible build a theoretical structural equation model, which predicted all pathways. Therefore, in this study I used an exploratory structural equation model (SEM) approach to establish an empirical model by first removing non-significant paths from the mediated model that included all possible paths (Figure 2.6), and then a bootstrap approach to test the mediated model. Based on a review of the literature, it was hypothesised that students' perceptions of the social climate of the mathematics classroom would have a direct influence on help-seeking, and that their self-theories of intelligence, and academic and social self-efficacy, would provide an indirect (mediated) path between students' perceptions of the social climate and their help-seeking goals and intentions.

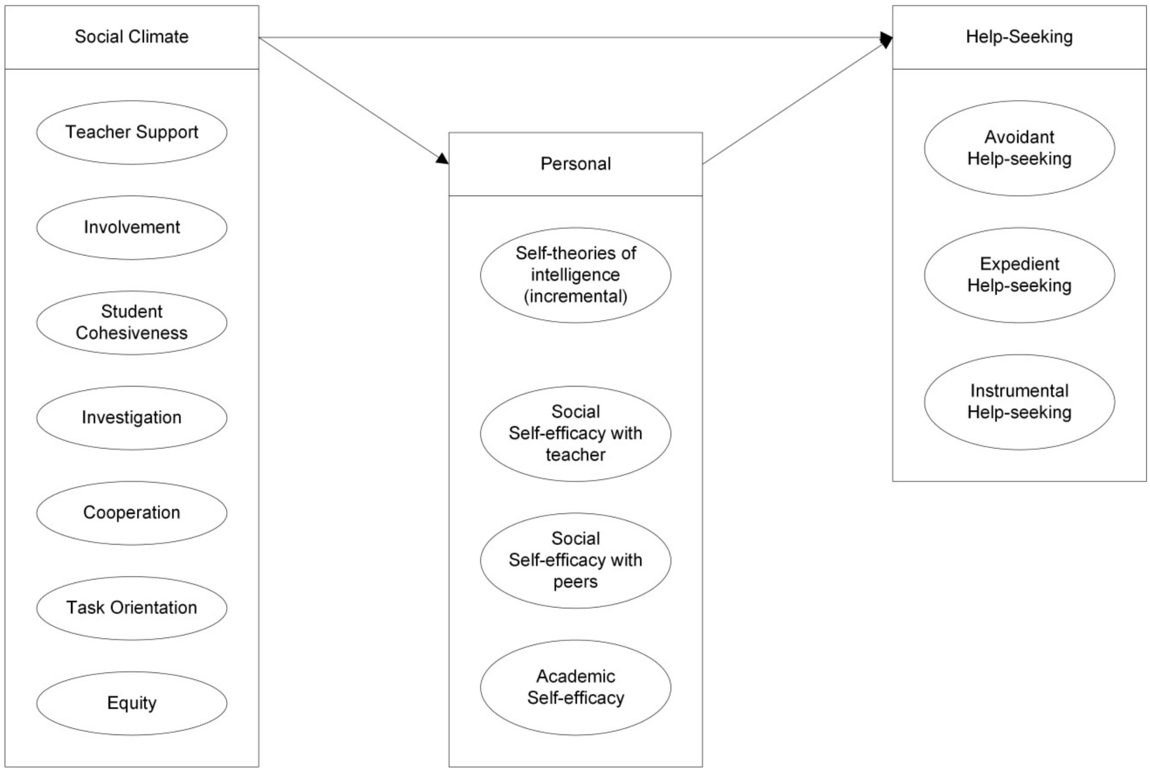

Figure 2.6 Conceptual framework of the mediated relationships between the social climates of the mathematics classrooms and students' help-seeking behaviours.

This study also contributes to the small number of studies that have used SEM to examine how the complex interactions between social climate and personal factors play out in mathematics classrooms to influence students' help-seeking behaviours. SEM was used to test if the causal relations hypothesised in the conceptual model were plausible (see Chapter 3). The causal sequencing of factors in the conceptual model is consistent with previous help-seeking studies using SEM (Arbreton, 1993; Bong, 2008; Federici, Skaalvik, & Tangen, 2015). To the best of the researcher's knowledge, this is the first study of academic help-seeking to be conducted in secondary mathematics classrooms in an Australian educational context, other than as an ancillary outcome of the study (e.g. Helme & Clarke, 2001; Ly & Malone, 2010; Sullivan et al., 2006).

Research Questions

This study will focus on the following research questions, which were derived from the conceptual framework (Figure 2.6).

1. What is the relationship between students' perceptions of the social learning environment (social climate) and their help-seeking behaviours during secondary mathematics?
2. To what extent does students' academic and social self-efficacy mediate the influence of the social climate on their help-seeking behaviours?
    a. What is the relationship between students' perceptions of the social climate and their academic and social self-efficacy?
    b. What is the relationship between students' help-seeking behaviours and their academic and social self-efficacy?
3. To what extent does students' self-theory of intelligence mediate the influence of the social climate on their help-seeking behaviours?
    a. What is the relationship between students' perceptions of the social climate and their self-theory of intelligence?
    b. What is the relationship between students' help-seeking behaviours and their self-theory of intelligence?
4. What empirical model best explains the relationship between students' perceptions of the social climate and their help-seeking behaviours?
    a. What direct and indirect relations exist in this empirical model between students' perceptions of the social climate and their help-seeking behaviours?
    b. What relative importance do different aspects of the social climate have on students' help-seeking behaviours?

CHAPTER 3: METHODOLOGY

In this chapter, I explain the methodology and the associated research design of the present study, which is presented in five parts. In the first section, I discuss the methodological approach that informed the study design. It also includes a discussion of threats to the validity of the study. In the second section, I outline the instruments used for collecting information from the participants. In the third section, I outline the sampling procedures, including a brief description of the problems encountered and how I modified the research design to meet these challenges. In the fourth section, I summarise the participants' details. In the last section, I outline the research design, including a brief description the approach taken to analyse the missing data and assessing the validity of the measurement and structural models.

Methodological Approach

The aim of the study was to investigate the relationship between students' perceptions of their role in the class and their help seeking behaviour in secondary mathematics classes (see Figure 3.1). The methodological approach used in this study was informed by four considerations. Firstly, the research questions required data analysis methods to establish relationships through correlational analyses. As noted in the introduction, this study marks the first time the selected constructs from the three research fields (psychosocial learning environments, academic help seeking, and motivational beliefs) have been brought together in the same study.

To build on and extend existing research, a cross-sectional approach was selected for this study using constructs from well-established instruments. Finally, to conduct appropriate data analyses, it was desirable to collect quantitative data from a substantial sample of respondents. Therefore, this study has adopted an ex post facto design with survey data collection methods.

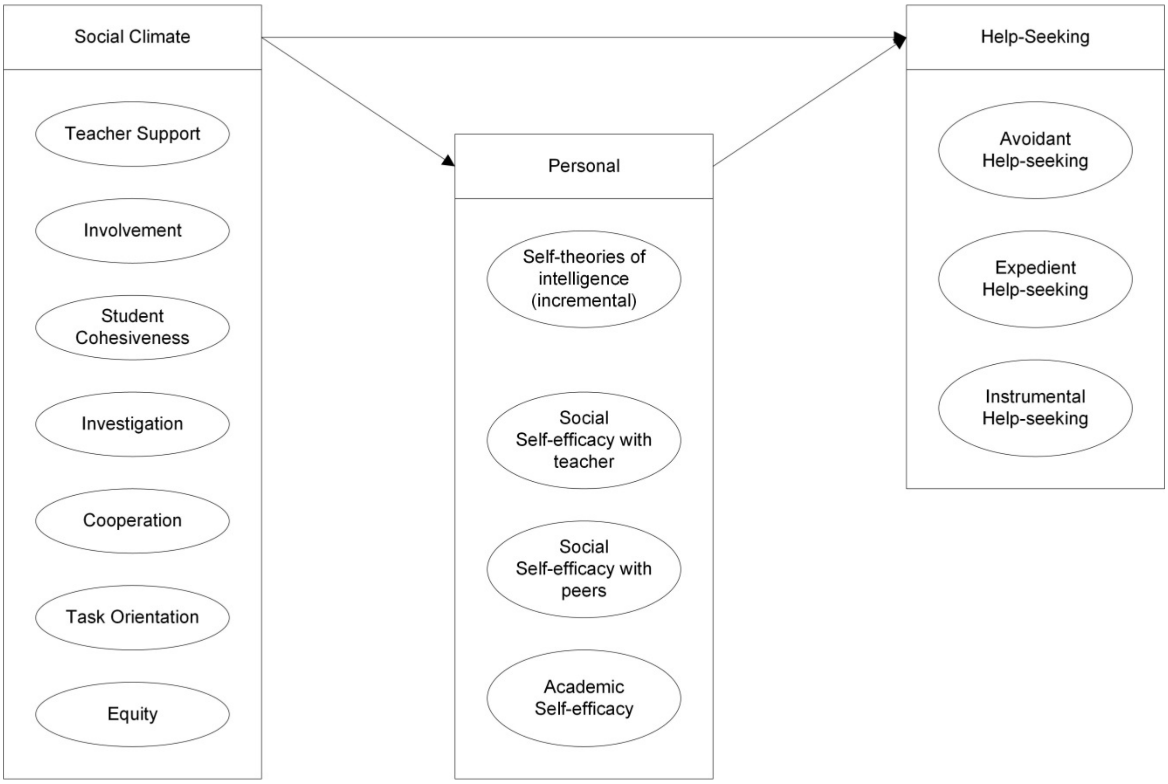

Figure 3.1 Conceptual model.

Design Threats to Validity

In this study I used a non-experimental design to explore causation - it has an ex-post facto design and uses statistical modelling procedures (Dannels, 2010). Cross sectional studies using ex post facto designs are the most common approach used in learning environments research due to the ethical constraints on deliberately manipulating the classroom learning environments in a true experimental design (Dorman, Aldridge, & Fraser, 2006). However, studies using this approach have long been recognised as one of the weaker forms of quasi-experimental designs (Campbell & Stanley, 1966). Studies in learning environments research field typically discuss threats to the design of studies in terms of internal and external validity (Walberg, 1984).

Internal Validity

Internal validity refers to the confidence that the observed effects on the dependent variables are due to the identified causal agent rather than some other variable (Dannels, 2010; Onwuegbuzie, 2000). The two main factors jeopardizing the internal validity of this study were maturation and selection bias.

Maturation refers to processes operating within participants as a function of the passage of time. Participants in this study included mostly young people attending secondary school, hence the level of development may be a factor in this study. In particular, the level of literacy and comprehension of items on the questionnaire may be an issue for younger participants. Hence, the current study used scales that had been shown to be valid and reliable when used with students in Year 7. Also, as the questionnaire took about 20 minutes to complete and contained 79 questions (see Appendix 1), exhaustion or boredom could be an issue for some students. While participants were reminded that they could exit the questionnaire at any time, this may be a particular issue for the completion of the pen and paper version. One teacher included a note with the returned questionnaires that some students appeared to be intentionally creating patterns of responses towards the end of the questionnaire. Hence, measurement error is likely to be an issue with the pen and paper version of the questionnaire.

Selection bias refers to the extent that groups differ with respect to cognitive, affective, personality, or demographic variables (Onwuegbuzie, 2000). This study was conducted with students attending secondary level mathematics classes who voluntarily participated in the study. As the study included students under the age of eighteen, the sampling procedure may have increased the normal biases associated with the use of cross-sectional surveys. The participation of individual students was constrained by the hierarchy of adult gatekeepers: the Principal, the Mathematics teachers, and the parents of students who were under eighteen and not living independently. This was a significant implementation factor and this issue will be explored in more detail in the section on sampling procedures.

External Validity

External Validity is the extent to which the conclusions can be generalized to, and across, other populations, environments, and times (Dannels, 2010; Onwuegbuzie, 2000). In particular, virtually all education studies face two threats to external validity relating to temporal, population and ecological validity (Onwuegbuzie, 2000). These threats that are commonly associated with cross-sectional designs and/or educational research during the design and data collection phases, are considered below.

Population validity refers to the extent the study findings can be generalized to the larger target population. Due to practical considerations, it was difficult to obtain a random sample of schools. The study was advertised via on online discussion board and newsletters of the Australian Association of Mathematics Teachers (AAMT) (see below for further discussion). As a result, access to the target population, secondary mathematics students, was limited by both the school administration and classroom teachers who were active members of AAMT. Therefore, the population validity of this study was threatened as the 600 participants in this sample were unlikely to be representative of the target population of Australian secondary mathematics students and further replication of the study will be required.

Ecological validity refers to what extent the findings can be generalized across settings, contexts, conditions and variables (Onwuegbuzie, 2000). Participants were included from schools representing the four educational sectors: government, catholic, independent, and adult (TAFE). However, the majority of schools were from

Melbourne. The two interstate schools represented the only regional and single gender (boys) schools included in the study. Therefore, as with most education studies, the ecological validity of this study is threatened as there are insufficient participating schools to determine to what extent the findings are independent of the settings and contexts in which the investigation took place.

Temporal validity refers to what extent the findings can be generalized across time. As this study explores the potential for integrating two parallel fields of study it was decided not to deviate from the normal methodological approaches common to both fields: multi-age cross-sectional designs using established self-report questionnaires. The timing of the distribution of the questionnaire was determined by the school and/or classroom teacher. As a result, the questionnaire was completed by participants at different times throughout the school year, but usually by all members of the same class at the same time. As the data were collected at a single point in time for each participant, this posed a potential threat to the temporal validity of the study.

Measurement Scales

In this section, I describe the measurement instruments used in this study. The questionnaire consisted of 79 items organised into four parts, determined by the type of information collected and the format of the response scales (see Appendix 1). The first part of the questionnaire was related to participant background information and contextual information of the mathematics class. The second part contained 8 items from the Theories of Intelligence Scale – Self Form for Adults (Dweck, 1999). The third part consisted of 26 items from six established instruments, which explored participants’ self-efficacy beliefs and help-seeking goals during mathematics classes. The last part contained a 35-item version of the WIHIC (Aldridge, Fraser, & Huang, 1999) relating to information about participants’ perceptions of the classroom learning environment. The following sections include information about the how each instrument was implemented during this study.

Background and Contextual Information

In the first part of the questionnaire, I collected background information about the participant, the mathematics class and the school. The name of the class and school were recorded, as part of the data screening process, to ensure that each survey could be linked to a specific class. The next three questions related to information about the number of mathematics subjects the participant was undertaking, especially relevant during the senior years, and current and previous topics being studied in this mathematics class. These questions related to contextual information about the class, which added to the information provided by the school; that is, the gender of the teacher, class size and composition, and time spent in class. The remaining five questions related to demographic information about the participant, including gender, age, birthplace, and birthplace of Mother and Father (if known).

Self-Theory of Intelligence (Mindsets)

The second part of the questionnaire contained eight items from the Theories of Intelligence Scale – Self form for adults (Dweck, 1999). In this section, the order of the likert-response scale was reversed to match the scale order, which was standard for each of the other instruments used in the study. The purpose of this rearrangement was to improve the reliability of responses by reducing the potential for students to misread one or more of the scales.

The adult form of the scale (Table 3.1) was selected, as the study was originally aimed at students in upper secondary classes (Years 10, 11, and 12) in Victorian schools. After the data collection process had commenced, some schools requested that the study be extended to include students in the junior secondary classes (Years 7, 8, and 9). While a child version of the scale (for children aged 10 and older) exists, the scale had fewer items and only two items had slightly different wording. Therefore, it was decided to continue using the existing scale for all participants.

In comparing the two versions of the scale, four items (STI01, STI02, STI06, and STI07_R) are the same, two items (STI04 and STI08_R) are only included in the Adult version, and the remaining two items have slightly simplified wording on the Child version of the scale. For item STI03_R 'significantly change your intelligence level' was changed to read 'change your intelligence a lot', and for item STI05_R 'substantially change' was changed to read 'greatly change'. The 8-item adult form has previously been used successfully by Shih (2011), with 8th Grade students, aged 12 to 15 years old, from 15 classes in three Taiwanese junior high schools (Cronbach's α = 0.77 & 0.83).

Table 3.1

Self-Theory of Intelligence item descriptions

Item	Question	Item Description
STI01	11	You have a certain amount of intelligence, and you can't really do much to change it
STI02	12	Your intelligence is something about you that you can't change very much
STI03_R	13	No matter who you are, you can significantly change your intelligence level (reversed)
STI04	14	To be honest, you can't really change how intelligent you are
STI05_R	15	You can always substantially change how intelligent you are. (reversed)
STI06	16	You can learn new things, but you can't really change your basic intelligence
STI07_R	17	No matter how much intelligence you have, you can always change it quite a bit (reversed)
STI08_R	18	You can change even your basic intelligence level considerably (reversed)

Academic and Social Self-Efficacy

The third part of the questionnaire contained items from scales measuring three types of self-efficacy: Academic Self-efficacy, Social Self-efficacy with Peers, and Social Self-efficacy with the Teacher (Dorman et al., 2003; Patrick et al., 2007). These scales all contain items phrased in terms of the student's perceived capability, what they *can do* rather than *will do,* thus adhering to the requirements for content validity (Bandura, 2006). Bandura (2012a) advised that self-efficacy scales should provide more, rather than fewer, response options so that they are sensitive to intermediate levels of performance and therefore more reliable. For this study, a 9-point response scale was used with anchors of 1 (*not at all true*), 5 (*moderately true*) and 9 (*very true*) for all self-efficacy scales.

This part also contained items from the three scales measuring different help-seeking strategies for academic self-regulated learning. These items were grouped together because they commonly use the type of Likert-type scale where responses range from 'not at all true' to 'very true'. The items from the help-seeking and self-efficacy scales were distributed randomly in this section of the questionnaire. The relative position of each item is indicated in Tables 3.2, 3.3, and 3.4. This part of the questionnaire included questions 19 to 44.

Academic Self-Efficacy

Academic self-efficacy refers to students' judgements of their capabilities to engage with the learning tasks they are given in their classroom. The instrument used in this study included the 7-item scale used by Dorman et al. (2003) (see Table 3.2) to assess academic efficacy in Year 8/10/12 Mathematics classrooms in Australia, Canada, and the United Kingdom (N = 3602, $\propto = 0.86$). The response format for the items, which was also used in this study, was a 9-point scale.

Table 3.2

Academic Self-Efficacy item descriptions

Item	Question	Item Description
		During this Mathematics class:
AES01	21	I'm certain that I can master the skills taught in maths this year.
AES02	19	I can do even the hardest work in this maths class if I try.
AES03	26	If I have enough time, I can do a good job on all my work in this maths class.
AES04	28	I can do almost all the work in this maths class if I don't give up.
AES05	31	Even if the maths is hard, I can learn it.
AES06	34	I'm certain I can figure out how to do the most difficult maths work.
AES07_R	36	No matter how hard I try, there is some maths work I'll never understand. (reversed)

Social Self-Efficacy with Peers

Social Self-Efficacy with Peers measures students' judgements of their ability to interact with peers during class. The questionnaire included the 4-item scale version (Table 3.3) developed by Patrick et al. (2007) based on the original 8-item scale developed by Patrick, Hicks, and Ryan (1997).

Table 3.3

Social Self-Efficacy with Peers item descriptions

Item	Question	Item Description
		During this Mathematics class:
SEP01	20	I find it easy to start a conversation with most students in my class.
SEP02	23	I can explain my point of view to other students in my class.
SEP03	25	I can get along with most of the students in my class.
SEP04	29	I can work well with other students in my class.

Social Self-Efficacy with the Teacher

Social Self-efficacy with the Teacher measures students' judgements of their ability to interact socially with the classroom teacher. This study used the 4-item scale version (Table 3.4) developed by Patrick et al. (1997). It was developed to be a parallel scale to the original Social Self-Efficacy with Peers measure.

Table 3.4

Social Self-Efficacy with Teacher item descriptions

Item	Question	Item Description
		During this Mathematics class:
SET01	38	I can explain my point of view to my teacher.
SET02_R	40	I find it hard to get along with my teacher. (reversed)
SET03	42	If my teacher gets annoyed with me, I can usually work it out.
SET04	44	I find it easy to just go and talk to my teacher.

Help-Seeking

The third part of the questionnaire also contained items from the three scales measuring different help-seeking strategies for academic self-regulated learning. The items from the three help-seeking scales were distributed throughout the section, alternating with items from one of the three self-efficacy scales. Also, the response format for all items was changed from the original 7-point scales, developed by Wolters et al. (2005) and Ryan and Pintrich (1997), to a 9-point scale with anchors of 1 (*not at all true*), 5 (*moderately true*), and 9 (*very true*). The response format was changed to be consistent with the self-efficacy scales, to reduce the cognitive load for the participants associated with mapping their answer onto the response alternatives (Streiner, Norman, & Cairney, 2014).

In previous studies, these scales have been modified to be a 5-point scale (e.g. Schenke et al., 2015), used in the original 7-point format (e.g. Wolters et al., 2005), or used in an 8-point format (Pajares, Cheong, & Oberman, 2004; White & Bembenutty, 2013).

Help-Seeking Avoidance

Avoiding Help-Seeking (Table 3.5) is a self-report measure assessing the avoidance of help-seeking when help-seeking is needed. The questionnaire uses the scale developed by Ryan and Pintrich (1997), as a 7-point Likert-type scale, and used by Turner et al. (2002) in a study of avoidance strategies used by sixth grade students during mathematics (N = 1092, $\propto = 0.81$). The only modification to the items was the replacement of ‘math’ with ‘maths’.

Table 3.5

Help-Seeking Avoidance item descriptions

Item	Question	Item Description
		During this Mathematics class:
HSA01	22	When I don't understand my maths work, I often guess instead of asking someone for help
HSA02	24	I don't ask questions during maths, even if I don't understand the lesson
HSA03	27	When I don't understand my maths work, I often put down any answer rather than ask for help
HSA04	30	I usually don't ask for help with my maths work, even if the work is too hard to do on my own
HSA05	32	If my maths work is too hard for me, I just don't do it rather than ask for help

Help-Seeking Expedient

Expedient Help-Seeking (Table 3.6) measures the extent to which learners are focused on seeking assistance in order to quickly find the answers to questions and to minimise effort. This questionnaire included the scale developed by Wolters et al. (2005). The only modification to the items was the replacement of 'class' with 'maths class' for all items.

Table 3.6

Help-Seeking Expedient item descriptions

Item	Question	Item Description
		During this Mathematics class:
HSE01	39	The purpose of asking somebody for help in this maths class would be to succeed without having to work as hard.
HSE02	41	If I were to ask for help in this maths class, it would be to quickly get the answers I needed.
HSE03	43	Getting help in this maths class would be a way of avoiding doing some of the work.

Help-Seeking Instrumental

Instrumental Help-Seeking (Table 3.7) measures the extent to which learners are focused on seeking assistance in order to further understanding. This questionnaire included the scale developed by Wolters et al. (2005). The only modification to the items was the replacement of ‘class’ with ‘maths class’ for all items.

Table 3.7

Help-Seeking Instrumental item descriptions

Item	Question	Item Description **During this Mathematics class:**
HSI01	33	I would get help in this maths class to learn to solve problems and find answers by myself.
HSI02	35	If I were to get help in this maths class, it would be to better understand the general ideas or principles.
HSI03	37	Getting help in this maths class would be a way for me to learn more about basic principles that I could use to solve problems or understand the material.

Social Climate

The fourth part of the questionnaire is a 35-item version of the personal form of the What Is Happening in This Class (WIHIC) developed by Fraser and colleagues in the mid-1990s (Fraser, 2012). The personal form of the WIHIC elicits the student's perception of his/her individual role within the classroom (Dorman, 2008). Its design integrates statistically significant factors from previous questionnaires and dimensions of concern in contemporary classrooms, such as equity and constructivist approaches to teaching (Fraser, 2012). The latent variables are organised according the social ecological approach for conceptualising human environments, which conceptualises all educational settings as having three underlying sets of social climate dimensions: Relationship, Personal Development, and System Maintenance and System Change (Moos, 1974, 2000).

The full version of the WIHIC consists of 56 items assigned to seven latent variables (eight items per scale); however, both a 42-item (6 items per scale) and 35-item (5 items per scale) version have been used and found to be valid with Australian secondary students (Dorman, 2003; Kelly, 2010). In the current study, a 35-item version of the instrument was used. The 35 WIHIC items were included in a separate part of the questionnaire to emphasise the change in the response format. The response format for all items in this part of the questionnaire used a 5-point scale (*almost never*, *seldom*, *sometimes*, *often*, *almost always*). There are no reversed-scored items. The items were distributed throughout this part of the survey by selecting one item from each of the seven factors in turn so that similarly worded items were not adjacent.

Relationship Dimensions

The relationship dimensions focus on measures of the nature and intensity of personal relationships as assessed using three scales: Student Cohesiveness, Teacher Support, and Involvement (Fraser, 2012).

The Student Cohesiveness scale (Table 3.8) measures the extent to which students know, help and are supportive of one another. I selected items to maintain these aspects of student-student social interactions. In particular, the first four items are related to the degree that students establish friendly relations with each other, item CSC03 was retained as it focused more on the general relationship aspect rather than 'making' friends. Schmuck (1966) found that classrooms with a nearly equal distribution of friendship were more cohesive.

Table 3.8

Student Cohesiveness item descriptions

Item	Question	Item Description **In this Mathematics class:**
CSC01	Omitted	I make friendships among students in this class.
CSC02	Omitted	I know other students in this class.
CSC03	51	I am friendly to members of this class.
CSC04	Omitted	Members of the class are my friends.
CSC05	58	I work well with other class members.
CSC06	65	I help other class members who are having trouble with their work.
CSC07	72	Students in this maths class like me.
CSC08	78	In this maths class, I get help from other students.

The Teacher Support scale (Table 3.9) measures the extent to which the teacher helps, befriends, trusts and is interested in students. Items were selected to maintain these aspects of teacher-student social interactions. In particular, items CTS02, CTS04 and CTS08 were retained due to their emphasis on the social and cognitive aspects of help giving.

Table 3.9

Teacher Support item descriptions

Item	Question	Item Description
		In this Mathematics class:
CTS01	50	The teacher takes a personal interest in me
CTS02	57	The teacher goes out of his/her way to help me
CTS03	Omitted	The teacher considers my feelings
CTS04	63	The teacher helps me when I have trouble with the work
CTS05	Omitted	The teacher talks with me
CTS06	Omitted	The teacher is interested in my problems
CTS07	71	The teacher moves about the class to talk with me
CTS08	79	The teacher's questions help me to understand

The Involvement scale (Table 3.10) measures the extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class. Items were selected which canvas various cognitive and affective aspects of mathematics as a social practice.

Table 3.10

Involvement item descriptions

Item	Question	Item Description **In this Mathematics class:**
CIT01	Omitted	I discuss ideas in class
CIT02	48	I give my opinions during class discussions
CIT03	56	The teacher asks me questions
CIT04	Omitted	My ideas and suggestions are used during classroom discussions
CIT05	Omitted	I ask the teacher questions
CIT06	59	I explain my ideas to other students
CIT07	70	Students discuss with me how to go about solving problems
CIT08	73	I am asked to explain how I solve problems

Personal Development Dimensions

The personal development dimensions, which assess the basic directions along which personal growth and self-enhancement tend to occur, were assessed by three scales: Investigation, Task Orientation, and Cooperation (Fraser, 2012).

The Investigation scale (Table 3.11) measures the extent to which skills and processes of inquiry and their use in problem solving and investigation are emphasised. In particular, items CIN03, CIN05 and CIN06 were omitted in favour of the more general version of these statements.

Table 3.11

Investigation item descriptions

Item	Question	Item Description **In this Mathematics class:**
CIN01	46	I carry out investigations to test my ideas
CIN02	52	I am asked to think about the evidence for statements
CIN03	Omitted	I carry out investigations to answer questions coming from discussions
CIN04	60	I explain the meaning of statements, diagrams and graphs
CIN05	Omitted	I carry out investigations to answer questions which puzzle me
CIN06	Omitted	I carry out investigations to answer the teacher's questions
CIN07	66	I find out answers to questions by doing investigations
CIN08	76	I solve problems by using information obtained from my own investigations

The Task Orientation scale (Table 3.12) measures the extent to which it is important to complete planned activities and to stay on the subject matter. Items that clearly described process goals and outcomes were retained. For example, g*etting a certain amount of work done* (CTO01) is a more clearly defined goal related to students' work habits that *I do as much as I set out to do* (CTO02).

Table 3.12

Task Orientation item descriptions

Item	Question	Item Description **In this Mathematics class:**
CTO01	45	Getting a certain amount of work done is important to me
CTO02	omitted	I do as much as I set out to do
CTO03	omitted	I know the goals for this class
CTO04	53	I am ready to start this class on time
CTO05	62	I know what I am trying to accomplish in this maths class
CTO06	68	I pay attention during this class
CTO07	77	I try to understand the work in this maths class
CTO08	Omitted	I know how much work I have to do

The Cooperation scale (Table 3.13) measures the extent to which students cooperate rather than compete with one another on learning tasks. In particular, items CCO04, CCO06 and CCO08 were omitted in favour of the more specific version of these statements. For example, CCO03 more clearly captures the extent to which students engage in group work during mathematics than working with *other students on projects* (CCO04). Also, items were selected which identify aspects of the contemporary and traditional classroom, which would support the conceptualisation of mathematics as a social practice. In particular, items CCO02 and CCO05 were retained due to their emphasis on the reciprocal nature of help-giving and help-seeking (Nadler, 2015).

Table 3.13

Cooperation item descriptions

Item	Question	Item Description **In this Mathematics class:**
CCO01	47	I cooperate with other students when doing assignment work
CCO02	55	I share my books and resources with other students when doing assignments
CCO03	64	When I work in groups in this maths class, there is teamwork
CCO04	Omitted	I work with other students on projects in this class
CCO05	67	I learn from other students in this maths class
CCO06	Omitted	I work with other students in this class
CCO07	74	I cooperate with other students on class activities
CCO08	Omitted	Students work with me to achieve class goals

System Maintenance and System Change Dimensions

The systems maintenance and system change dimensions measure the extent to which the environment is orderly, clear in expectations, maintains control and is responsive to change. The Equity scale (Table 3.14) measures the extent to which students are treated equally by the teacher. In particular, items CEQ01 and CEQ02 were retained due to their emphasis on the reciprocal nature of help-giving and help-seeking (Nadler, 2015).

Table 3.14

Equity item descriptions

Item	Question	Item Description **In this Mathematics class:**
CEQ01	49	The teacher gives as much attention to my questions as to other students' questions
CEQ02	54	I get the same amount of help from the teacher as do other students
CEQ03	61	I have the same amount of say in this maths class as other students
CEQ04	Omitted	I am treated the same as other students in this class
CEQ05	69	I receive the same encouragement from the teacher as other students do
CEQ06	75	I get the same opportunity to contribute to class discussions as other students
CEQ07	Omitted	My work receives as much praise as other students' work
CEQ08	Omitted	I get the same opportunity to answer questions as other students

Sampling Procedures

Due to ethical considerations, this study required the consent of the school principal prior to contacting students. As an intermediary step, in order to reduce their workload, schools were able to select specific classes for inclusion in the study. In this section, I summarise the recruitment process and describe the schools and classes that agreed to be included in the study, including a discussion of some of the factors that could potentially influence the validity and reliability of the study, and how these were addressed. I then describe the characteristics of the participating students.

Sampling Schools

This study involved two rounds of data collection. In the 2014 cohort, only Victorian schools were invited to participate in the study. In Australia, education and curriculum development was (at the time) a state responsibility. As the Australian Curriculum was still being developed, it was decided to initially restrict data collection to one state, Victoria. While a diversity of Victorian schools expressed interest in participating in the study, student participation was much lower than expected. During 2014, several teachers in other states had also expressed interest in participating in the study. Therefore, a second round of data were collected during 2015 and secondary schools from all Australian states and territories were invited to participate.

During each year, a variety of sampling methods were used (see Tables 3.15 and 3.16). Random sampling approaches were used during 2014 to select the Victorian schools for inclusion in the study. It quickly became clear that this approach would not yield a sufficiently large sample. In response to this concern, I used both volunteer and convenience sampling approaches to maximise access to interested schools. This was the main approach used during the second round of data collection in 2015.

The Victorian Sample

At the start of the study, the goal was to collect data that represented the diversity of students and school learning environments in Victoria. Participation in the study was open to all government, catholic, adult and independent schools. In December 2013, 50 schools (32 state, 13 independent, 3 catholic, and 2 adult schools) were randomly selected from the VCAA list (http://schlprv.vcaa.vic.edu.au/schoolsstudiessearch/default.asp) of schools offering

General Mathematics and contacted via an email addressed to the principal. Two independent schools, two metropolitan TAFEs, and one state secondary school accepted the invitation to participate. Four schools declined to participate, two independent schools and two state secondary schools, and there was no response from the remaining 41 schools.

Given the low response rate, a second round of invitations was sent to schools just prior to the start of the 2014 school year. A purposive sampling approach was adopted to maximise the benefits of any school that opted into the study. Schools were sorted by size and 70 new schools were then randomly sampled from those with more than 250 students from a diversity of locations. This resulted in another two state secondary schools and one catholic secondary college accepting the invitation, with five state schools declining to participate. After discussions with colleagues still working in schools, I decided to advertise the study directly to mathematics teachers. Other recent large-scale Australian studies (for example McPhan et al., 2008) have also noted the need to identify key teacher advocates within the school before approaching the principal for permission.

During semester one, mathematics teachers were alerted to the study. Initially an invitation to participate was placed on the discussion list of the Australian Association of Mathematics Teachers (AAMT) (see Appendix 2). Two schools expressed interest – one state secondary school and one catholic secondary school. Towards the end of semester one, a brief outline of the study was also included in an online newsletter sent to all members of the Mathematics Association of Victoria (see Appendix 3). This resulted in teachers from three secondary schools and three primary schools requesting further information about the study.

Table 3.15

Summary of schools opting in during 2014

School	Sampling method	Permission	Classes & Year level	Consent	Survey	Comments
IS01	Convenience	Nov 2013	2 Yr 9 & 10	Not distributed	Not distributed	Pilot study site.
TI02	Email Invitation	17 Dec 2013	9 Numeracy	87	86	Semester 2 CGEA & VCAL
TI03	Convenience	16 Dec 2013	12 Yr 11-12	61 (8 classes)	47	Semester 1 – items missing from Survey Instrument
SS04	Email Invitation	22 Feb 2014	10 Yr 10	93	8	Semester 2 Year 10 only
SS05	Email Invitation	25 Feb 2014	Unknown VCAL	Not distributed	Not distributed	Query regarding need to send consent forms.
SS06	Email Invitation	5 Feb 2014	9 Yr 11-12	45 (4 classes)	25	Semester 1- items missing from Survey Instrument

Table 3.15 continued

School	Sampling method	Permission	Classes & Year level	Consent	Survey	Comments
CS07	Email Invitation	14 Feb 2014	14 Yr 9-12	64 (10 classes)	34	Semester 2
CS08	Volunteer (AAMT)	26 Feb 2014	No details provided	No details provided	No details provided	Did not proceed to data collection
IS09	Email Invitation	7 Mar 2014	Unknown Yr 9-12	Not distributed	Not distributed	Objections related to items referring to the Teacher.
SS10	Volunteer (AAMT)	5 Mar 2014	No details provided	No details provided	No details provided	Did not proceed to data collection
SS11	Volunteer (MAV)	21 Aug 2014	2 Yr 9	14	0	Consent forms from 14 students in 2 Year 9 classes

During 2014, a total of 11 schools (see Table 3.15) expressed interest in participating in the study: two independent schools, two multi-campus TAFEs; two catholic schools from the Melbourne archdiocese; and five state secondary schools (four metropolitan and one regional). The most common reason for schools opting out during the data collection phase appeared to be related to increasing workloads associated with the day-to-day running of the school. Of particular concern was the amount of effort and time needed to distribute and collect the parental consent forms. In particular, several schools noted that surveys were common practice in schools and that parents had already provided consent at the start of the school year. For example, one school chose not to continue participating in the study as they believed that approaching parents a second time for consent would be both confusing for the parents and a waste of time for school staff.

The National Sample

At the end of the 2014 data collection period, it was determined that there were still too few participating students and schools to proceed with the analysis. After careful consideration of the alternatives, it was decided to allow expressions of interest from any Australian school offering secondary mathematics. The study was readvertised on the AAMT discussion list during November 2014 for schools interested in participating during Semester 1, 2015 (see Appendix 4). The advertisement was modified to highlight the connection and relevance of the study in the light of topics currently of interest to Mathematics teachers on the list, such as the relevance of Dweck’s (1999) work on Self-Theories of Intelligence. The advertisement generated expressions of interest from schools in Queensland (2), New South Wales (2), Western Australia (1), and Tasmania (1) (see Table 3.16).

Table 3.16

Summary of schools opting in during 2015

School & State	Sampling method	Permission	Classes & Year level	Surveys returned	Comments
IS01 Victoria	Convenience (from 2014)	12 Feb 2015	No details provided	Nil	No response from Math Coordinator.
TI02 Victoria	Volunteer (from 2014)	17 Dec 2014	No details provided	Nil	No response from VCAL coordinator
TI03 Victoria	Convenience	1 Dec 2014	6 Yr 11-12	71	Semester 1 Hardcopy version
CS08 Victoria	Convenience (from 2014)	5 May 2015	Unknown Year 10	Nil	Did not proceed to data collection.
SS12 New South Wales	Convenience	25 Dec 2014	4-6 Yr 7-12	Nil	No Surveys returned.
CS13 Victoria	Convenience (from 2014)	18 Dec 2014	8 Yr 7-12	41	Semester 1 Online version
IS14 New South Wales	Volunteer (AAMT)	17 Feb 2015	2 Yr 9-10	Nil	No surveys returned.

Table 3.16 continued

School & State	Sampling method	Permission	Classes & Year level	Surveys returned	Comments
IS15 Western Australia	Volunteer (AAMT)	16 Feb 2015	16 Yr 7-12	223	Semester 1 Online version
SS16 Victoria	Convenience	23 Mar 2015	1 Yr 9	19	Semester 1 Online version
SS17 Victoria	Volunteer (AAMT)	20 Feb 2015	8 Yr 9-12	30	Semester 2 Hardcopy Survey
SS18 Queensland	Volunteer (AAMT)	23 Dec 2014	No details provided	Nil	Did not proceed to data collection
IS19 Queensland	Volunteer (AAMT)	17 Dec 2014	No details provided	Nil	Did not proceed to data collection
IS20 Tasmania	Volunteer (AAMT)	Feb 2015	1 Yr 11/12	14	Online Survey Yr 11/12 composite class

I also contacted schools who had previously expressed interest but were unable to proceed. One State and two Catholic schools accepted the invitation. In total 13 schools from five states expressed interest in the study in 2015: four independent schools, five state schools, two catholic schools, and two TAFE institutes.

Participating Schools

A total of 25 schools expressed interest in participating in the study. Students at 10 schools, in 54 classes, completed and returned the survey. A total of 609 surveys were received (representing a completion rate of 56%), including 432 from male respondents and 162 from female respondents, 403 using the online survey link and 206 using the hardcopy format. Each survey is referred to as a case.

Nine cases were removed from the dataset. Three cases were removed as the participant had select ‘no’ for the question *Are you a voluntary participant in this study?* on the online version of the survey (Appendix 5). Six participants did not complete parts 1 or 2, the Background Information or Your Beliefs about Intelligence items, and these cases were deleted as they did not provide sufficient information for their responses to be useful during analysis. Therefore, a total of 600 cases were retained for further analysis.

In Table 3.17, a summary of the number of participating classes and surveys returned is provided. The classes listed include all four levels of mathematics classes at Year 11 or 12 in Victorian schools. In Victoria, many schools offer both the Victorian Certificate of Education (VCE) and the Victorian Certificate of Applied Learning (VCAL).

Table 3.17

Summary of participating schools and classes

School ID	Description	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Total cases
01	Victoria, State SC					2 (11)	1 (14)	25
02	Victoria, Catholic SC			2 (18)	5 (15)	1 (1)		34
03	Victoria, State SC				2 (9)			9
04	Victoria, TAFE Institute, 3 campuses					1 (6) 2 (17) 2 (25)	1 (8) 6 (53) 1 (10)	119
05	Victoria, TAFE Institute, 2 campuses			3 (37)		6 (49)		86
06	Regional Tasmania, Independent					1 (14)		14
07	Western Australia, Independent	2 (47)	1 (21)	3 (60)	1 (27)	2 (37)	2 (31)	223
08	Victoria, State SC			1 (19)				19
09	Victoria, Catholic SC	1 (24)	1 (17)					41
10	Victoria, State SC						4 (30)	30
	Total No. of Participants	71	38	134	51	160	146	600
	Total No. of Classes	3	2	9	8	17	15	54

In the VCE, mathematics is an optional subject, however, all VCAL students are required to do at least one numeracy module. Many TAFEs also offer the Certificates in General Education for Adults (CGEA) for students without a Year 10 pass. The CGEA numeracy subjects are also compulsory and are deemed to be equivalent to a Year 9 or Year 10 level course (Department of Education and Early Childhood Development [DEECD], 2013a; Victorian Curriculum and Assessment Authority [VCAA], 2013).

The participation of individual classes was at the discretion of the school principal, mathematics coordinator and individual teachers. Prior to distributing the surveys, each school was asked to provide some background information about each class selected to participate in the study (see Appendix 6). This information included the ID and gender for each teacher, which was matched to each Class ID. Many teachers teach more than one mathematics class in a school. In this sample, there were about an equal number of male (28) and female (26) teachers. Twenty-five teachers had one class participate in the study, 9 males and 16 females. Twenty-nine classes were taught by twelve teachers as each had two (4 males, 5 females), three (1 male), or four (2 males) of their classes participate.

Background information (Table 3.18) was also collected for each participating school from the MySchool School profile page for 2014 (http://www.myschool.edu.au). The majority of schools were from a diverse range of Melbourne suburbs. This has been illustrated by summarising information on the proportion of students with a language background other than English (LBOTE) for parents or student, and the socio-educational composition of the school. The distribution of student 'Socio-Educational Advantage' (SEA) in the school, based on student-level factors, represents the proportion of students in the school likely to experience relative disadvantage or advantage respectively (Australian Curriculum Assessment and Reporting Authority

[ACARA], 2015d). All of the participating schools had fewer than 3% of their students who identified themselves as an Aboriginal and/or Torres Strait Islander.

Table 3.18

Contextual information for participating schools

School ID	State	Location	Sector	Type	Size	LBOTE	Student SEA Q1 – Q4
01	Vic.	Western Suburbs	State	7-12	1400	45%	26% - 18%
02	Vic.	Mornington Peninsula	Catholic	7-12	950	8%	16% - 14%
03	Vic.	Northern Suburbs	State	7-12	1550	26%	8% - 35%
04	Vic.	South Eastern Suburbs	Adult	TAFE	Large Multi Campus	Not known	Not known
05	Vic.	South Eastern Suburbs	Adult	TAFE	Large Multi Campus	Not known	Not known
06	Tas.	Regional	Indep.	P-12	1000	4%	3% - 58%
07	WA	Metropolitan	Indep.	PP-12	1400	18%	1% - 71%
08	Vic.	Eastern	State	7-12	2000	84%	9% - 48%
09	Vic.	North East	Catholic	7-12	1300	30%	9% - 31%
10	Vic.	South Eastern	State	7-12	1020	17%	13% - 27%

Note: Tas. – Tasmania, Vic. – Victoria, WA – Western Australia, Indep. - Independent school

Information was unavailable for the two TAFEs as they were not included in the MySchool website. Both TAFEs offer a full range of courses from general education through to bachelor degrees. Each of the campuses is located in geographically and socio-economically diverse suburbs close to major transport hubs. The location for these TAFEs is listed as South Eastern in order to reduce the potential for their identification; each campus is located in suburbs east of the Melbourne CBD.

Distributing the Questionnaire

The following procedure was designed to take into account the limitations imposed by the human ethics requirements of the different school sectors (Appendices 7, 8, 9, 10, & 11). In all sectors, the principal had the final say on whether the school would participate in the study. Hence, the research design anticipated and addressed the likely concerns of principals from a wide variety of school 'types'. For instance, the DEECD (2013b) advised that the most successful applications are those that have straightforward procedures and minimum time demands, however, all studies were restricted to an opt in approach. Once approval had been obtained from the principal, a plain language statement explaining the study (Appendix 12) was given to secondary students enrolled in selected Mathematics classes. This allowed young people to make the decision about whether to participate in the study. Most students required consent from parents/caregivers to participate. Participants aged 18 and over, mostly from one of the two TAFEs, provided their own informed consent (Appendix 13).

Data collection was approached differently by each participating school so as to minimise the impact on the teaching and learning program. Thus, a clear and well documented process was needed to it could be implemented by the teachers and school administration. Teachers were provided with a script to read to participating students prior to commencing the survey (see Appendix 14). The questionnaire was initially distributed to students using an on-line survey platform (Qualtrics) preferred by the Monash University Faculty of Education (Appendix 5). The benefits of using online questionnaires include, minimizing the workload and costs for schools, increasing the potential for non-metropolitan schools to participate, eliminating transcription errors associated with printed surveys, and reducing instances of accidental missing data (Buchanan & Hvizdak, 2009).

During Round 1, students were provided with a unique link to the online survey after parental consent was forwarded to the researcher. Each survey link was associated with a specific student, in a specific class within the school. This approach reduced concerns about privacy, confidentiality, and the integrity of the data, as the questionnaire did not identify the student. Ultimately, this approach was deemed too time-consuming for some schools. A more streamlined approach was developed for use during the second round of data collection whereby a single web address could be used to access the survey. This anonymous survey link was enhanced by using the Quatrics Authenticator tool (Snow, Mann, & Page, 2012), to allow participants to access the questionnaire using a login screen (Appendix 5). Each participating class was identified by a code, supplied by the school, and a list of generic participant IDs and passwords was created for the maximum number of students in each class. This allowed the school staff supervising the distribution of the survey to allocate a generic ID to each student upon receipt of the parental consent form (see Appendix 14, page 2).

Schools also had hardware issues related to school access to the internet. Some schools reported that their internet connection was too slow or that there were insufficient computers to enable all participants in a class to access to the internet at the same time. Consequently, a number of schools and individual classes elected to use a pen and paper version of the questionnaire (see Appendix 1). Participants were asked to provide extra information in order to clearly identify the appropriate class. During the second round, participants could use the Generic ID rather that their name (which was optional) to enable their responses to be linked to a consent form. On receipt of the pen and paper versions of the survey, I used the Qualtrics questionnaire to enter the participant's responses. All data was crosschecked and verified at the time of entry, and again during the data-cleaning phase prior to analysis.

Description of Participants

In the following section, I provide an overview of the characteristics for students who were voluntary participants in this study using the information collected in Section 1 of the survey. The first part of the questionnaire contained ten questions relating to demographic and contextual information. The first two questions, name of school and mathematics class, were included for validation purposes only and are not included in this section.

Participant's Exposure to Mathematics

To gauge students' interest in, or exposure to, Mathematics, question 3 asked participating students "*How many Mathematics subjects are you attending this year?"*. Table 3.19 summarises the number of cases where participants indicated that they were enrolled in more than one mathematics class for the year. The information provided should be interpreted with caution as Years 9-12 included students enrolled in either Numeracy or Mathematics subjects. Some numeracy students, such as those doing the CGEA or VCAL at TAFE, enrol in a series of elective modules that are of shorter duration than traditional mathematics classes. For example, all the Year 9 students doing more than one subject were enrolled in the CGEA and eight of the Year 11 students doing two subjects were enrolled in VCAL. However, this question was meant to capture information about the proportion of students who were enrolled in multiple mathematics subjects at the same time, not sequentially.

Table 3.19

Number of mathematics subjects by Year level (Grade)

# Subjects	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Total
Blank					3	1	4
1	71	38	120	41	124	101	495
2			13	9	33	37	92
3			1	1	0	7	9
Total	71	38	134	51	160	146	600

Area of Study

Question 4 and 5 asked participants to describe the current and previous topic studied in their mathematics class, and the area of study. As the survey was distributed to students at different times, in different states, throughout the year, as diverse range of topics were covered. These topics covered the three content strands of the Australian mathematics curriculum for Foundation to Year 10 (Australian Curriculum Assessment and Reporting Authority [ACARA], 2015b): Measurement and Geometry, Number and Algebra, and Probability and Statistics. The topics studied in the senior secondary certificates for Year 11 and 12 in Tasmanian, Victorian, and West Australia were also grouped according to these strands, with the addition of a Calculus strand to cover advanced mathematics topics not studied prior to Year 11. In summary, of the 47 classes surveyed, 15 were currently studying a topic from the Measurement and Geometry strand (e.g., trigonometry), 20 from the Number and Algebra strategy (e.g., fractions and quadratics), and 7 from the Probability and Statistics strand. For senior secondary classes, 5 classes were studying Calculus topics: calculus, kinematics, vectors, and anti-differentiation. There was a similar distribution for the previous topic covered: 18 from Measurement and Geometry, 17 from Number and Algebra, 5 from Probability and Statistics, and 5 from Calculus.

Participant Gender

Question 6 asked participants to indicate their gender. Nine participants chose not to answer this question, 432 identified as Male, and 168 identified as being Female. One reason for the high number of males was the inclusion of a single sex school in the study (223 participants). Excluding the single sex school would reduce the number of cases to 377 with 209 males and 168 females.

Participant Age

Question 7 asked participants for their age (see Table 3.20); however, this variable will be excluded from further analysis as 205 (34%) of the participants were from the two TAFEs. This level of participation was unexpected. The first version of the survey, used in 2014, was designed based on the assumption that most participants would be school aged and only one option for participants over 19 was provided. On the second version of the survey, used in 2015, participants were able to provide their actual age, eight participants ranged in age from 20 to 41. A total of 68 participants listed their age as over 19.

Table 3.20

Distribution of cases by age

Age	11	12	13	14	15	16	17	18	19	>19
Number	8	64	44	89	71	120	85	33	17	68

Participant and Parent's Birthplace

Questions 8 to 10 asked participants in which country they were born and the birthplaces of their parents. The participant qualitative responses were recoded using the Standard Australian Classification of Countries (Australian Bureau of Statistics [ABS], 2015, Table 1.2).

Participants were classified as an Australian, whose first language is most likely English, when the student had at least one parent that was born in Australia. Students born in Australia with both parents born overseas or unknown were classified as First Generation Australian. These participants were possibly multilingual, or at the very least, had multicultural backgrounds. Participants were classified as coming from overseas if they were not born in Australia, irrespective of the birthplace of the parents. Any participant whose birthplace, or parent's birthplace, was not stated or was not identifiable was classified as unknown. Table 3.21 summarises the distribution of the participant's birthplace for each school sector.

Table 3.21

Distribution of cases by participant birthplace

	State		Catholic		Independent		Adult		
Birthplace	M	F	M	F	M	F	M	F	Total
Australia	19	24	26	29	144	5	70	36	353
First Gen.	5	8	10	8	38	0	26	9	104
Overseas	11	16	1	1	49	1	30	30	139
Unknown	0	0	0	0	0	0	3	1	4
Total	35	48	37	38	231	6	129	76	600

In total, 457 of the 600 participants were born in Australia. The remaining participants were born in 41 different countries representing each of the regions worldwide (see Table 3.22). Countries with more than five participants included China (25), United Kingdom (17), New Zealand (10), Afghanistan (10), South Africa (9), and Sudan (8). One participant couldn't be allocated to a region as their birthplace was identified as Africa, their mother was born in England and their father in Ireland.

Table 3.22

Regions where participants and parents were born

	Student		Mother	Father
Region	Male	Female		
Oceania and Antarctica (inc. Australia & NZ)	346	121	325	316
North-West Europe (inc UK)	17	2	53	64
Southern and Eastern Europe	7	2	21	25
North Africa and The Middle East	5	10	18	17
South-East Asia (inc Indonesia)	8	7	38	31
North-East Asia (inc China & Japan)	14	13	33	31
Southern and Central Asia (inc India)	13	6	32	28
Americas (inc USA, Mexico, and Brazil)	11	0	11	9
Sub-Saharan Africa (inc South Africa)	7	6	20	24
Unknown	4	1	49	55
Total	432	168	600	600

For the parents whose birthplace was known, nearly half of both the mothers (246) and fathers (242) were born overseas. The participant's parents were born in a total of 65 different countries. Mothers were from 53 countries while the fathers were from 52 countries. The main birthplaces for mothers were the United Kingdom (46), China (31), New Zealand (14), Afghanistan (12), Malaysia (12), South Africa (12), India (10), and The Philippines (8). The main birthplaces for the fathers were the United

Kingdom (57), China (28), Afghanistan (12), Greece (12), Malaysia (11), South Africa (11), and New Zealand (8). Hence, the sample is a good representation of the multicultural diversity of the contemporary Australian Mathematics classroom.

Research Design

The design of this study is viewed as exploratory in that the research was aimed at testing if secondary students' help seeking behaviours were related to their perceptions of the social climate of the their mathematics classroom, mediated by academic self-efficacy, social self-efficacy with peers and the teacher, and their self-theories of intelligence. The current study utilized SEM, via the Mplus 7 program, which is the method of choice for assessing hypothesized structural relations in educational contexts, particularly those that involve mediation (In'nami & Koizumi, 2013). Structural equation modelling (SEM) encompasses a collection of statistical techniques, developed since the 1990s, which are used for confirming (or disconfirming) complex models in a quantitative fashion (Schumacker & Lomax, 2004). It is an analytical process used to test the fit between correlational data and one or more theoretical models (Mueller & Hancock, 2010).

A conventional two-phase modelling process was used to facilitate the diagnosis and remediation of data-model misfit in the latent variable path model (Mueller & Hancock, 2010). In phase one, confirmatory factor analysis (CFA) was used to test the construct validity of the each of the scales in the measurement instrument for the current sample, sometimes referred to as factorial validity (Brown, 2006; Wang & Wang, 2012). Each of the scales in this study had a strong theoretical foundation, which had been validated in prior studies. The analytical approach included assessing model fit, factor loadings, modification indices, and item reliabilities.

In the structural phase, SEM was used to establish if a direct relationship existed between help-seeking behaviour and the social climate factors in the final measurement model, and the potential for indirect paths via academic self-efficacy, social self-efficacy with peers and self-theory of intelligence was investigated. The current study was designed with the intention that the primary unit of analysis would be the class and the data would be analysed using multilevel modelling. In this study, multilevel data was collected. The hierarchical nature of these data is acknowledged where students are grouped in classes within schools (Fraser, 2012; Marsh et al., 2012). As multilevel analysis preserves the nested nature of data collected from individuals in classes, it is the preferred approach for school and classroom environment studies (Dorman, 2009, 2012; Morin, Marsh, Nagengast, & Scalas, 2013). An advantage of multilevel modelling is its capability to handle interpretation and statistical errors (Preacher, 2011; Tabachnick & Fidell, 2013). A preliminary analysis of the item-level intraclass correlations (ICC) was undertaken and it was determined that the clustered effect of the sample needed to be taken into account (see below for further discussion). However, subsequent attempts to conduct a multilevel modelling CFA analysis of the data, using Mplus 7 with TYPE = COMPLEX, consistently returned warning messages concerning inadmissible solutions. This was most likely due to the small number of classes (clusters) in the sample (Hox & Maas, 2001). Therefore, further analysis of the conceptual structural model used the individual as the unit of analysis.

The hypothesised structural model derived from the review of the literature is both exploratory and confirmatory. Therefore, an exploratory single-level SEM approach was used to establish an empirical model that best explains the relationship between students' perceptions of the social learning environment and their help-seeking strategies. First, SEM was used to establish if a direct relationship existed between the three help-seeking factors and the four learning environment factors in the measurement model. Then the potential for indirect paths via academic self-efficacy, social self-efficacy with peers and self-theory of intelligence were investigated. A fully mediated structural model was then constructed, which incorporated the significant paths from each of these constructs and confidence intervals were generated for the path estimates. A bootstrap resampling technique (see below for further details) was used to take into account the potentially biased standard error estimates of the predictors whilst analysing the single-level structural model (Lai & Kwok, 2015).

The following sections detail the practical issues that need to be addressed before using SEM techniques (data screening) and while using the two-phase modelling approach (Mueller & Hancock, 2010; Ullman, 2013). A preliminary missing data analysis was conducted to identify the proportions and mechanism of cases missing and to justify the missing data algorithm that was utilized. Next, item-level skewness and kurtosis were examined to determine the extent of univariate normality. Mplus uses the maximum likelihood estimation method to analyse structural equation models, which assumes multivariate normality (Wang & Wang, 2012). SEM also requires the use of measures with good construct validity and reliability and is sensitive to extreme collinearity between variables (Kline, 2011). The next section describes the approaches used for evaluating the validity and reliability of each measure during data screening and the analysis of the measurement model.

A key feature of SEM is the assessment of how well the model fits the sample data (Wang & Wang, 2012). The model fit indices used in the current study are outlined next. As is common for applied research, the measurement models required some modification (re-specification) in order to improve data-model fit (Brown, 2006). The sources of ill fit were diagnosed through the interpretation of the modification indices, the factor loadings, and item reliability, which are described in the penultimate section. The last section details the bootstrap resampling technique used to test the significance of the multiple mediation paths in the single-level structural equation model

Missing Data Analysis

A common problem with quantitative research studies in educational settings is the issue of missing data (Peugh & Enders, 2004). Missing data has an impact on analysis and can occur at three nested levels: person, construct, and item level (Newman, 2014). The nonresponse rate is associated with person-level missingness, where individuals have not responded to any items on the survey. The response rate for the current study was 60%. The sample of 551 participants was drawn from 47 classes with a total enrolment of 637 males and 288 females. A sensitivity analysis was not conducted for the current study as the response rate was above 30% (Newman, 2014).

Data missing for covariates and at the construct level is the next issue of significance for analysis. For this study, all participants provided information on their gender, age, and place of birth. Contextual information for each class, such as class size and gender of the teacher, was provided by the school. Furthermore, the questionnaire was designed to limit the likelihood that participants would avoid completing items for individual constructs. In the current study, 25 participants (4.5%) did not respond to all of the items associated with one of more of the latent constructs.

Item-level missingness was the most common form of nonresponse for this study. Item-level nonresponse can be deliberate, as is the case for the online survey where participants received a warning when an item was unanswered but had the option to continue the survey (due to an oversight). In the following section I describe the missing data in terms of its pattern and the possible mechanisms which may explain why the data are missing. Contemporary missing data theory puts emphasis on identifying the missing data mechanism, as this influences the selection of the most appropriate imputation technique (Enders, 2010).

The missing value patterns and mechanisms for this dataset were analysed using the Multiple Imputation and Missing Value Analysis procedures of IBM SPSS 22 (IBM, 2013). The Multiple Imputation procedures were used first to provide a description of the amount and pattern of the missing data. The Missing Value Analysis procedures were then used to determine the likely missing data mechanisms for the dataset.

For the full dataset, 551 participants, each of the 69 Likert-type items (variables) in the questionnaire had at least one case (participant) with a missing value. Eighty-five of the 551 cases (15.43%) had at least one missing value. There were a total of 1380 missing item values, which accounted for 3.63% of the data. Twenty-two variables were missing between 5.1% and 6.9% of their values. These 22 variables were in fact the questions at the end of the survey (questions 58 to 79) and were most likely missing due to students running out of time to complete the survey.

The missing data are grouped into 59 patterns of missingness (Figure 3.2). These patterns were characteristic of two of the typical missing data patterns described by Little and Rubin (2002). The first 41 patterns were for the fifty students (9.07%) with missing data who completed the survey. These patterns mostly adhere to the general missing data pattern, which is characterised by an apparent random distribution of a few missing values per participant, dispersed across the range of variables. For example, the participants in this study were missing 120 values for 57 of the 69 variables.

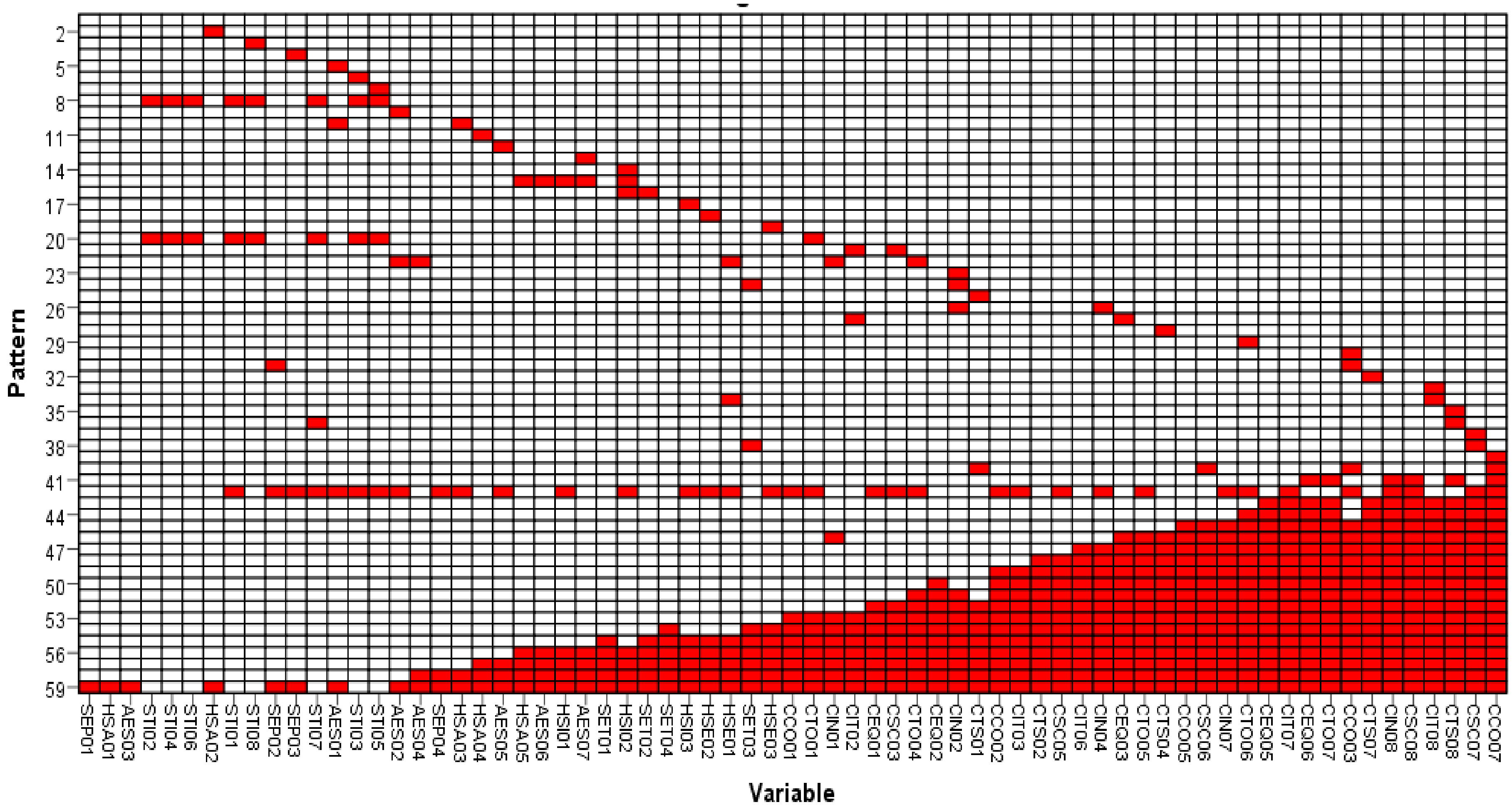

Figure 3.2 Missing value patterns

The remaining 18 patterns were for the 35 students (6.35%) who did not complete the survey. These patterns mostly adhere to a monotone missing data pattern where a participant drops out and does not return to complete the survey, and so all subsequent measures after the last response are missing. These participants accounted for 1260 missing values for 61 of the 69 variables. There were 18 distinct patterns for the missing variables.

All but one of the incomplete surveys was from schools that used the online version of the survey. For these participants, data was collected regarding the start and finish times and therefore it is possible to compare missing data patterns for completers and non-completers of the online version of the survey. There were 32 participants with incomplete surveys. A review of the data for the participants with incomplete surveys, in the context of the class, suggests that most of these participants started the survey later but finished at the same time as several other members of their class who had completed the survey. Therefore, it appears that the incomplete surveys may be due to a time constraint for running the survey during the maths lesson.

The various approaches for dealing with missing data depend on the underlying reason for missingness, the missing data mechanism, rather than the total number of missing values. In missing data theory, there is a widely used classification system for describing how the probability of a missing value may be related to other data (Enders, 2010). When data is missing completely at random (MCAR), the value is missing purely be chance, its missingness is unrelated to the data. When data is missing at random (MAR), the probability of the missingness of a given value is related to one or more other measured variables in the study. Data is Missing Not at Random (MNAR or NMAR) when the reason a value is missing is due to the potential value itself, for example, a high-income participant may not wish to disclose his/her income while lower paid participants are willing to answer the question.

For any given dataset, some values are likely to be missing due a combination of these mechanisms. Before deciding on an approach for handling missing data, such as listwise deletion or imputation, I determined the extent to which each of the mechanisms influenced the probability of a variable having missing data. First, I ran Little's MCAR test to check if the missing data mechanism was missing completely at random. Little's MCAR test is available when you choose the EM option on the Missing Values Analysis procedure in SPSS 22 (IBM, 2013). The null hypothesis that the data were MCAR was not supported as the significance value was less than 0.05 ($p<0.05$) (Chi-Square = 3677.546, df = 3345, Sig. = .000).

Since the data was not MCAR, I determined if the reasons for item-level missingness was ignorable or not, that is if missing data were MAR rather than MNAR. It is generally asserted that this is difficult to do, especially for cross-sectional studies, without obtaining follow up data from the participants with missing data (Graham, 2012). However, McKnight, McKnight, Sidani, and Figueredo (2007) have developed an index of messiness that can be used to differentiate between ignorable and systematic mechanisms for missing data.

$$Index\ of\ Messiness = \frac{Missing\ Value\ Patterns - 1}{Cases\ with\ missing\ values}$$

Using this equation, the index of messiness for this dataset is 0.68, $I = \frac{58}{85}$.

Smaller values for the index suggest that the reasons for missingness are systematic and therefore non-ignorable, as most or all participants have similar patterns of missingness (McKnight et al., 2007). An index value of 0.68 for the missing data in this dataset suggests that overall, the reasons for missingness are more likely to be ignorable: that is, that the predominant missing data mechanism for this dataset is MAR.

In the current study I used the default Mplus approach for handling missing data, called *full information maximum likelihood* (FIML). FIML is a common technique for handling both MCAR and MAR missing data mechanisms, as it is less biased and more efficient than traditional approaches (Wang & Wang, 2012). Additionally, FIML has been found to provide an accurate measure of the standard errors for all missing data mechanisms, including MNAR (Newman, 2014). Compared to multiple imputation, the advantages of the FIML approach are that no item-level missing data is replaced prior to estimation; all the available data contributes to the analysis and no statistical information is wasted (Marsh & Hau, 2007).

Descriptive Statistics

Before proceeding the analysis of the measurement and structural models, the skewness and kurtosis for each scale item were interpreted (see Table 3.23). The skew for all items ranged from -1.31 to 0.95 and the kurtosis ranged from -0.98 to 0.92. As the absolute skewness and kurtosis values were no greater than 2.0, the scale items were considered to be normally distributed for the purposes of SEM (Bandalos & Finney, 2010).

Before testing this model, data were first evaluated to determine the appropriate level of analysis for the conceptual model (Hox & Maas, 2001). The intraclass correlations (ICC(1) and ICC(2)) and the design effect (deff) were calculated for each scale item, using the two-level basic function of Mplus version 7, from N = 551 and 47 classrooms (average cluster size of 11.7, median = 13, mode = [13, 14], range = [1, 27]).

Table 3.23

Summary of item level skewness and kurtosis for each scale

	Skewness			Kurtosis		
Scale	Min	Max	Mean	Min	Max	Mean
Self-theory of Intelligence	-0.76	-0.10	-0.50	-0.81	0.42	-0.23
Help-seeking						
Help Seeking Avoidance	0.55	0.95	0.72	-0.67	0.19	-0.33
Help Seeking Expedient	-0.52	-0.31	-0.45	-0.26	-0.10	-0.19
Help Seeking Instrumental	0.14	0.72	0.38	-0.97	-0.35	-0.72
Self-efficacy						
Academic Self-efficacy	-0.96	-0.24	-0.63	-0.98	0.65	-0.07
Social Self-efficacy - Peers	-1.04	-0.43	-0.78	-0.12	0.66	0.18
Social Self-efficacy -Teacher	-1.31	-0.48	-0.75	-0.67	0.92	-0.06
Social climate						
Task Orientation	-1.05	-0.70	-0.86	0.02	0.67	0.41
Investigation	-0.26	-0.12	-0.19	-0.26	0.01	-0.13
Cooperation	-0.82	-0.41	-0.65	-0.31	0.66	0.24
Teacher Support	-0.93	-0.22	-0.51	-0.57	0.24	-0.27
Student Cohesiveness	-0.95	-0.40	-0.65	-0.20	0.54	0.19
Involvement	-0.52	-0.13	-0.37	-0.60	0.29	-0.06
Equity	-0.94	-0.53	-0.70	-0.27	0.34	0.01

A summary of the item level intraclass correlations for each scale are presented in Table 3.24. All ICC(1) values were above 0.05 and the average design effect ranged from 1.77 to 2.82, with the exception of the Social Self-Efficacy with Peers scale, the design effect for the majority of items was above 2.0.

Table 3.24

Summary of item level intraclass correlations and design effect

Scale	ICC(1) Min	ICC(1) Max	ICC(1) Average	ICC(2) Average	deff Average
Self-theory of Intelligence	0.07	0.14	0.09	0.53	1.97
Help-seeking					
Help-seeking Avoidance	0.09	0.20	0.14	0.63	2.42
Help-seeking Expedient	0.12	0.15	0.14	0.64	2.41
Help-seeking Instrumental	0.05	0.09	0.07	0.47	1.77
Self-efficacy					
Academic Self-efficacy	0.12	0.21	0.16	0.68	2.68
Social Self-efficacy - Peers	0.07	0.13	0.09	0.53	1.96
Social Self-efficacy -Teacher	0.11	0.23	0.16	0.68	2.69
Social climate					
Task Orientation	0.14	0.22	0.18	0.70	2.80
Investigation	0.08	0.14	0.10	0.56	2.06
Cooperation	0.10	0.18	0.13	0.62	2.36
Teacher Support	0.14	0.19	0.16	0.68	2.63
Student Cohesiveness	0.10	0.14	0.12	0.60	2.23
Involvement	0.09	0.19	0.12	0.60	2.25
Equity	0.11	0.30	0.18	0.69	2.82

Therefore, the clustered effect of the sample should be taken into account (Julian, 2001). However, multilevel CFA, with TYPE = COMPLEX, consistently returned warning messages concerning inadmissible solutions. This was most likely due to the small number of groups and the degree of cluster size imbalance in the sample (Hox & Maas, 2001). Therefore, further analysis of the measurement and structural models used the individual as the unit of analysis. A bootstrap resampling technique (see below) was used to take into account the potentially biased standard error estimates of the predictors whilst analysing the single-level structural model (Lai & Kwok, 2015).

Item and Scale Validity

Convergent and discriminant validity were evaluated for each of the 14 scales at two points during the analysis of the measurement model. First, I assessed the initial validity of the scales using traditional approaches, to enable comparison with previous studies using similar constructs. A common approach for assessing the convergent validity of a construct is to examine the correlations of the items for each measure (Trochim & Donnelly, 2008). Many studies use item-total correlations (> 0.3) and inter-item correlations (0.30 to 0.70) as evidence of convergent validity (DeVon et al., 2007). Discriminant validity may be established by examining the inter-scale correlation matrix to determine the extent to which measures that should not be related to each other are in fact unrelated (Ping, 2004). An inter-scale correlation below |.7| is generally accepted as being indicative of discriminant validity (Vaske, 2008). As I outline in Chapter 4, the initial analysis of the constructs using a traditional approach supported the convergent and discriminant validity of each scale.

An advantage of CFA is the availability of general measures of item and scale reliability are more robust than measures commonly used in education research (Wang & Wang, 2012). When measurement models are respecified in order to improve fit, their convergent and discriminant validity should be reassessed. The construct reliability value (CR) was used to assess the convergent validity of the factors in the measurement model (Farrell & Rudd, 2009; Fornell & Larcker, 1981). The Average Variance Extracted (AVE) was used to determine discriminant validity for each factor in the model (Ping, 2004; Shiu, Pervan, Bove, & Beatty, 2011).

Both item and scale reliability use the standardised factor loadings of the indicator variable on the latent variable. In Mplus, this information is obtained by using the OUTPUT command STDYX. The item reliability is measured using the squared standardized factor loading of each item on its latent factor and is equivalent to the R-square estimate in the STDYX Standardization section of the Mplus output (Wang & Wang, 2012). Kline (2011) suggests that the R-squared estimate for each indicator should be greater than 0.50; that is, the majority of the variance of each indicator should be explained by the factor model.

The construct reliability value (CR) was used to assess the convergent validity of the factors in the measurement model (Farrell & Rudd, 2009). Scale reliability, or construct reliability (CR), refers to the reliability of a construct underlying a set of observed indicators and was calculated using Equation 3.1 (Wang & Wang, 2012). Compared to Cronbach's alpha, construct reliability is a more dependable estimate of scale reliability as it accounts for the effects of measurement error. When measurement errors are correlated, the general equation for the construct reliability of a scale is shown in Equation 3.1.

$$CR = \frac{(\sum_i \lambda_i)^2}{(\sum_i \lambda_i)^2 + \sum_i \delta_i + 2\sum_i \sum_j \delta_{ij}} \qquad \textit{Equation 3.1}$$

In equation 3.1, λ represents the standardised factor loadings and δ represents the standardised residual variances reported by Mplus for each indicator variable, and $2\sum_i \sum_j \delta_{ij}$ is two times the sum of the covariance between error terms (Wang & Wang, 2012). As with Cronbach's alpha, the rule of thumb is that a CR $\geq$ 0.70 indicates that a scale has good reliability (Hair, Babin, & Krey, 2017).

The Average Variance Extracted (AVE) was used to determine discriminant validity for each factor in the measurement model (Shiu et al., 2011). As with CR, in the current study an Excel spreadsheet was used to calculate the AVE (using the second approach in Equation 3.2) for each scale using Equation 3.2.

$$AVE = \frac{\left(\sum_i \lambda_i{}^2\right)}{\left(\left(\sum_i \lambda_i{}^2\right) + \left(\sum_i\left(1 - \lambda_i{}^2\right)\right)\right)} = \frac{\left(\sum_i \lambda_i{}^2\right)}{n} \qquad \textit{Equation 3.2}$$

In equation 3.2, λ are the standardised factor loadings and *n* is the number of items in the scale (Farrell, 2010; Gefen, Straub, & Boudreau, 2000). Discriminant validity can be determined for a CFA measurement model if the AVE of a latent construct is greater than the construct's highest squared correlation with any other construct, or $\sqrt{AVE} > |r|$ (Hair et al., 2017).

Model Fit Indices

There are many indices available for assessing model fit, and Mplus provides information for the five indices most commonly used in applied research (Brown, 2006): Chi-square (χ^2), Root Mean Square Error of Approximation (RMSEA), Comparative fit index (CFI), Tucker-Lewis index (TLI), and the Standardized Root Mean Square Residual (SRMR). These fit indices provide different information about model fit. The absolute fit indexes, χ^2 and SRMR, evaluate how well the sample data are predicted by the model. Parsimony corrected indexes, RMSEA, favour models where the solution has fewer freely estimated parameters and penalises poor parsimony models. The comparative fit indexes, CFI and TLI, have the most liberal fit criteria as the user-specified model is compared to a 'null' baseline model where the covariance are fixed to zero (Brown, 2006). While there are no 'golden rules' for the use of fit indexes, the following guidelines were used for evaluating model fit (Brown, 2006; Kline, 2011; Wang & Wang, 2012).

The Chi-square statistic was the original fit index, but it is rarely used to assess goodness-of-fit due to several well-known limitations, such as being highly sensitive to sample size (Wang & Wang, 2012). However, the Chi-square statistic is still useful as a badness-of-fit measure; the larger the value, the greater the difference between variance/covariance matrices for the model and the sample data. χ^2 is an exact-fit test, when p > 0.05, the exact-fit hypothesis is not rejected, therefore Kline (2011) recommends that the chi-square statistics are always reported before diagnosing the extent and possible sources of the misfit.

Root Mean Square Error of Approximation (RMSEA) is based on the Chi-square statistic. RMSEA values that are very close to zero indicate a good model fit. While the RMSEA is less sensitive to sample size, it is sensitive to the number of parameters in the model (Brown, 2006). A RMSEA estimate ≤ 0.05 is generally accepted as indicating a reasonably good fit. RMSEA values in the range 0.05-0.08 suggest an adequate model fit; 0.08-0.10 suggest a mediocre fit; and models with values above 0.10 should be rejected (Brown, 2006). The RMSEA also provides a confidence interval. The upper and lower bounds of the confidence interval can be used in conjunction with these guidelines to test both close-fit and poor-fit hypotheses (Kline, 2011).

The Standardized Root Mean Square Residual (SRMR) is the mean absolute difference between the observed and predicted correlations for *p* indicators in the model (Kline, 2011). The conventional threshold for an acceptable fit is when SRMR ≤ 0.08. However, Bagozzi (2010) suggests that this criterion is too liberal and that a better criterion would be SRMR ≤ 0.07.

The Comparative Fit Index (CFI) is a population based incremental fit index, which measures the relative improvement of the theoretical model compared to the baseline model (Kline, 2011; Sun, 2005). The baseline model for Mplus differs slightly from the independence model used by other SEM software such as LISREL. For CFA, only the residual variances and intercepts of the observed indicators are estimated for the baseline model, with all factor loadings set to 1 and all variances/covariances set to 0 (Wang & Wang, 2012). A CFI value ≥ 0.95 is taken to indicate a good fit and a value ≥ 0.90 indicates an acceptable fit (Brown, 2006; Sun, 2005).

The Tucker-Lewis Index (TLI) is a sample based non-normed incremental fit index, and, unlike the CFI, its values are not restricted to [0,1]. The TLI imposes a penalty for increasing model complexity. The degrees of freedom of the model (df_M) will decrease as more parameters are freed, resulting in a smaller value for the TLI (Wang & Wang, 2012). While the TLI tends to have values smaller than the CFI, the same rules of thumb are used to assess fit; that is, a TLI value ≥ 0.95 is taken to indicate a good fit and a value ≥ 0.90 indicates an acceptable fit (Wang & Wang, 2012).

As the standard cut-off criteria used for assessing model fit may be considered to be too conservative when evaluating more complex models, such as in this study, the following criteria were used: RMSEA ≤ 0.05, upper limit of RMSEA 90% CI < 0.1, CFI ≥ 0.90, TLI ≥ 0.90, SRMR ≤ 0.07.

Model Re-Specification

It is common for applied data sets to result in poor fitting models, based on one or more of the fit indices, and so models generally require some revision in order to improve fit (Brown, 2006). The sources of ill fit were diagnosed through the interpretation of the modification indices, the reasonability of the factor loadings, and item reliability.

The standardised loadings of the indicators for each factor were examined to check that they adhered to underlying theory for each scale. In this study, all indicators should have a positive relationship with the latent factor. Each scale was designed as a prorated scale where the scale score was the average of the item scores. Therefore, it was expected that the factor loadings for the indicators would have similar values. In the current study, items with standardised factor loadings below the conventional 0.3 cut-off point were subsequently removed in order to improve model fit and the validity of the measurement model (Wang & Wang, 2012).

An analysis of the item reliability was also used to inform the decision about whether to remove an item from a measurement model. Item reliability is measured using the squared standardized factor loading of each item on its latent factor and is equivalent to the R-square estimate (Wang & Wang, 2012). Kline (2011) suggests that the majority of the variance of each indicator should be explained by the factor model, and that the R-square estimate for each indicator should be greater than 0.50. Indicators with very low R-square estimates were candidates for removal from the factor in order to improve overall fit.

Modification indices were also inspected to identify sources of misfit and identify indicators that could potentially cross load on other factors in the measurement model. Modification indices can be inspected to identify two sources of misfit. In a congeneric CFA model, the error terms for indicator variables loading onto the same latent factor would not be correlated. However, in practice it is likely that some indicator variables may share sources of error that are not captured by the model (Wang & Wang, 2012). During analysis, the Mplus *modification indices* (MI) were used to identify error terms which could be correlated in a substantively meaningful way in order to improve the fit of the model (Wang & Wang, 2012).

Bootstrapping

Bootstrapping is a non-parametric resampling procedure which is recommended for testing SEM models with multiple mediators (Preacher & Hayes, 2008). In a bootstrap approach, *k* bootstrap samples of size *N* are generated by randomly sampling cases, with replacement, from the dataset. Nonparametric bootstrapping is a robust technique for dealing with non-normal variables (Brown, 2006), the only assumptions being that the population and sample distributions have the same shape and that $N \geq 200$ (Kline, 2011). The number of bootstrap samples is specified by the researcher but needs to be sufficiently large (at least 500) to produce reliable averages of the parameter estimates (Brown, 2006). In the current study, multiple trails (with $k = 1000, 2000, 5000, 10000$) found that confidence intervals for the average parameter estimates were stable for $k \geq 5000$.

CHAPTER 4: VALIDATION OF INSTRUMENTS

This study used well-established scales to measure four sets of constructs: help-seeking, self-efficacy, social climate, and self-theory of intelligence. As the reliability and validity of scales can vary depending on the population samples they are used with, the reliability and validity of each scale was examined for participants in the study.

The first section assesses the validity of the scales using the traditional approach; that is, where the scales are each assumed to be unidimensional with equally weighted items. The scale scores were calculated as the average of the items for participants with no missing data.

The second section reports on the analysis and validation of the measurement models in preparation for the analysis of the structural equation model. Confirmatory factor analysis (CFA) was used to test the fit of each measurement model to the data. This analysis provided a more sophisticated approach for confirming the validity of the established scales. The findings of the analysis of the factorial validity of the scales, using full information maximum likelihood, are presented in this chapter.

Scale Reliability

The most commonly used indicator of scale reliability in the social sciences is Cronbach's alpha reliability coefficient. A scale is generally accepted as having good internal consistency if it has an alpha value above 0.7 (Knapp & Mueller, 2010). The alpha value was calculated for cases which had complete data for each scale and are displayed in Table 4.1.

Table 4.1

Indicators of convergent validity

Scale	Valid Cases (551)	# items	Cronbach	Inter-item Correlation			Corrected Item-Total Correlation		
				Mean	Min	Max	Mean	Min	Max
Self-Theory of Intelligence	542	8	0.878	0.476	0.322	0.719	0.641	0.566	0.685
Academic Self-Efficacy	527	7	0.863	0.489	0.266	0.618	0.643	0.452	0.718
Social Self-Efficacy with Peers	544	4	0.773	0.461	0.323	0.585	0.578	0.455	0.635
Social Self-Efficacy with Teacher	529	4	0.592	0.275	0.154	0.392	0.379	0.286	0.453
Help-Seeking Avoidance	531	5	0.843	0.520	0.438	0.625	0.650	0.590	0.701
Help-Seeking Instrumental	528	3	0.667	0.405	0.349	0.499	0.482	0.413	0.521
Help-Seeking Expedient	527	3	0.652	0.386	0.302	0.441	0.466	0.421	0.531
Task Orientation	512	5	0.776	0.415	0.338	0.542	0.552	0.486	0.610
Investigation	511	5	0.737	0.360	0.246	0.535	0.501	0.389	0.617
Cooperation	510	5	0.761	0.395	0.253	0.554	0.533	0.416	0.643
Involvement	511	5	0.744	0.370	0.286	0.503	0.510	0.457	0.603
Teacher Support	506	5	0.802	0.450	0.269	0.572	0.589	0.468	0.684
Student Cohesiveness	510	5	0.759	0.393	0.192	0.559	0.532	0.390	0.624
Equity	514	5	0.804	0.455	0.383	0.587	0.591	0.544	0.686

The majority of scales had an alpha value greater than 0.7. The three exceptions were Social Self-Efficacy with Teacher (α = 0.592, 4 items), Help-Seeking Instrumental (α = 0.667, 3 items) and Help-Seeking Expedient (α = 0.652, 3 items). The alpha values for Help-Seeking Instrumental and Help-Seeking Expedient, were consistent with values reported in prior studies (Wolters et al., 2005). Whereas the alpha values for the Social Self-Efficacy with Teacher scale were slightly lower than those reported in prior studies (Patrick et al., 1997; Ryan & Patrick, 2001).

The mean inter-item correlation was also calculated for each scale as it can provide another measure of homogeneity for scales that consist of a small number of items (John & Benet-Martinez, 2000). The mean inter-item correlations for all scales in this study generally fell within the optimal range of 0.2 to 0.4 (Briggs & Cheek, 1986). In particular, each of the scales with less than four items had a mean inter-item correlation above 0.2 and therefore could be considered as reliable measures for participants in this study. In summary, each of the 14 scales was deemed to produce a reliable measure of the latent variables used.

Construct Validity

Validity is an assessment of the extent to which a scale measures what it is intended to measure for a specific sample of the population (Vaske, 2008; Watson, 2013). Recently, methodologists have synthesised the various approaches for assessing the validity of instruments to provide a general approach to assessing the quality of measurements of a construct (Newton & Shaw, 2013). In Figure 4.1 the relationship between the main approaches used to assess validity are outlined (see Newton & Shaw, 2013).

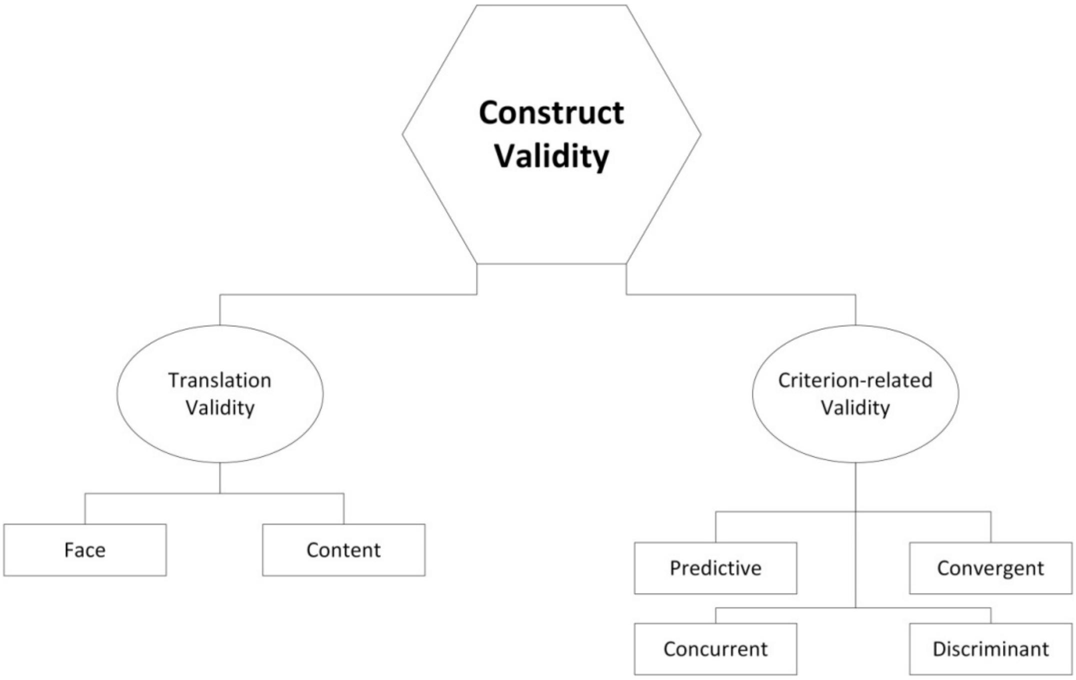

Figure 4.1 Construct validity.

Face validity of a measure relies on the judgement of others as to whether it is a good measure of the underlying concept. In this study, the face validity of each of the scales was established after discussions with colleagues who were experienced secondary mathematics and English teachers. Content validity involves checking that the operationalization of the construct represents the content domain. As only existing (published) scales were used in this study, the content validity of each was considered to be established.

Criterion related validity is a judgement of how well the operationalised construct performs when compared with related measures. Predictive validity assesses the scales ability to predict something that it is theoretically related to or distinguish between groups that it should theoretically able to distinguish between (Trochim & Donnelly, 2008). Concurrent validity assesses the extent to which the scale correlates with a 'gold standard' that is measured at the same time (Watson, 2013). The complex nature of this study means that the predictive and concurrent validity of each scale was assessed during the analysis phase. Convergent and discriminant validity were evaluated for each of the 14 scales and the findings are presented below.

Evaluating Convergent Validity

A common approach to assessing convergent validity of a construct is to examine the correlations of the measures (Trochim & Donnelly, 2008). DeVon et al. (2007) noted that many studies use item-total correlations (> 0.3) and inter-item correlations (0.30 to 0.70) as evidence of convergent validity. These statistics measure the discriminating power of each item in a scale; that is, the degree to which the items are measuring the same thing (Murphy & Davidshofer, 1991). The corrected item-total correlation measures the agreement between a particular item and the sum of the remaining items for the scale; that is, the degree of homogeneity of the scale (Everitt, 1998). The inter-item correlation is particularly useful for understanding why an item may have a low item-total correlation and so have little discriminating power (Murphy & Davidshofer, 1991). In general, inter-item correlations should be positive and, as a rule of thumb, be above 0.3 (DeVon et al., 2007).

Table 4.1 contains a summary of the statistics for the inter-item correlation and corrected item-total correlation for each scale included in this study. The average item-total correlation was calculated as a convenient index of the discriminating power for each scale. The mean corrected item-total correlation for each scale was well above 0.3. This finding suggests that each of the items in the scale successfully discriminates between those who score high and those who score low on the scale (Murphy & Davidshofer, 1991). This is further supported by the inter-item correlations, which are all positive with most mean inter-item correlations above 0.3. The corrected item-total correlation and inter-item correlation statistics provide evidence to support the convergent validity of each scale; that is, the items in each scale converge on the same construct.

Evaluating Discriminant Validity

A common approach to establishing discriminant validity is to use the inter-scale correlation matrix to examine the extent to which measures that should not be related to each other are in fact unrelated (Vaske, 2008). The Pearson's *r* correlation matrix of the correlations between each scale (excluding missing values pairwise) are summarised in Table 4.2. Constructs which are potentially related are grouped for easy analysis. Ping (2004) suggested that an inter-scale correlation below |.7| is generally accepted as being indicative of discriminant validity.

The correlations between each of the measures of self-efficacy are positive, significant ($p<0.01$), and range from 0.388 to 0.488. This is consistent with the correlations reported in previous studies of 5^{th} and 8^{th} grade students in the USA where correlations range from 0.26 to 0.62 (Patrick et al., 1997; Patrick et al., 2007; Ryan & Patrick, 2001). Thus, these results provide further evidence for the discriminant validity of the three measures of self-efficacy.

The correlations between each of the measures of help-seeking are consistent with previous studies, with high school and college students, which included all three measures (Karabenick, 2003; Shim et al., 2013; White & Bembenutty, 2013). There is a significant negative relationship between Help-Seeking Instrumental and Help-Seeking Avoidance, -0.273 ($p < 0.01$), and Help-Seeking Expedient, -0.105 ($p < 0.05$). Previous studies reported correlations ranging from -0.16 to -0.52. A slightly stronger positive correlation was found for measures of Help-Seeking Avoidance and Help-Seeking Expedient.

Table 4.2

Pearson Correlation Matrix for Scales

		Self-Efficacy			Help-Seeking			Social Climate						
	STI	AES	SEP	SET	HSA	HSI	HSE	CTO	CIN	CCO	CIT	CTS	CSC	CEQ
Self-Theory of Intelligence (STI)	1													
Academic Self-Efficacy (AES)	.312**	1												
Social Self-Efficacy with Peers (SEP)	.271**	.388**	1											
Social Self-Efficacy with Teacher (SET)	.210**	.448**	.423**	1										
Help-Seeking Avoidance (HSA)	-.261**	-.280**	-.278**	-.360**	1									
Help-Seeking Instrumental (HSI)	.253**	.441**	.314**	.391**	-.273**	1								

Table 4.2 continued

	Self-Efficacy				Help-Seeking			Social Climate						
	STI	AES	SEP	SET	HSA	HSI	HSE	CTO	CIN	CCO	CIT	CTS	CSC	CEQ
Help-Seeking Expedient (HSE)	-.224**	-.219**	-0.081	-.131**	.365**	-.105*	1							
Task Orientation (CTO)	.214**	.455**	.258**	.463**	-.393**	.389**	-.260**	1						
Investigation (CIN)	.134**	.473**	.352**	.442**	-.187**	.315**	-0.033	.568**	1					
Cooperation (CCO)	.192**	.182**	.492**	.400**	-.231**	.355**	-0.055	.383**	.384**	1				
Involvement (CIT)	.117**	.327**	.504**	.491**	-.285**	.301**	-0.006	.459**	.606**	.538**	1			
Teacher Support (CTS)	0.084	.252**	.262**	.562**	-.219**	.323**	-0.064	.408**	.409**	.458**	.523**	1		
Student Cohesiveness (CSC)	.191**	.226**	.552**	.401**	-.262**	.318**	-0.052	.453**	.373**	.718**	.601**	.484**	1	
Equity (CEQ)	.162**	.316**	.293**	.546**	-.308**	.343**	-.201**	.500**	.416**	.464**	.490**	.645**	.473**	1

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

This finding was also consistent with previous studies, which reported correlations ranging from 0.25 to 0.54. Thus, these results provide further evidence for the discriminant validity of the three measures of Help-Seeking.

Most of the inter-scale correlations for the learning environments instrument *What Is Happening in This Class?* are below the recommended cut-off value of 0.7. The only exception is a correlation coefficient of 0.718 for Cooperation (CCO) with Student Cohesiveness (CSC). While these two measures appear to be strongly correlated, the constructs they represent may still be sufficiently unique to be of value in the assessment of the mathematics learning environment. To check the conceptual equivalence of the constructs, Fraser (1974) suggested that if Pearson's correlation coefficient is less than the square root of the product of the scale reliabilities, $r < \sqrt{\propto_{CCO} \times \propto_{CSC}}$, this is an alternate indicator of discriminant validity or uniqueness. For these two scales, this value is 0.760. Since the correlation coefficient of 0.718 is less than 0.760, this suggests that the scales may still be interpreted as measuring distinct constructs.

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was used to test the construct validity of the hypothesized structure of the scales in the measurement model for the current sample, sometimes referred to as factorial validity (Brown, 2006; Wang & Wang, 2012). The factorial structure of each of the scales used in this study are based on the use of effects indicators (Bollen & Bauldry, 2011). Each of the scales has a strong theoretical foundation which has been validated in prior studies. Therefore, in this section I focus on assessing the goodness-of-fit for each model for the current sample.

This study used the five model fit indices most commonly used in applied research (Brown, 2006): Chi-square (χ^2), Root Mean Square Error of Approximation

(RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and the Standardized Root Mean Square Residual (SRMR). As the standard cut-off criteria used for assessing model fit may be considered to be too conservative when evaluating more complex models, such as in this study, the following criteria were used: RMSEA ≤ 0.05, upper limit of RMSEA 90%CI < 0.1, CFI ≥ 0.90, TLI ≥ 0.90, SRMR ≤ 0.07 (Bagozzi, 2010; Hair et al., 2017).

The standardised loadings of the indicators for each factor were examined to check that they adhered to underlying theory for each scale. Modification indices were also inspected to identify sources of misfit and identify indicators that could potentially cross load on other factors in the measurement model. An analysis of the item reliability was also used to inform the decision about whether to remove an item from a measurement model or not. Item reliability is measured using the squared standardized factor loading of each item on its latent factor and is equivalent to the R-square estimate (Wang & Wang, 2012).

When measurement models are respecified in order to improve fit, their convergent and discriminant validity should be reassessed. The construct reliability value (CR) was used to assess the convergent validity of the factors in the measurement model (Farrell & Rudd, 2009; Fornell & Larcker, 1981). The Average Variance Extracted (AVE) was used to determine discriminant validity for each factor in the model (Ping, 2004; Shiu et al., 2011). According to Fornell and Larcker (1981) discriminant validity can be determined for a CFA measurement model if the AVE for two scales is greater than their correlation coefficient squared, or $\sqrt{AVE} > |r|$.

Help-Seeking

The factorial structure of the help-seeking measurement model was evaluated using confirmatory factor analysis. The fit indices (RMSEA = 0.073, 90% CI

[0.062,0.085], Pr(RMSEA<0.05) = 0.001, SRMR = 0.059, CFI = 0.930, and TLI = 0.906) indicate that the help-seeking CFA measurement model (shown in Figure 4.2) had an adequate fit to the data. As the model achieved an adequate fit and there were no high modification indices, the highest being 18.96 for HSA02 with HSA04, no further parameters were freed.

Table 4.3 shows the values for CR, AVE, and the correlation matrix (where the diagonal contains the $\sqrt{AVE}$, for each scale). Cronbach alpha for each scale is included for comparative purposes. The construct reliability value for Help-Seeking Avoidance (HSA) was well above the recommended value of 0.7; which was a slight improvement when compared to the Cronbach alpha value.

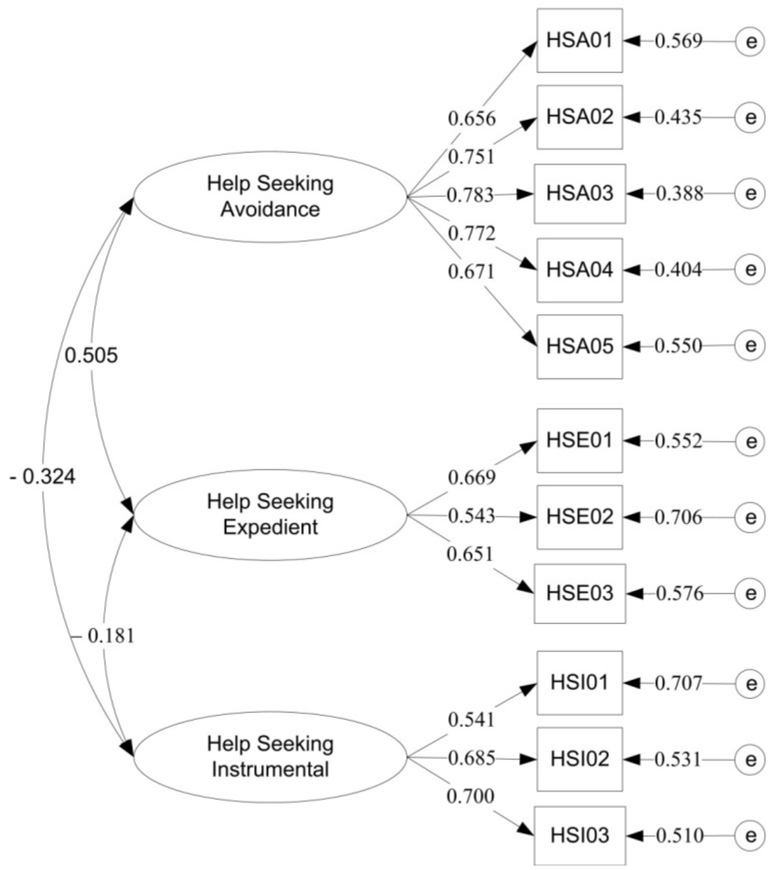

Figure 4.2 Help-Seeking CFA measurement model – standardised output.

The values of CR for Help-Seeking Instrumental (HSI) and Help-Seeking Expedient (HSE) were below the recommended value. An examination of the standardised residual variances for these factors (shown in Figure 4.2) identified a single item in each factor with a value above 0.7. That is, the lack of convergent reliability of item HSE02 and HSI01 influenced the overall reliability of the measure. It is common practice to delete such items from factors in order to improve the fit of the measurement model. However, it is generally recommended that factors should have a minimum of three or four items (Wang & Wang, 2012) and so it was decided not to remove any items. The CR values for these factors were greater that the respective Cronbach alpha values therefore, as per the earlier analysis, these factors may have sufficient convergent validity provided they also show good discriminant validity (Ping, 2009). An inspection of the correlations for each pairs of factors (shown in Table 4.3) show that for each factor $\sqrt{AVE} > |r|$. Thus, the three help-seeking factors were deemed to be measuring different constructs.

Table 4.3

Help-seeking Reliability, Average Variance Extracted, and Correlation Matrix

	α	CR	AVE	HSI	HSE	HSA
Help-Seeking Instrumental (HSI)	0.667	0.680	0.417	*0.646*		
Help-Seeking Expedient (HSE)	0.652	0.654	0.389	-0.181	*0.623*	
Help-Seeking Avoidant (HSA)	0.843	0.849	0.531	-0.324	0.505	*0.729*

Note: Diagonal of correlation matrix contains $\sqrt{AVE}$. Values in bold indicate $\sqrt{AVE} < |r|$

Self-Efficacy

This study includes three scales to measure students' self-efficacy beliefs related to their ability to (i) perform academic tasks, (ii) maintain positive social relationships with their teacher, and (iii) maintain positive social relationships with their peers. The initial CFA measurement model for self-efficacy is illustrated in Figure 4.3.

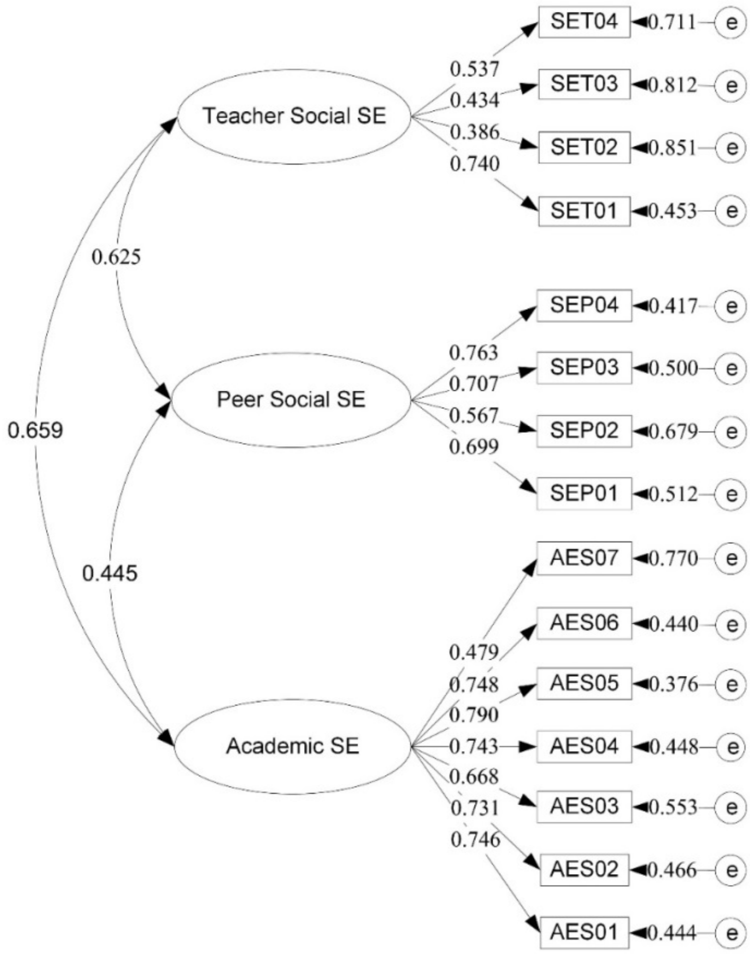

Figure 4.3 Self-Efficacy CFA measurement model 1 – standardised output.

The fit indices are summarised in Table 4.4. While the RMSEA (0.080, 90% CI [0.073 – 0.089]) and SRMR (0.065) indices suggest that initial model is an adequate fit, both TLI (0.872) and CFI (0.894) values are below the recommended minimum of 0.90. Therefore, the model was deemed a poor fit for the sample data.

Table 4.4

Fit Information Self-Efficacy Models

	Model 1	Model 2	Model 3
Chi-Square Test			
Value	396.689	236.212	130.802
Degrees of Freedom	87	43	33
P-Value	0	0	0
RMSEA			
Estimate	0.080	0.090	0.073
90 Percent C.I.	0.073 – 0.089	0.076 – 0.102	0.060 – 0.087
Pr(RMSEA) ≤ .05	0	0	0.002
CFI	0.894	0.919	0.955
TLI	0.872	0.897	0.939
SRMR	0.065	0.068	0.043

The initial evaluation of the source of misfit involved an analysis of the convergent and discriminant validity of the CFA measurement model. For convergent validity to be established, the CR should be greater than 0.70. While Academic Self-Efficacy (0.873) and Social Self-efficacy with Peers (0.780) were above the cut-off, and have good construct reliability, the Social Self-Efficacy with the Teacher (0.592) is well below the cut-off. An examination of the output for this measurement model indicates that this was most likely due to the very high values for the standardised residual variances for two indicators SET02 (0.851) and SET03 (0.812). The correlation of SET with AES (0.659) and SEP (0.625) is greater than $\sqrt{AVE}$ for SET (0.542) (see Table 4.5). Therefore, the Social Self-efficacy with the Teacher scale fails the test for discriminate validity.

Table 4.5

Construct Reliability, Average Variance Extracted and correlations for Self-Efficacy Model 1

				Correlation Matrix		
	α	CR	AVE	AES	SEP	SET
Academic Self-efficacy (AES)	0.863	0.873	0.500	*0.707*		
Social SE – Peers (SEP)	0.773	0.780	0.473	0.445	*0.688*	
Social SE – Teachers (SET)	0.592	0.609	0.293	**0.659**	**0.625**	*0.542*

Note: Diagonal of correlation matrix contains $\sqrt{AVE}$. Values in bold indicate $\sqrt{AVE} < |r|$

Due to the poor convergent and discriminant validity of the Social Self-Efficacy with the Teacher scale, it was decided to remove this construct from the measurement model. The self-efficacy measurement model was subsequently modified and rerun.

The fit indices for Model 2 were slightly worse than the initial factor model (Model 1). To identify the potential sources of misfit, the R-square values for each item and the modification indices were again inspected. Item SEP02, *I can explain my point of view to other students in my class*, was identified as a potential source for the misfit. This item had a very low R-square value of 0.299. This item also accounted for the largest modification index (MI = 51.107, *epc* = 0.462) if it was cross-loaded on the Academic Self-Efficacy factor. It appears that the participants were interpreting the phrase *explain my point of view* in terms of academic efficacy rather than social interactions. As each of the other item statements focus on social interactions with peers, it was decided to remove SEP02 from the Social Self-Efficacy with Peers factor.

The fit indices for the revised model improved significantly once this item was removed. As the value for RMSEA (0.081) was still above the recommended cut-off of 0.08, the modification indices (MI) were evaluated for potential parameters that could be freed in order to further improve in the fit indices. An examination of the modification indices suggested that the model fit could be further improved by freeing the estimate of the correlation of AES04 with AES03 (MI = 26.092, *epc* = 0.417). These Academic Self-Efficacy items shared an emphasis on time and persistence as underpinning students' ability to do *all the work in this maths class*. The resulting fit indices indicated that this final revised model (Model 3) was a good fit for the data.

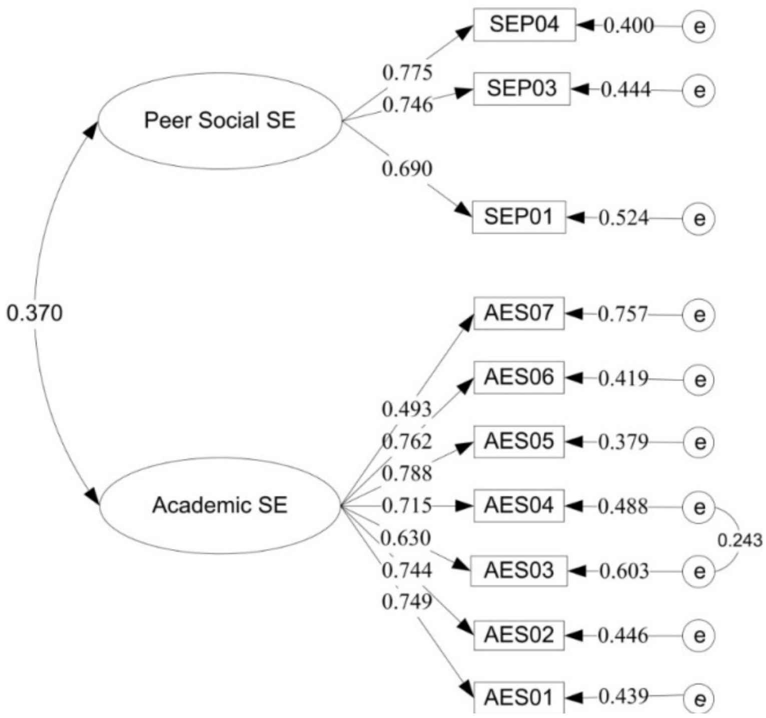

Figure 4.4 Final Self-efficacy measurement model – standardised output

The final measurement model, as illustrated in Figure 4.4, had good convergent and discriminant validity. The construct reliability for Academic Self-Efficacy (0.856) and Social Self-Efficacy with Peers (0.781) were both above the recommended value of 0.7. The $\sqrt{\text{AVE}}$ for Academic Self-Efficacy (0.704) and Social Self-Efficacy with Peers (0.738) are both well above the correlation of AES with SEP (0.370).

Social Climate

The social climate of the classroom was measured using the *What Is Happening In this Class?* (WIHIC) instrument. The initial 7-factor measurement model is illustrated in Figure 4.5.

While the RMSEA (0.070, 90% C.I. [0.067–0.074]) and SRMR (0.067) fit indices indicated an adequate fit, both the CFI (0.810) and TLI (0.790) indicated the model was a poor fit to the sample data. This result was not consistent with the few previous studies that have validated the WIHIC model fit using confirmatory factor analysis, rather than exploratory factor analysis (Dorman, 2003, 2008; Fraser, 2012; Velayutham, Aldridge, & Afari, 2013). In addition, Mplus generated an error message that the "latent variable covariance matrix (psi) is not positive definite".

The output was inspected for suggested reasons for the problem with the covariance matrix. No negative variance/residual variances were found, however, a number of correlations close to one were found (see Table 4.6). In particular, there was a very high correlation between Student Cohesiveness, and Cooperation (0.943), and Involvement (0.808). This suggested that there may be a problem with discriminant validity of the WIHIC scales. Recall, that high correlations between independent (exogenous) variables is a problem in SEM as it produces inaccurate estimates or regression coefficients and standard errors (Shiu et al., 2011). The construct reliability and average variance extracted were calculated for each scale.

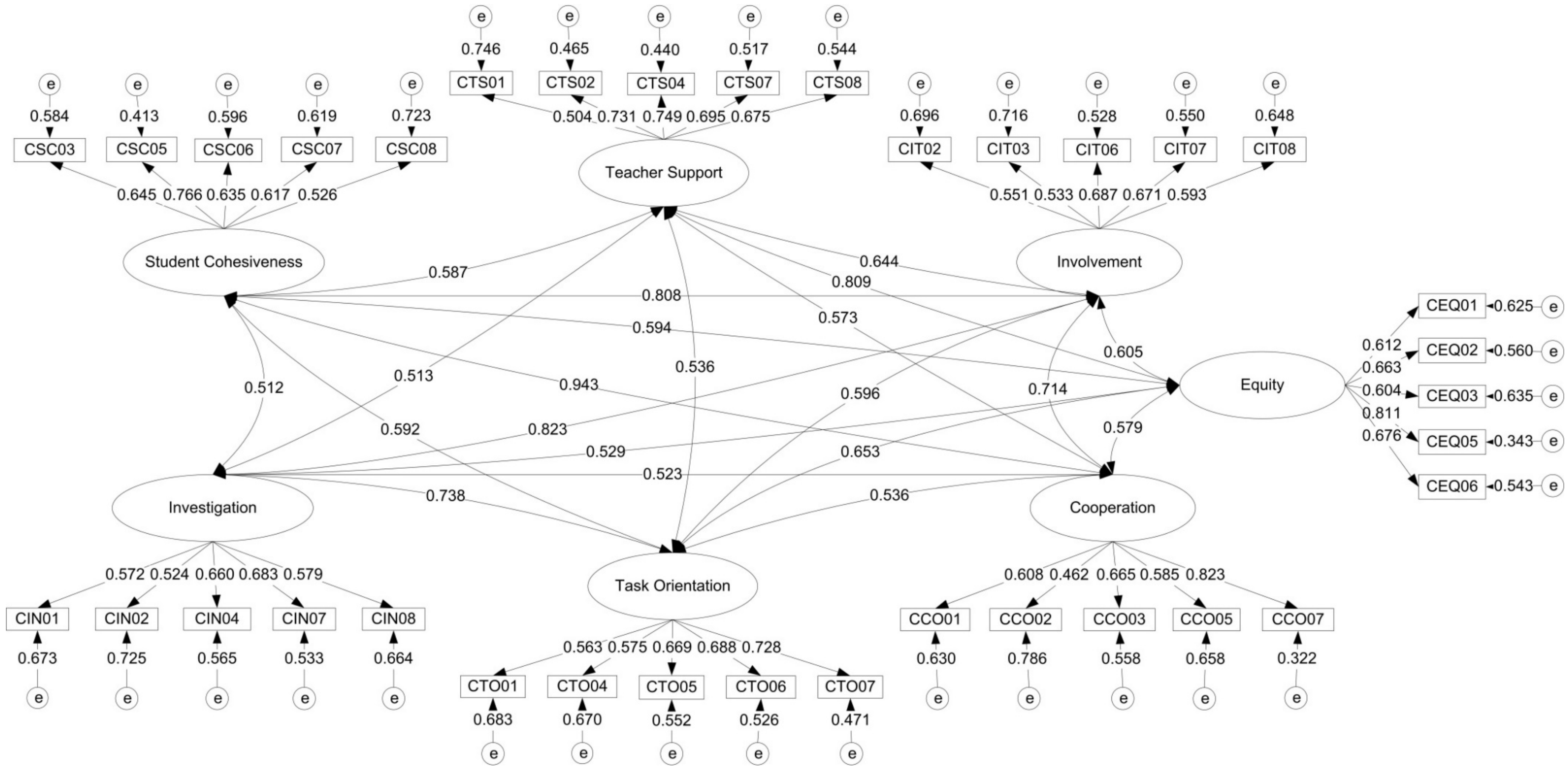

Figure 4.5 Initial CFA measurement model for WIHIC factors – standardised output.

Table 4.6

WIHIC Model 1- Construct Reliability, Average Variance Extracted, Correlations

	CR	AVE	CTO	CIN	CCO	CIT	CEQ	CTS	CSC
Task Orientation	0.782	0.420	*0.648*						
Investigation	0.742	0.368	**0.738**	*0.606*					
Cooperation	0.770	0.409	0.536	0.523	*0.640*				
Involvement	0.746	0.372	0.596	**0.823**	**0.714**	*0.610*			
Equity	0.807	0.459	**0.653**	0.529	0.579	0.605	*0.677*		
Teacher Support	0.806	0.458	0.536	0.513	0.573	**0.644**	**0.809**	*0.642*	
Student Cohesiveness	0.776	0.413	0.592	0.512	**0.943**	**0.808**	0.594	0.587	*0.642*

Note: Diagonal of correlation matrix contains $\sqrt{AVE}$. Values in bold indicate $\sqrt{AVE} < |r|$

The Involvement scale had poor discriminant validity with four of the other scales: Investigation (0.823), Student Cohesiveness (0.808), Cooperation (0.714), and Teacher Support (0.644). The R-squared and modification indices were inspected to identify variables that could potentially affect the discriminant validity of the instrument. Five items were found to have an R^2 values less than 0.3: CCO02 (0.214), CTS01 (0.254), CIN02 (0.275), CSC08 (0.277), and CIT03 (0.284). The modification indices were then inspected to identify the potential cross loading of these variables onto other factors in the WIHIC measurement model: CIT03 with CEQ (31.297) and CTS (80.547); CIN02 with CIT (13.771), CEQ (18.475) and CTS (28.923); CCO02 with CIT (17.190); and CSC08 with CCO (13.638).

Each of these variables were removed from the revised measurement model in sequence and the discriminant validity and model fit of the resulting model was re-evaluated. The fit indices for the revised 7-factor model (Model 1) indicate a poor fit (see Table 4.7).

Table 0.7

Fit indices of successive CFA models for WIHIC factors

	Model 1	Model 2	Model 3	Model 4
Free Parameters	111	93	73	57
Chi-Square test				
Value	1209.559	809.668	550.539	317.825
Degrees of Freedom	384	284	179	113
P-Value	0	0	0	0
RMSEA				
Estimate	0.064	0.059	0.063	0.058
90 Percent C.I.	0.060 - 0.068	0.054 - 0.064	0.057 - 0.069	0.051 - 0.066
Pr(RMSEA) ≤ .05	0	0	0	0.033
CFI	0.868	0.899	0.906	0.928
TLI	0.850	0.885	0.889	0.913
SRMR	0.060	0.057	0.056	0.050

While high correlations between several factors were reduced (Table 4.8), the revised 7-factor model still lacked discriminant validity between most of the previously identified factors. To achieve both discriminant validity and a good model fit, the measurement model was further revised by the removal of factors in the following sequence: Involvement, Equity, and Student Cohesiveness. At each stage the same set of variables (CCO02, CTS01, CIN02, CSC08, and CIT03) were identified as having R^2 values below 0.3 and were subsequently removed in order to improve model fit and the validity of the measurement model. In Table 4.7, the fit indices for each of these revised models is listed: the 6-factor revised model after removing the Involvement scale

(Model 2), the 5-factor revised model after also removing the Equity scale (Model 3), and the 4-factor revised model after removing the Student Cohesiveness scale (Model 4).

Table 4.8

Discriminant validity of the revised WIHIC 7-factor model

	CR	AVE	CTO	CIN	CCO	CIT	CEQ	CTS	CSC
Task Orientation	0.782	0.420	*0.648*						
Investigation	0.740	0.418	**0.698**	*0.646*					
Cooperation	0.769	0.461	0.501	0.448	*0.679*				
Involvement	0.725	0.400	0.586	**0.773**	**0.681**	*0.633*			
Equity	0.807	0.459	**0.653**	0.478	0.567	0.557	*0.677*		
Teacher Support	0.802	0.503	0.551	0.435	0.665	0.553	**0.824**	*0.709*	
Student Cohesiveness	0.777	0.468	0.618	0.483	**0.877**	**0.796**	0.586	0.566	*0.684*

Note: Diagonal of correlation matrix contains $\sqrt{AVE}$. Values in bold indicate $\sqrt{AVE} < |r|$

The revised 4-factor measurement model (Model 4) consists of Task Orientation (5 items), Investigation (4 items), Cooperation (4 items), and Teacher Support (4 items). This revised model is a good fit for the data. However, there persists a slight problem with the discriminant validity between the revised Task Orientation and Investigation factors. A review of the R^2 values for the revised 4-factor model identified one remaining item with a value below 0.3, CIN04 (0.276). This variable was removed resulting in a measurement model (Model 5) with improved fit.

The final measurement model (Model 5), as illustrated in Figure 4.6, has good convergent and discriminant validity, and had an acceptable level of fit with the data (χ^2 = 277.102 (*df* = 98, *p*=0), RMSEA = 0.059 [0.051, 0.067], CFI = 0.933, TLI = 0.918, SRMR = 0.045).

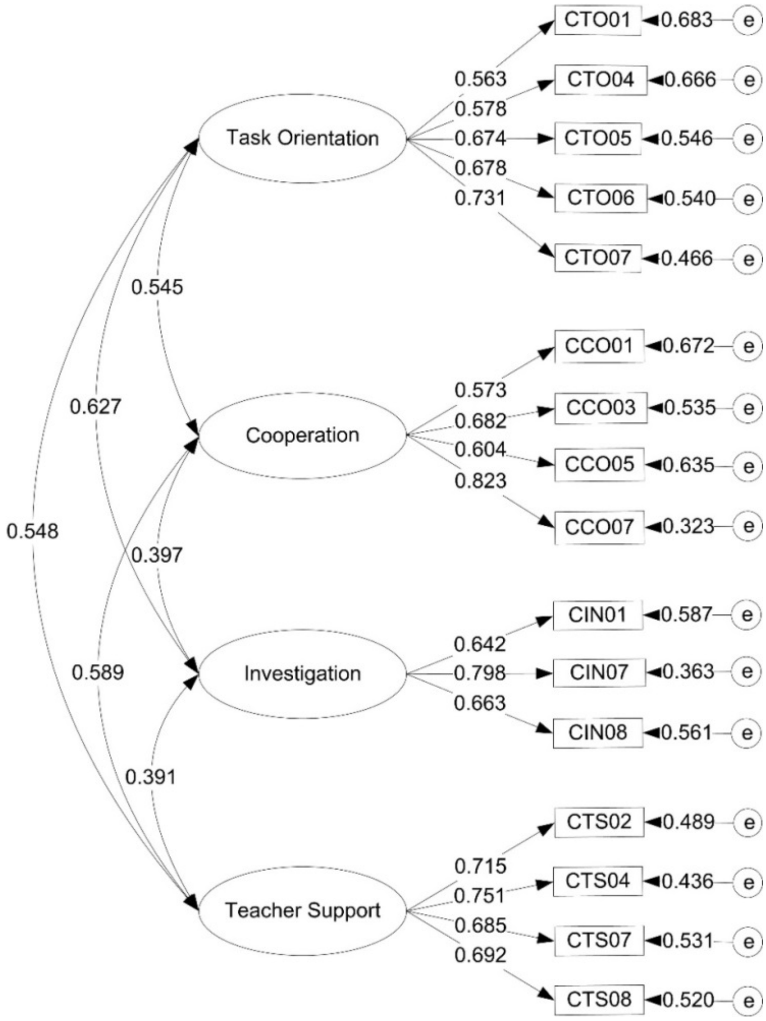

Figure 4.6 Final 4-factor WIHIC measurement model – standardised output.

The final 4-factor measurement model consists of Task Orientation (5 items), Investigation (3 items), Cooperation (4 items), and Teacher Support (4 items). The construct reliability value for each scale (shown in Table 4.9) was greater than the recommended 0.7. An inspection of the correlations for each pairs of factors show that for each factor $\sqrt{AVE} > |r|$. Thus, the four learning environment factors were deemed to be measuring different constructs.

Table 4.9

Discriminant Validity for WIHIC model 5

	CR	AVE	CTO	CIN	CCO	CTS
Task Orientation (CTO)	0.782	0.420	*0.648*			
Investigation (CIN)	0.745	0.496	0.627	*0.704*		
Cooperation (CCO)	0.769	0.459	0.545	0.397	*0.677*	
Teacher Support (CTS)	0.804	0.506	0.548	0.391	0.589	*0.711*

Note: Diagonal of correlation matrix contains $\sqrt{AVE}$. Values in bold indicate $\sqrt{AVE} < |r|$

Self-Theory of Intelligence

The model fit information for the Self Theory of Intelligence base model (Model 1) is summarised in Table 4.10. The fit statistics indicate that the base model (see Figure 4.7) is a poor fit for the sample data.

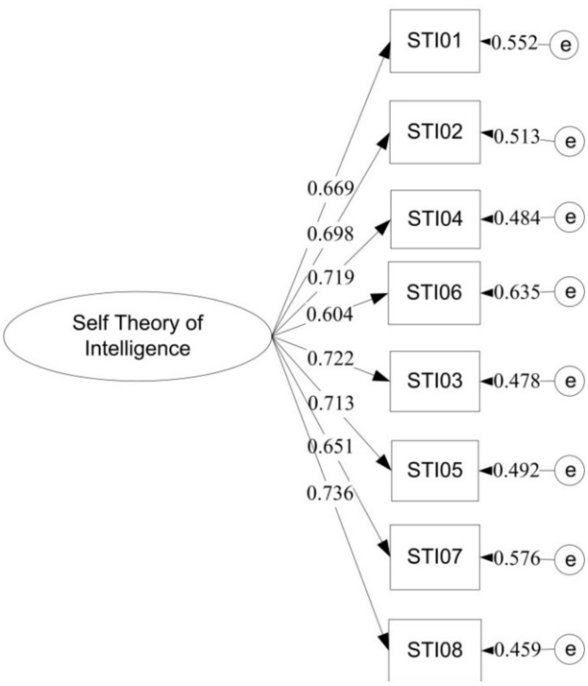

Figure 4.7 Initial measurement model for Self-Theory of Intelligence (model 1) – standardised output.

Table 4.10

Fit Information for Self-Theory of Intelligence Measurement models

		Model 1	Model 2
Number of Free Parameters		24	30
Chi-Square Test			
	Value	411.835	48.245
	Degrees of Freedom	20	14
	P-Value	0.0000	0.0000
RMSEA			
	Estimate	0.189	0.067
	90 Percent C.I.	0.173 - 0.205	0.047 - 0.088
	Pr(RMSEA) ≤ .05	0.000	0.081
CFI		0.811	0.983
TLI		0.736	0.967
SRMR		0.078	0.021

While the Self-Theory of Intelligence factor was developed as a unidimensional scale, some studies have found that the entity focused items and the incremental focused items load onto two factors (De Castella & Byrne, 2015; Diseth, Meland, & Breidablik, 2014; Leroy, Bressoux, Sarrazin, & Trouilloud, 2007; Shih, 2011). An examination of the item correlations shown in Table 4.11, suggests that this may be the case for this sample as well. The indicators associated with Entity (E) focused statements (STI01, STI02, STI04, and STI06) are more highly correlated with each other than the Incremental (I) focused statements, and vice versa.

Table 4.11

Correlation matrix for Self Theory of Intelligence Model 1

	STI01	STI02	STI03	STI04	STI05	STI06	STI07	STI08
STI01 (E)	1							
STI02 (E)	**0.708**	1						
STI03 (I)	0.398	0.427	1					
STI04 (E)	**0.600**	**0.614**	0.477	1				
STI05 (I)	0.388	0.405	**0.638**	0.453	1			
STI06 (E)	**0.449**	**0.507**	0.363	**0.504**	0.339	1		
STI07 (I)	0.348	0.351	**0.517**	0.401	**0.546**	0.321	1	
STI08 (I)	0.372	0.408	**0.601**	0.443	**0.610**	0.476	**0.623**	1

The entity focused items are negatively worded; for example, *Your intelligence is something about you that you can't change very much*. Therefore the modification indices were examined to determine if the model fit might be improved by allowing for a method effect. The modification indices were grouped according to the assumed method effect between similarly worded items (Table 4.12). As shown in Table 4.10, freeing the correlations between the error terms for the entity items resulted in a significant improvement in the fit of the model to the data (Model 2). This finding is consistent with other studies that have used different approaches for catering for method effect inherent in the self-theory of intelligence latent construct (García-Cepero & McCoach, 2009; Roskam & Nils, 2007).

Table 4.12

Modification Indices for Self-Theory of Intelligence Model 1

			M.I.	E.P.C.
STI02	WITH	STI01	154.456	0.582
STI04	WITH	STI01	41.233	0.301
STI04	WITH	STI02	41.010	0.282
STI06	WITH	STI02	15.786	0.183
STI06	WITH	STI04	11.706	0.157
STI08	WITH	STI07	59.930	0.252
STI05	WITH	STI03	52.725	0.266
STI08	WITH	STI05	27.014	0.172
STI08	WITH	STI03	18.811	0.146
STI07	WITH	STI05	17.230	0.148

The final model (Model 2), as illustrated in Figure 4.8, retained an acceptable level of reliability, CR = 0.72, and was therefore deemed to be a valid construct.

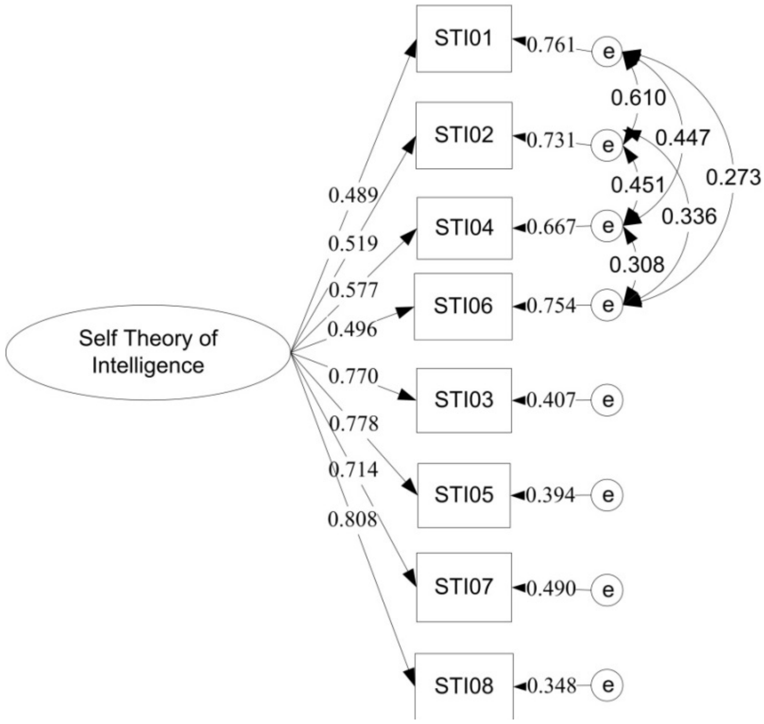

Figure 4.8 Final measurement model for Self-Theory of Intelligence (model 2) – standardised output.

Full Measurement Model

The estimated correlation matrix for the latent factors is presented in Table 4.13. The full measurement model, which included all validated scales, was a good fit to the data (chi-square(893) = 1875.091, RMSEA = 0.045, 90% CI = 0.042 to 0.048, Pr(RMSEA<0.05) = 0.999, CFI = 0.901, TLI = 0.890, SRMR = 0.056). The correlation matrix provided further support for the discriminant validity of the scales included in this study, as there were no correlations greater than 0.7.

Table 0.13

Estimated Correlation Matrix for Latent Factors

	Self-Efficacy			Social Climate				Help-Seeking		
	STI	AES	SEP	CTO	CIN	CCO	CTS	HSA	HSE	HSI
Self-Theory of Intelligence	1									
Academic Self-Efficacy	0.345**	1								
Social Self-Efficacy with Peers	0.288**	0.388**	1							
Task Orientation	0.255**	0.575**	0.318**	1						
Investigation	0.177**	0.485**	0.257**	0.634**	1					
Cooperation	0.245**	0.255**	0.685**	0.544**	0.394**	1				
Teacher Support	0.161*	0.291**	0.334**	0.553**	0.395**	0.579**	1			
Help-Seeking Avoidance	-0.255**	-0.289**	-0.314**	-0.488**	-0.190**	-0.266**	-0.337**	1		
Help-Seeking Expedient	-0.264**	-0.272**	-0.113	-0.389**	-0.045	-0.117	-0.102	0.508**	1	
Help-Seeking Instrumental	0.369**	0.590**	0.421**	0.555**	0.368**	0.479**	0.475**	-0.361**	-0.199*	1

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Chapter Summary

In this chapter, validation data for the scales used in this study are detailed. Confirmatory factor analysis and convergent and discriminant validity data were presented and discussed in this chapter. The four main constructs (help-seeking, classroom climate, self-efficacy and self-theory of intelligence) in this study were assessed using a combination of existing scales. Three scales were used to measure the self-reported help-seeking behaviour in mathematics classes. Confirmatory factor analysis supported the construct and factorial validity of the three scales without modification.

Three scales were also used to measure different aspects of academic and social self-efficacy of the participants. The validity of the Social Self-Efficacy with the Teacher scale was not confirmed and it was subsequently excluded from further analysis. Confirmatory factor analysis supported the validity of the two remaining scales after one item was dropped from the Social Self-Efficacy with Peers scale, and the measurement errors for two items on the Academic Self-Efficacy scale were freed to correlate. The two modified scales had good model fit indices and construct reliability.

The seven scales from the *What is Happening in This Class?* instrument were used to measure the classroom climate in this study. Initial confirmatory factor analysis indicated a poor model fit with four pairs of scales having very strong correlations, above 0.8. The revised classroom climate construct retained four scales, which were modified by deleting some items from the original scale. The modified scales had reasonable model fit indices and were highly reliable.

Self-Theory of Intelligence was measured using a single 8-item scale with the four negatively worded items reversed scored. To take into account the method effect and achieve good model fit the error terms, the four negatively worded (entity) items were freely correlated. The final construct had very good model fit indices and good reliability.

The validation data confirms the validity and reliability of the measurement model and provides a basis for the subsequent analysis of the proposed structural model presented in Chapter 5 of this thesis.

CHAPTER 5: ANALYSIS AND INTERPRETATION OF DATA

Data reported in the previous chapter attest to the validity of the different scales employed in this study. The resulting measurement model was a good fit to the data. The purpose of this chapter is to report on the analysis of the structural relations between the scales for the data collected from a sample of 551 secondary mathematics students. Each of the following sections addresses one of the four research questions:

1. What is the relationship between students' perceptions of the social learning environment (social climate) and their help-seeking behaviours during secondary mathematics?
2. To what extent does students' academic and social self-efficacy mediate the influence of the social climate on their help-seeking behaviours?
    a. What is the relationship between students' perceptions of the social climate and their academic and social self-efficacy?
    b. What is the relationship between students' help-seeking behaviours and their academic and social self-efficacy?
3. To what extent does students' self-theory of intelligence mediate the influence of the social climate on their help-seeking behaviours?
    a. What is the relationship between students' perceptions of the social climate and their self-theory of intelligence?
    b. What is the relationship between students' help-seeking behaviours and their self-theory of intelligence?
4. What empirical model best explains the relationship between students' perceptions of the social climate and their help-seeking behaviours?

a. What direct and indirect relations exist in this empirical model between students' perceptions of the social climate and their help-seeking behaviours?

b. What relative importance do different aspects of the social climate have on students' help-seeking behaviours?

From Social Climate to Help-Seeking

To address the first research question, SEM was used to establish if a direct relationship existed between the three Help-Seeking factors and the four social climate factors in the measurement model. In Figure 5.1 the final structural model is illustrated after trimming non-significant ($p > 0.05$) paths. This model had 97 free parameters, a chi-square (308, N = 551) of 763.106, and is an adequate fit to the data (RMSEA = 0.052, 90% CI [0.047, 0.056], Pr(RMSEA<0.05) = 0.252, CFI = 0.905, TLI = 0.891, and SRMR = 0.057).

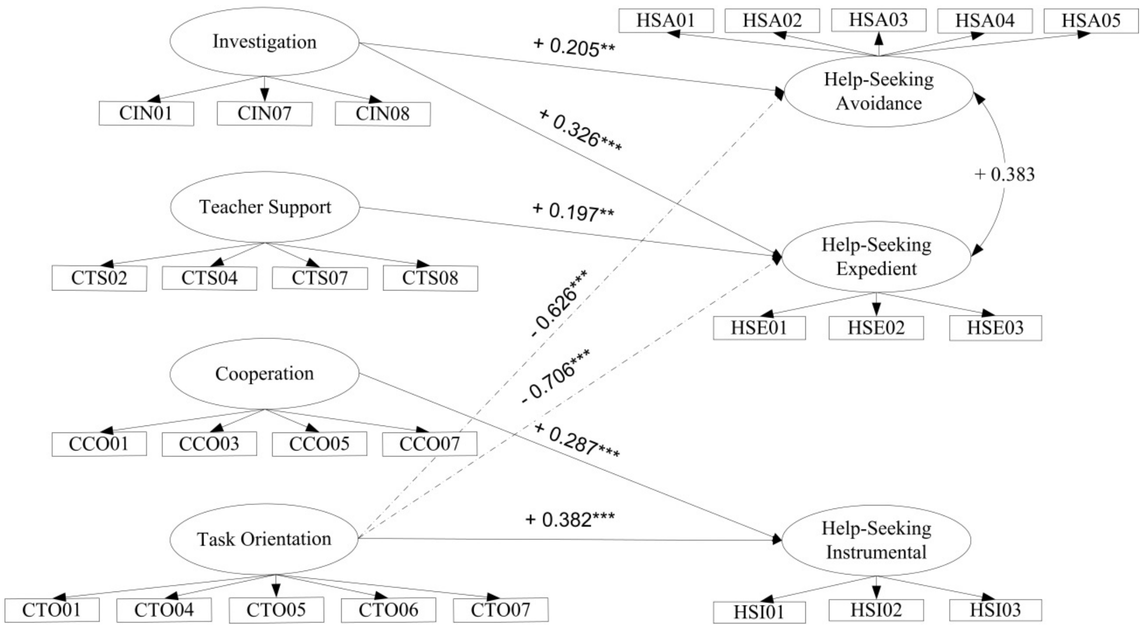

*Figure 5.1 Help-Seeking regressed on Social Climate factors. *** p<0.001, ** p<0.01, * p<0.05.*

Investigation had a positive relationship with both Help-Seeking Avoidance and Help-Seeking Expedient. The Investigation scale measures students' perceptions of the extent to which they use inquiry-based practices to test their own ideas, solve problems and find their own answers to questions by doing investigations. Thus, the scale refers to the broader investigative practices a student may engage in during mathematics, which include, but are not limited to, investigations as a learning activity. The findings indicate that students who perceived their classroom as promoting the use of investigative practices were more likely to avoid seeking help or to get quick answers rather than improve their understanding of the mathematics.

Teacher Support had a direct relationship with Help-Seeking Expedient. Teacher Support measures students' perceptions of the extent to which the teacher helps and is interested in students. The findings indicate that students who have a positive perception of support from the teacher are more likely to ask the teacher for help so that they can quickly move on to other work.

Cooperation had a direct relationship with students' use of instrumental help-seeking during mathematics class. Cooperation is a measure of the students' perceptions of the extent to which students work with, and learn from other, students in the class. This finding indicates that classrooms perceived as supporting learning as a social practice encourages students to seek help in order to further understanding.

Task Orientation was the only social climate factor to have a direct relationship with each of the help-seeking factors. Task Orientation measures students' perceptions that the classroom environment supports the importance of staying on task, completing planned activities and understanding the work. This factor had a positive relationship with students' use of strategic help-seeking during mathematics class. Task Orientation was also associated with a lower likelihood of avoiding seeking help when it is required or engaging in help seeking with the goal of reducing effort.

The R^2 estimates for each dependent variable were 0.272 for Help-Seeking Avoidance, 0.245 for Help-Seeking Expedient, and 0.348 for Help-Seeking Instrumental. That is, the four social climate factors accounted for between 24.5 % and 34.8 % of the variance in the help-seeking factors. These figures suggest that the social climate of the mathematics classroom is an important factor influencing the help seeking goals and strategies of students during class.

From Social Climate to Help-Seeking via Self-Efficacy Factors

This section reports the investigation of the second research question, which aims to establish if social and academic self-efficacy mediates the relationship between help-seeking and the social climate of the mathematics classroom.

Self-Efficacy to Help-Seeking

The first step in testing for mediation was to evaluate if a direct relationship existed between the three help-seeking factors and the two self-efficacy factors. In Figure 5.2 the final model is illustrated after trimming non-significant (p>0.05) paths and correlations from the saturated model. The final model had 73 free parameters, chi-square (179, N=551) of 581.370. Most of the fit indices indicate an adequate model fit for the data (RMSEA = 0.064, 90% CI [0.058, 0.070], Pr(RMSEA<0.05) = 0.0, CFI = 0.905, TLI = 0.889, and SRMR = 0.064).

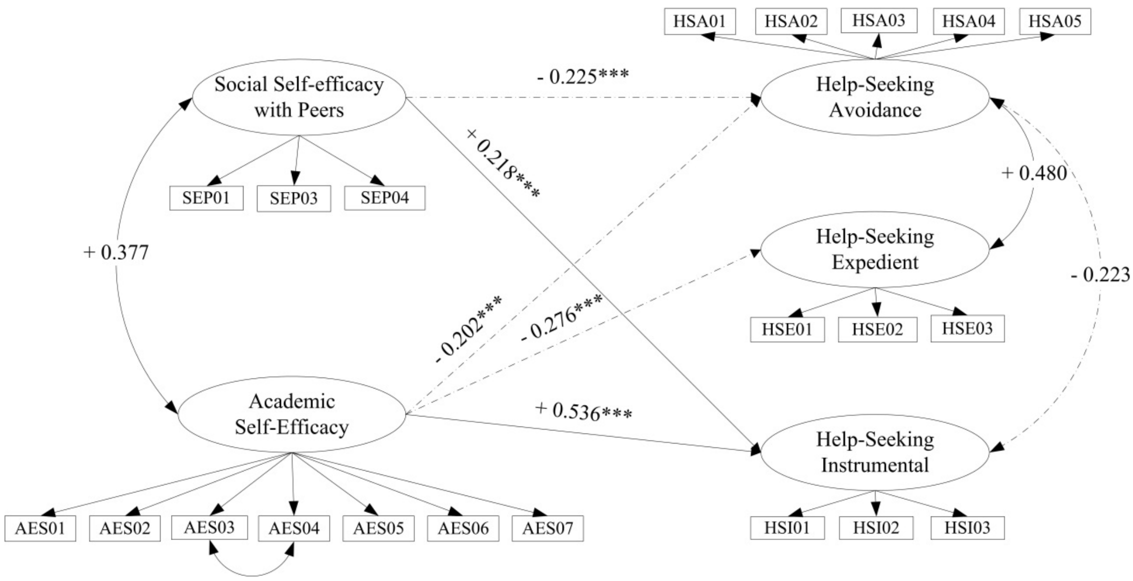

*Figure 5.2 Help-Seeking regressed on Self-Efficacy. *** p<0.001, ** p<0.01, * p<0.05.*

In terms of Social Self-Efficacy with Peers, the results of the analysis indicated that students who are confident in their ability to establish a positive relationship with peers are also more likely to engage in help seeking as a strategic (instrumental) goal. Social Self-Efficacy with Peers also had a direct effect on reducing Help-Seeking Avoidance, but not on Help-Seeking Expedient. These finding suggest that students are less likely to avoid seeking help during mathematics if they are confident in their capability to establish a positive relationship with their peers.

In terms of Academic Self-Efficacy, the results of the analysis indicated that the more confident a student is in their ability to learn mathematics the more likely they are to favour using help-seeking as a strategic (instrumental) goal to aid their learning. Similarly, Academic Self-Efficacy had a direct negative effect on Help-Seeking Avoidance and Help-Seeking Expedient. These findings suggest that the more confident a student is in their ability to learn mathematics, the less likely they are to avoid seeking help when help is needed or ask the teacher for the answer so that they can quickly move on to other work.

The R^2 estimates for each dependent variable were 0.126 for Help-Seeking Avoidance, 0.076 for Help-Seeking Expedient, and 0.422 for Help-Seeking Instrumental. Thus, academic and social self-efficacy accounted for between 7.6 % and 42.2 % of variance in the help-seeking factors. It appears that both academic and social self-efficacy are important factors that have a stronger influence on encouraging the use of adaptive approaches to help-seeking (Help-Seeking Instrumental) than on reducing the use of non-adaptive approaches to help-seeking.

From Social Climate to Self-Efficacy

The second step in testing for mediation was to evaluate if a direct relationship existed between the four social climate factors and the two self-efficacy factors. In Figure 5.3 the final trimmed model is illustrated with substantive paths that had significant ($p<0.05$) standardised regression coefficients. This model had 89 free parameters and chi-square (288, N = 551) of 645.883. The fit indices indicate that the model is a good fit for the data (RMSEA = 0.048, 90% CI [0.043, 0.052], Pr(RMSEA<0.05) = 0.792, CFI = 0.932, TLI = 0.923, and SRMR = 0.049).

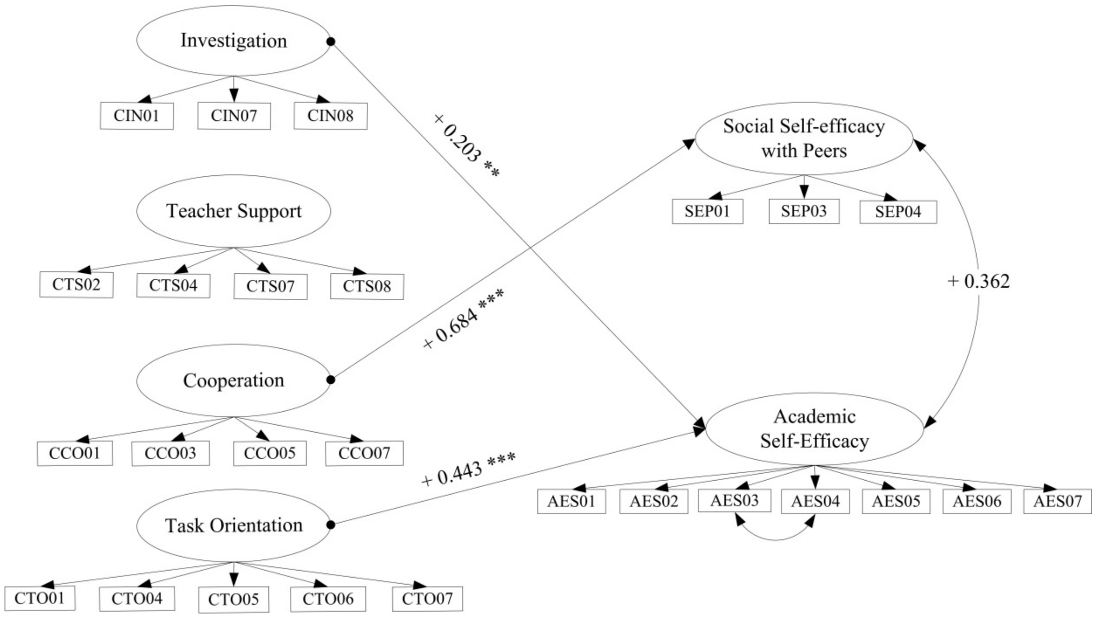

*Figure 5.3 Self-Efficacy regressed on Social Climate. *** p<0.001, ** p<0.01, * p<0.05.*

Investigation and Task Orientation had a positive direct effect on Academic Self-Efficacy. This finding indicates that the clearer students' understanding is of the cognitive demands of the classroom, the greater their confidence in their capabilities to complete the learning tasks.

Cooperation had a positive direct effect on from Social Self-Efficacy with Peers. That is, a classroom that encourages student cooperation, rather than competition, enables students to develop confidence in their capability to interact with their peers when working on learning tasks.

The R^2 estimates for each dependent variable were 0.352 for Academic Self-Efficacy, and 0.467 for Social Self-Efficacy with Peers. The social climate factors accounted for 35.2 % and 46.7 % of the variance in the self-efficacy factors. This suggests that social climate of the mathematics classroom is an important factor that influences the academic and social self-efficacy of students during class.

In this section, I reported findings from an investigation to see if social and academic self-efficacy mediates the relationship between help seeking and the social climate. A direct relationship was found between self-efficacy factors and the help-seeking factors. A direct relationship was also found between three measures of the social climate and the two self-efficacy factors. Therefore, Academic Self-Efficacy and Social Self-Efficacy with Peers factors appear to mediate the relationship between Help-Seeking and the social climate.

From Social Climate to Help-Seeking via Self-Theory of Intelligence

In this section I reports findings from an investigation of the third research question, which aims to establish if students' self-theory of intelligence mediates the relationship between help-seeking and the social climate.

From Self-Theory of Intelligence to Help-Seeking

The first step in testing for mediation was to evaluate if a direct relationship existed between the three help-seeking factors and Self-Theory of Intelligence. In Figure 5.4 the final trimmed model is illustrated with significant ($p<0.05$) standardised regression coefficients and significant correlations shown. This model had 69 free parameters, chi-square (140, N= 551) of 346.956, and is a good fit to the data (RMSEA= 0.052, 90% CI [0.045, 0.059], Pr(RMSEA<0.05) = 0.292, CFI= 0.946, TLI = 0.935, SRMR = 0.056).

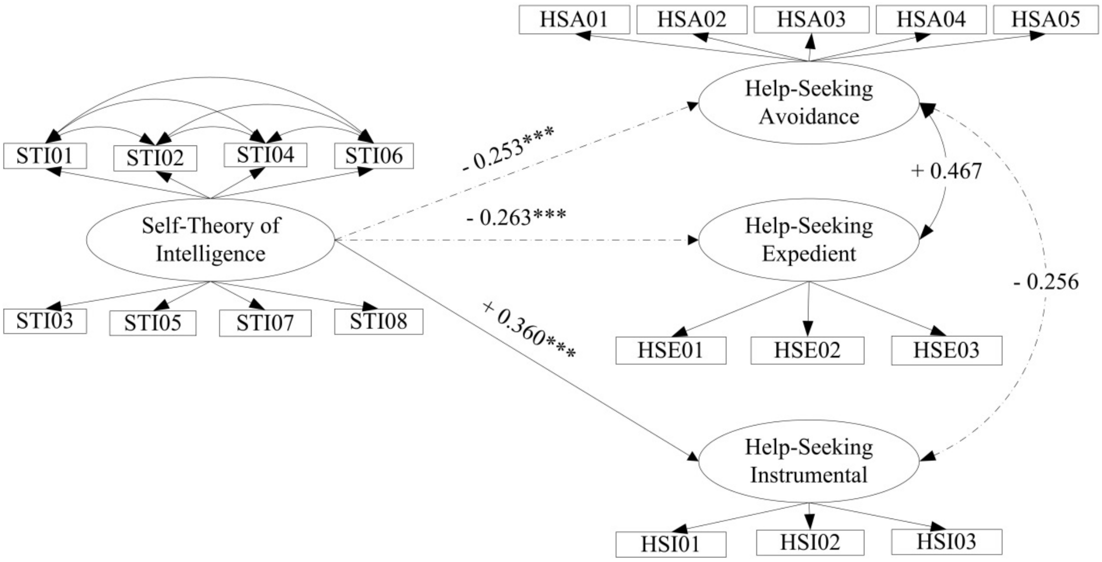

*Figure 5.4 Help-Seeking regressed on Self-Theory of Intelligence. *** p<0.001, ** p<0.01, * p<0.05.*

Self-Theory of Intelligence had a direct effect on each of the three help-seeking factors. For the Self-Theory of Intelligence scale, a high score indicates that students believe that intelligence is due to effort and that a low score indicates a belief that intelligence is due to innate ability. The results of the analysis indicate that students who agree that intelligence is primarily due to effort are more likely to be strategic help seekers; that is, they seek help to improve their understanding of mathematics. Similarly, the results suggest that these students are more likely to not use non-adaptive approaches to help-seeking, such as avoiding seeking help or seeking help in order to reduce effort.

The R^2 estimates for each dependent variable were 0.064 for Help-Seeking Avoidance, 0.069 for Help-Seeking Expedient, and 0.130 for Help-Seeking Instrumental. Self-Theory of Intelligence factors account for between 6.9 % and 13.0 % of the variance in the help-seeking factors. The findings suggest that a student's self-theory of intelligence had a small, though significant, effect on their help-seeking goals and strategies during class.

From Social Climate to Self-Theory of Intelligence

The second step in testing for mediation was to evaluate if a direct relationship existed between the social climate factors and Self-Theory of Intelligence. In Figure 5.5 the final trimmed model is illustrated with significant (p<0.05) standardised regression coefficients and significant correlations shown. This model had 86 free parameters, chi-square (238, N= 551) of 480.578, and was a good fit to the data (RMSEA = 0.043, 90% CI [0.037, 0.049], Pr(RMSEA<0.05) = 0.982, CFI = 0.950, TLI = 0.942, SRMR = 0.043).

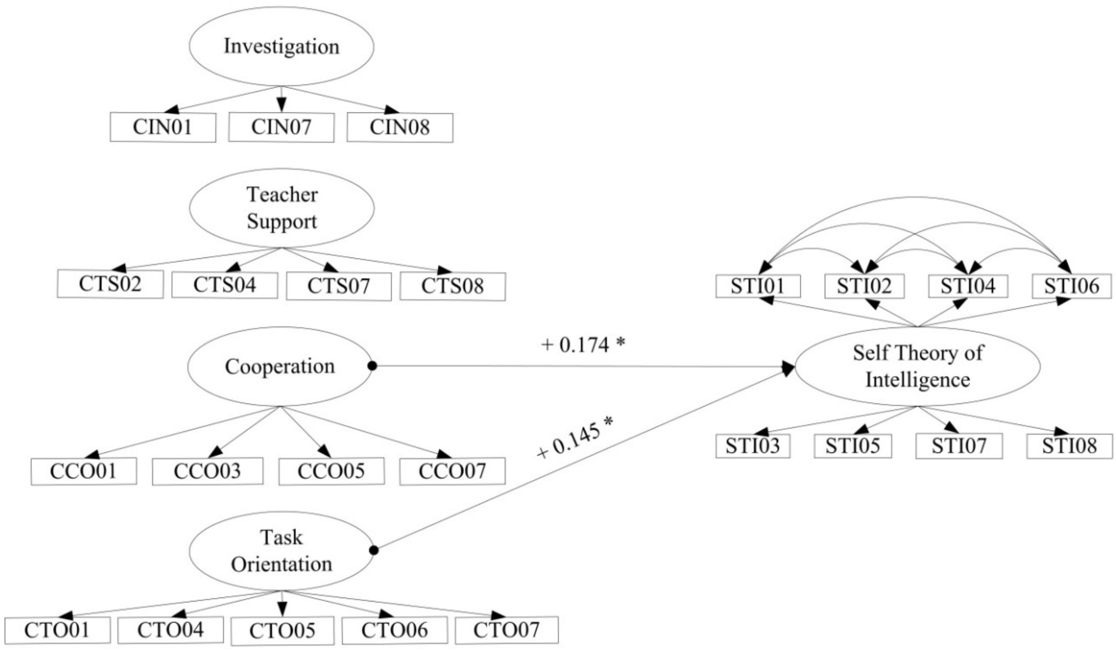

*Figure 5.5 Self-Theory or Intelligence regressed on Social Climate factors. *** p<0.001, ** p<0.01, * p<0.05.*

Cooperation and Task Orientation were the only two social climate factors that had a direct effect on Self-Theory of Intelligence. It appears that, students who cooperate with other students and know what they are trying to accomplish in class, are more likely believe that intelligence is the result of sustained effort rather than just ability.

The R^2 estimates for Self-Theory of Intelligence was 0.079. That is, Cooperation and Task Orientation accounted for 7.9 % of the variance in the Self-Theory of Intelligence factor. This suggests that social climate of the mathematics classroom had a small, though significant, effect on students' self-theory of intelligence.

In this section, findings from the investigation to establish if self-theory of intelligence mediates the relationship between help-seeking and the social climate is reported. A direct relationship was found between the self-theory of intelligence and the help-seeking factors. A direct relationship was also found between two measures of the social climate and the self-theory of intelligence factors. Therefore, it appears that the Self-Theory of Intelligence factor is a potential mediator of the relationship between the social climate and students' academic help-seeking behaviours.

Mediated Structural Model

In this section, I report on the investigation relating to the fourth research question to find an empirical model that best explains the relationship between students' perceptions of the social climate and their help-seeking strategies. A fully mediated structural model was constructed, which incorporated the significant paths from each of the models detailed previously. This model had 171 free parameters, chi-square (909, N = 551) of 1958.302, and was a reasonable fit to the data (RMSEA = 0.046, 90% CI [0.043, 0.049], Pr(RMSEA<0.05) = 0.994, CFI = 0.894, TLI = 0.884, SRMR = 0.063).

In the fully mediated structural model, three of the paths from the self-efficacy factors to the help-seeking factors were no longer significant: Academic Self-Efficacy to Help-Seeking Avoidance ($p = 0.840$), and to Help-Seeking Expedient ($p = 0.243$), and Social Self-Efficacy with Peers to Help-Seeking Instrumental ($p = 0.817$). The confidence intervals for the specific indirect effect of each mediated path, from the social climate factors to the help-seeking factors, were analysed to determine the potential for the removal of each of these non-significant paths.

In Table 5.1, the standardized estimates and bootstrap confidence intervals (5000 draws) for each of the direct and indirect paths from the social climate factors to the three help-seeking factors are listed.

Table 5.1

Standardised confidence intervals of specific indirect and direct effects

	Lower .5%	Lower 2.5%	Lower 5%	Estimate	Upper 5%	Upper 2.5%	Upper .5%
		95% CI	90% CI	---	90% CI	95% CI	
Direct effect on Help-Seeking Avoidance							
Task Orientation	-0.788	-0.725	-0.697	-0.552	-0.416	-0.389	-0.328
Investigation	-0.021	0.040	0.063	0.208	0.357	0.394	0.450
Specific indirect effect on Help-Seeking Avoidance via Self-Theory of Intelligence							
Task Orientation	-0.067	-0.053	-0.047	-0.020	-0.001	0.002	0.011
Cooperation	-0.061	-0.045	-0.040	-0.017	0.000	0.003	0.008
Specific indirect effect on Help-Seeking Avoidance via Academic Self-efficacy							
Task Orientation	-0.078	-0.055	-0.044	0.011	0.073	0.086	0.112
Investigation	-0.045	-0.030	-0.023	0.004	0.029	0.035	0.046
Specific indirect effect on Help-Seeking Avoidance via Social Self-efficacy with Peers							
Cooperation	-0.212	-0.186	-0.172	-0.110	-0.041	-0.029	-0.009

Table 5.1 continued

	Lower .5%	Lower 2.5%	Lower 5%	Estimate	Upper 5%	Upper 2.5%	Upper .5%
		95% CI	90% CI	---	90% CI	95% CI	
Direct effect on Help-Seeking Expedient							
Task Orientation	-0.951	-0.864	-0.821	-0.614	-0.413	-0.373	-0.306
Investigation	0.080	0.143	0.176	0.351	0.531	0.568	0.640
Teacher Support	-0.063	-0.006	0.022	0.163	0.294	0.321	0.372
Specific indirect effect on Help-Seeking Expedient via Self-Theory of Intelligence							
Task Orientation	-0.085	-0.07	-0.062	-0.031	-0.007	-0.004	0.001
Cooperation	-0.073	-0.06	-0.052	-0.025	-0.004	-0.001	0.005
Specific indirect effect on Help-Seeking Expedient via Academic Self-efficacy							
Task Orientation	-0.153	-0.122	-0.108	-0.041	0.031	0.046	0.073
Investigation	-0.088	-0.064	-0.054	-0.017	0.012	0.018	0.032
Direct effect on Help-Seeking Instrumental							
Task Orientation	-0.092	-0.022	0.010	0.163	0.310	0.340	0.394
Cooperation	-0.039	0.029	0.067	0.274	0.470	0.510	0.595
Specific indirect effect on Help-Seeking Instrumental via Self-Theory of Intelligence							
Task Orientation	-0.001	0.003	0.005	0.026	0.058	0.065	0.083
Cooperation	-0.005	0.000	0.003	0.021	0.044	0.051	0.063
Specific indirect effect on Help-Seeking Instrumental via Academic Self-efficacy							
Task Orientation	0.043	0.070	0.086	0.176	0.278	0.301	0.355
Investigation	-0.002	0.015	0.022	0.073	0.136	0.152	0.181
Specific indirect effect on Help-Seeking Instrumental via Social Self-efficacy with Peers							
Cooperation	-0.195	-0.141	-0.116	-0.001	0.127	0.155	0.203

The 90% confidence intervals for the paths from the social climate to the help-seeking factors via three mediators contained zero. For Help-Seeking Avoidance via Academic Self-Efficacy, the 90% confidence intervals for both Task Orientation (-0.044, 0.073) and Investigation (-0.023, 0.029) contained zero. For Help-Seeking Expedient via Academic Self-Efficacy the 90% confidence intervals for both Task Orientation (-0.108, 0.031) and Investigation (-0.054, 0.012) contained zero. For Help-Seeking Instrumental via Social Self-Efficacy with Peers the 90% confidence intervals for Cooperation (-0.116, 0.127) contained zero. These paths were subsequently removed from the structural model.

An analysis of the results of the bootstrap confidence intervals also indicates a potential problem with Self-Theory of Intelligence as a mediator between the social climate factors and Help-Seeking Avoidance. The upper bounds of the 90% confidence interval for both Task Orientation (-0.047, -0.001) and Cooperation (-0.040, 0.000) very close to zero and therefore is some doubt about the role of Self-Theory of Intelligence as a mediator. When the bootstrap confidence intervals were recalculated, after removing the three non-significant self-efficacy mediators, there was no change in the values for Self-Theory of Intelligence. As a result, the path from Self-Theory of Intelligence to Help-Seeking Avoidance was removed. Figure 5.6 illustrates the final structural model with confidence intervals and significant correlations.

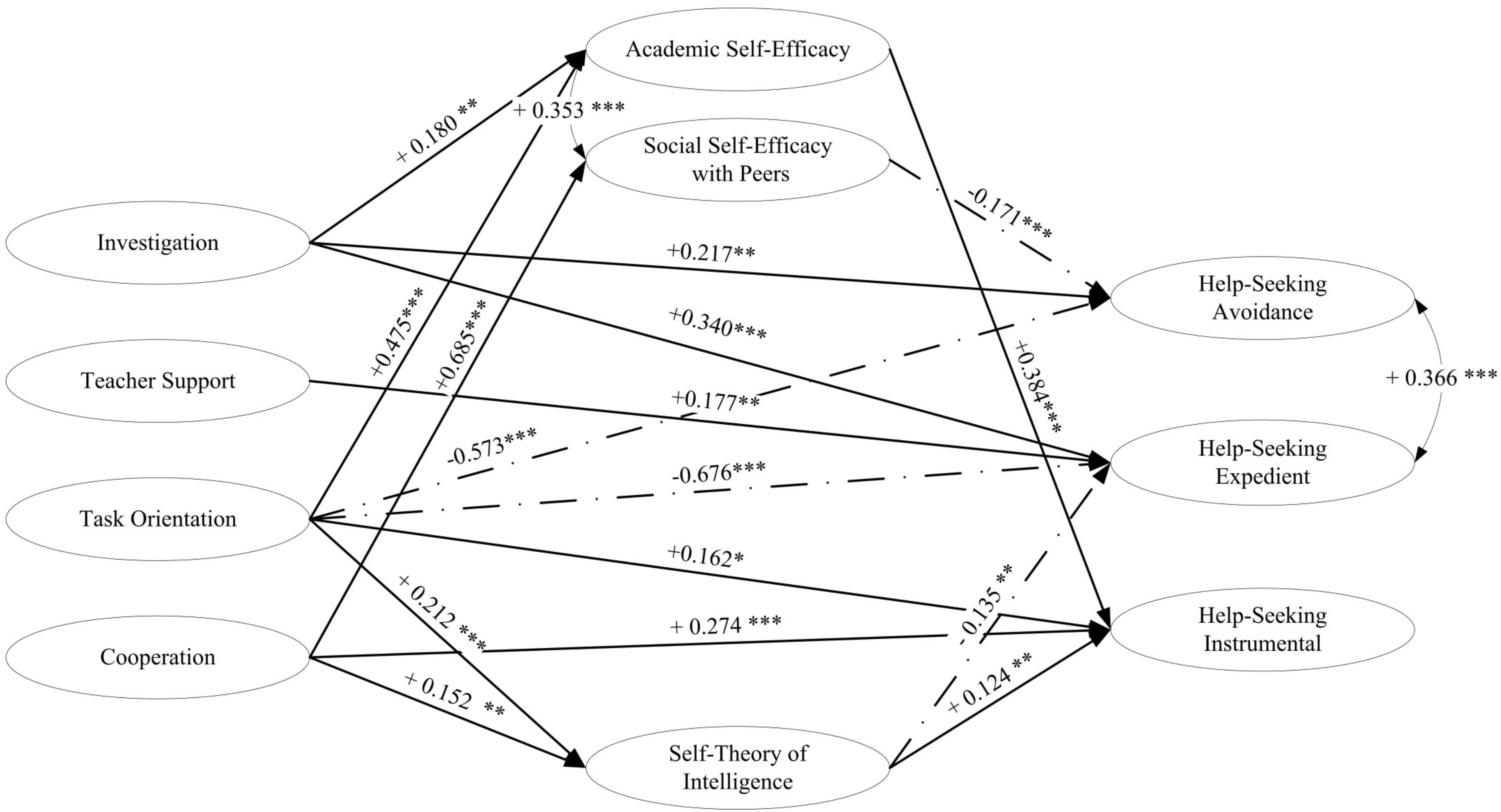

*Figure 5.6 Final structural model. *** 99%CI, **95%CI, *90%CI.*

The estimates and bootstrap confidence intervals for the specific indirect (mediated) and direct paths for the final model are shown in Table 5.2. The results provide strong support for the direct and indirect effect of social climate on approaches to help-seeking in the mathematics classroom.

Table 5.2

Standardised confidence intervals of specific indirect and direct effects for final model

	Lower .5%	Lower 2.5% (95% CI)	Lower 5% (90% CI)	Est. ---	Upper 5% (90% CI)	Upper 2.5% (95% CI)	Upper .5%
Direct effect on Help-Seeking Avoidance							
Task Orientation	-0.801	-0.742	-0.715	-0.573	-0.437	-0.413	-0.371
Investigation	0	0.051	0.075	0.217	0.362	0.397	0.453
Specific indirect effect on Help-Seeking Avoidance via Social Self-efficacy with Peers							
Cooperation	-0.221	-0.194	-0.179	-0.117	-0.051	-0.040	-0.015
Direct effect on Help-Seeking Expedient							
Task Orientation	-0.997	-0.912	-0.875	-0.676	-0.480	-0.442	-0.379
Investigation	0.071	0.136	0.165	0.34	0.519	0.562	0.628
Teacher Support	-0.044	0.008	0.039	0.177	0.309	0.334	0.393
Specific indirect effect on Help-Seeking Expedient via Self-Theory of Intelligence							
Task Orientation	-0.079	-0.065	-0.058	-0.029	-0.005	-0.003	0.005
Cooperation	-0.065	-0.052	-0.046	-0.02	-0.002	0.001	0.006

Table 5.2 continued

	Lower .5%	Lower 2.5% (95% CI)	Lower 5% (90% CI)	Est. ---	Upper 5% (90% CI)	Upper 2.5% (95% CI)	Upper .5%
Direct effect on Help-Seeking Instrumental							
Task Orientation	-0.06	-0.005	0.02	0.162	0.293	0.316	0.366
Cooperation	0.092	0.14	0.162	0.274	0.381	0.403	0.444
Specific indirect effect on Help-Seeking Instrumental via Self-Theory of Intelligence							
Task Orientation	-0.003	0.002	0.004	0.026	0.058	0.067	0.084
Cooperation	-0.006	-0.001	0.002	0.019	0.04	0.047	0.059
Specific indirect effect on Help-Seeking Instrumental via Academic Self-efficacy							
Task Orientation	0.057	0.082	0.098	0.183	0.284	0.306	0.347
Investigation	-0.007	0.011	0.019	0.069	0.129	0.146	0.175

There was a small improvement in some of the fit indices for the final structural model. The final model had 168 free parameters, a chi-square (912, N = 551) of 1932.501, and was a reasonable fit to the data (RMSEA= 0.045, 90% CI = 0.042 to 0.048, Pr(RMSEA<0.05) = 0.998, CFI = 0.897, TLI = 0.888, SRMR = 0.063). There was only one significant correlation between the Help-Seeking factors. Help-Seeking Avoidance was positively correlated (0.366, p = 0) with Help-Seeking Expedient. This association was expected as both factors are theorised to measure non-adaptive learning strategies. The lack of a negative association between these non-adaptive factors and Help-Seeking Instrumental is noteworthy. The findings suggest that the structural model has accounted for most of the expected association between Help-Seeking Instrumental and the other help-seeking factors.

To improve clarity and interpretation of the structural model, correlations between the social climate factors were not included in Figure 5.6. In Table 5.3, correlations between the social climate factors shows the expected direct relationship between the scales. Students who had a positive perception of one measure of the social climate were also likely to have a positive perception of other social climate factors. Task Orientation had the strongest association with each of the other social climate factors, including Investigation (0.634, $p = 0$). In comparison, Investigation had weaker association with both Cooperation (0.389, $p = 0$) and Teacher Support (0.388, p=0).

Table 5.3

Correlation Coefficients for Social Climate Factors in Final Structural Model.

	Investigation	Teacher Support	Cooperation	Task Orientation
Investigation	1			
Teacher Support	0.388	1		
Cooperation	0.389	0.576	1	
Task Orientation	0.634	0.558	0.514	1

R^2 estimates for Self-Theory of Intelligence was 0.102. That is, Cooperation and Task Orientation accounted for 10.2 % of variance in the Self-Theory of Intelligence factor. This suggests that social climate of the mathematics classroom had a small, though significant, effect on the self-theory of intelligence of students during class.

R^2 estimates for the self-efficacy mediators were 0.367 for Academic Self-Efficacy and 0.470 for Social Self-Efficacy with Peers. That is, three of the social climate factors accounted for 36.7 % and 47.0 % of variance in the Academic Self-Efficacy and Social Self-Efficacy with Peers factors respectively. This suggests that social climate of the mathematics classroom had an important influence on the academic and social self-efficacy of students during class.

R^2 estimates for each help-seeking factor were 0.296 for Help-Seeking Avoidance, 0.269 for Help-Seeking Expedient, and 0.496 for Help-Seeking Instrumental. That is, the social climate, self-efficacy and self-theory of intelligence factors accounted for between 26.9% and 49.6% of the variance in help-seeking. This suggests that social climate of the mathematics classroom is an important influence on the how students use help-seeking as a learning strategy: especially for seeking help to improve understanding of concepts (Help-Seeking Instrumental), rather than seeking help for reducing effort (Help-Seeking Expedient) or not seeking help when needed (Help-Seeking Avoidance).

Each relation depicted in Figure 5.6 represents a statistically significant effect between two factors in the model. In Table 5.4 the direct, indirect, and total effects that factors of the psychosocial climate have on adaptive and non-adaptive approaches to help seeking for each of the structural paths are shown. When comparing these relations between different aspects of social climate on the help-seeking strategies, the following trends emerged.

Table 5.4

Direct (D), total indirect (I), and total effects (T)

	Mediators									Outcomes								
	Academic Self-Efficacy			Social Self-Efficacy with Peers			Self-Theory of Intelligence			Help-Seeking Avoidance			Help-Seeking Expedient			Help-Seeking Instrumental		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
Independent Var.																		
Investigation	0.180		0.180							0.217		0.217	0.340		0.340		0.069	0.069
Teacher Support													0.177		0.177			
Cooperation				0.685		0.685	0.152		0.152		-0.117	-0.117		-0.020	-0.020	0.274	0.019	0.293
Task Orientation	0.475		0.475				0.212		0.212	-0.573		-0.573	-0.676	-0.029	-0.704	0.162	0.209	0.371
Mediators																		
Academic Self-Efficacy																0.384		0.384
Social Self-Efficacy with Peers										-0.171		-0.171						
Self-Theory of Intelligence													-0.135		-0.135	0.124		0.124

Investigation had a total effect on Help-Seeking Avoidance and Help-Seeking Expedient that is about half the corresponding total effect of Task Orientation. The Investigation factor supported the use of non-adaptive strategies, and had a positive total effect, while both Task Orientation and Cooperation had the effect of reducing the use of these non-adaptive strategies.

Teacher Support was the least influential of the four social climate factors included in the structural model for this study. The only help-seeking factor it had direct effect on was Help-Seeking Expedient, though the total effect was half that of Investigation and a quarter of the effect of Task Orientation. However, as with Investigation, the Teacher Support factor supported the use of this non-adaptive strategy (Help-Seeking Expedient), while both Task Orientation and Cooperation had the effect of reducing the use of this non-adaptive strategy.

The direct influence of Cooperation on Help-Seeking Instrumental was larger than the direct influence of Task Orientation. The Cooperation and Task Orientation factors have similar levels of total influence (direct + indirect effects) on the Help-Seeking Instrumental factor. Cooperation had a larger indirect effect, via Social Self-Efficacy with Peers, on Help-Seeking Avoidance than the other social climate factors.

Task Orientation was the only social climate factor that had a direct effect on each of the help-seeking factors. It had a direct effect of reducing the use of non-adaptive strategies, Help-Seeking Avoidance and Help-Seeking Expedient, and increasing the strategic use of help-seeking in order to further understanding. Task Orientation also had an indirect effect on two of the help-seeking factors via a positive effect on the student's self-theory of intelligence. It also had a specific indirect effect on Help-Seeking Instrumental via a positive effect on Academic Self-Efficacy. The total influence of Task Orientation on the non-adaptive help-seeking factors, Help-Seeking

Avoidance and Help-Seeking Expedient, was at least two times stronger than the other social climate factors. For Help-Seeking Instrumental, the total (direct + indirect) effect was greater than the total effect for the Cooperation factor.

Chapter Summary

In this chapter, I reported on the analysis and development of the structural equation model in response to the research questions. In summary, the Task Orientation and Cooperation factors were mostly associated with directly supporting the use the adaptive help-seeking strategies. In contrast, the Investigation and Teacher Support factors were mostly associated with supporting the use of non-adaptive strategies (Help-Seeking Avoidance and Help-Seeking Expedient). However, the Investigation factor did have a small indirect effect on Help-Seeking Instrumental via the mediating factor of Academic Self-Efficacy.

The structural model accounted for 29.6% of the variance for the Help-Seeking Avoidance factor, 26.9% for Help-Seeking Expedient, and 49.6% for Help-Seeking Instrumental. For the mediators the social climate factors accounted for 10.2% of the variance in the Self-Theory of Intelligence, 36.7% for Academic Self-Efficacy, and 47.0% for Social Self-Efficacy with Peers.

CHAPTER 6: DISCUSSION

In this study, SEM was used to examine the relations between four social climate factors (Task Orientation, Cooperation, Investigation, and Teacher Support), three competency mediators (Academic Self-Efficacy, Social Self-Efficacy with Peers, and Self-Theories of Intelligence), and students' academic help-seeking behaviours (Instrumental, Expedient, and Avoidance). An exploratory approach was taken to build and test a model of the multivariate relationships between the latent variables. For this purpose, SEM had three distinct advantages when compared to other statistical techniques used in education research. Firstly, as a confirmatory method, SEM is suited to modelling complex multivariate relations and indirect effects that are difficult to implement via other approaches. Secondly, SEM explicitly models measurement error. Third, SEM supports robust techniques for handling missing data, such as full information maximum likelihood (FIML), which are more efficient and less biased than traditional approaches (Wang & Wang, 2012). In this chapter, a discussion of the findings is presented, followed by an outline of the practical implications for teachers, research limitations and suggestions of future research.

Theoretical Contributions

The aim of this study was to explain how the social climate of the secondary mathematics classroom interacts with personal characteristics to influence students' help seeking behaviours. The conceptual framework of the present study drew on Bandura's (2012b) social cognitive theory to examine a mediated model of the relationships between the social climate and students' help-seeking behaviours. A review of the mathematics education, self-regulation and learning environments literature identified Academic and Social Self-Efficacy and a student's Self-Theory of

Intelligence as potential mediators in the structural model. Confirmatory factor analysis (CFA) and structural equation modelling (SEM) were used to test if the causal relations hypothesised in the conceptual model were plausible. The analyses were guided by the following four research questions:

1. What is the relationship between students' perceptions of the social climate and their help-seeking behaviours during secondary mathematics?

2. To what extent does students' academic and social self-efficacy mediate the influence of the social climate on their help-seeking behaviour?

3. To what extent does students' self-theory of intelligence mediate the influence of the social climate on their help-seeking behaviour?

4. What empirical model best explains the relationship between students' perceptions of the social climate and their help-seeking behaviours?

In the following sections, I discuss the findings in accordance with each of the research questions.

Research Question 1

> *What is the relationship between students' perceptions of the social climate and their help-seeking behaviours during secondary mathematics?*

The first step in testing the proposed mediation model was to establish the nature of the direct relationships between the social climate factors and students' help-seeking behaviours. Subsequent to testing the construct validity of the social climate measurement model, four social climate factors (Investigation, Teacher Support, Cooperation, and Task Orientation) were retained for inclusion in the structural model. The structural path model (Figure 6.1) of the relationships between students' perceptions of social climate and their academic help-seeking behaviours was an adequate fit to the data (χ^2 = 763.106 (N = 551, *df* = 308, *p*=0), RMSEA = 0.052 [0.047, 0.056], Pr(RMSEA<0.05) = 0.252, CFI = 0.905, TLI = 0.891, and SRMR = 0.057). Social climate factors accounted for 27.2% of the variance in students' behaviours related to Help-seeking Avoidance, 24.5% for Help-seeking Expedient, and 34.8% for Help-seeking Instrumental. These figures suggest that students' perceptions of the social climate of the classroom influence their academic help-seeking goals and intentions during secondary mathematics.

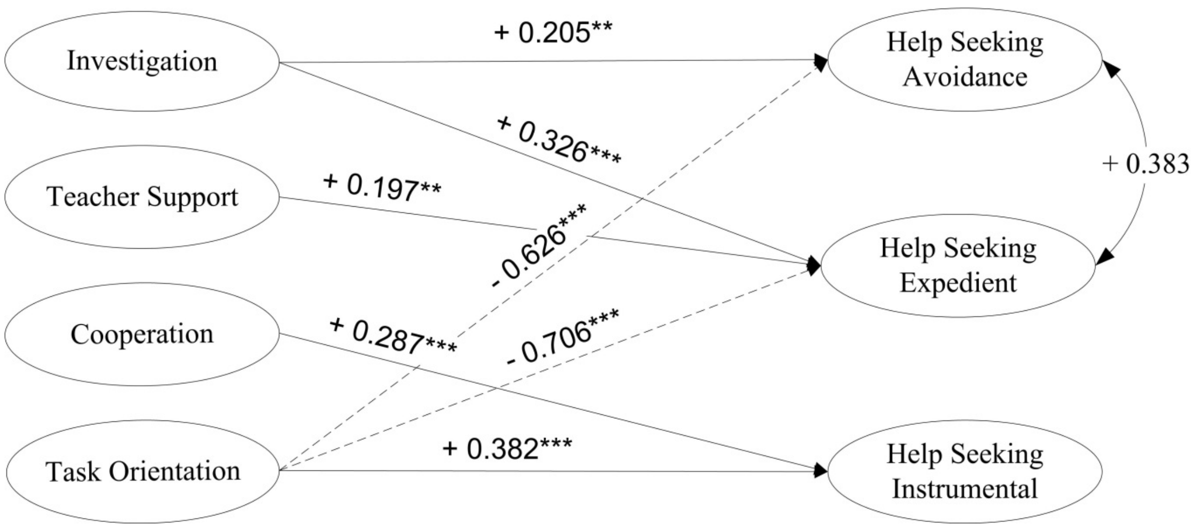

Figure 6.1 Structural model of the direct relationship between the social climate factors and students' help-seeking behaviours.

Task Orientation and Students' Help-Seeking Behaviours

The social climate of the classroom represented by the factor Task Orientation was found to have a strong negative effect on students' avoidance of help-seeking and expedient help-seeking, and a moderate positive effect on students' instrumental help-seeking. That is, students who perceived their classroom to be task oriented, where it was considered important to complete assigned activities, were less likely to engage in non-adaptive help-seeking behaviours and more likely to seek instrumental help. This finding adds to the social climate literature that has highlighted the importance of establishing a classroom climate that promotes on task behaviours. Studies that have used the WIHIC have found the factor Task Orientation to influence students' affective and cognitive outcomes, including students' mathematics self-concept (Lui, Toh, & Chung, 2009), enjoyment of mathematics (Wahyudi, 2010), and perceived usefulness of mathematics (Yang, 2015). In terms of the help-seeking literature, the effect of promoting on task behaviours on students' help-seeking behaviours is a new finding.

Investigation and Students' Help-Seeking Behaviours

The classroom factor called Investigation had a significant and moderately positive effect on students' expedient help-seeking and help-seeking avoidance. That is, when holding other factors constant, students who perceived the classroom as being supportive of the use of investigative processes (including inquiry-based, problem-solving, or challenging approaches) were more likely to seek help in order to reduce effort, and more likely to avoid seeking help when needed. This finding suggests that investigative approaches may well encourage undesirable help seeking behaviours and is new to the help seeking literature. It is important because there is currently a strong push towards more student-centred pedagogy, including the use of investigative approaches.

While this finding is new to the help-seeking literature, it is consistent with previous social climate researchers who have used the WIHIC and found a positive relationship between the Investigation scale and other avoidance outcomes, such as maths anxiety (Taylor & Fraser, 2003) and performance-avoidance goals (Kelly, 2010). A possible reason for learners avoiding asking for help while solving investigative tasks is the desire to feel competent by solving problems oneself (Marais, van der Westhuizen, & Tillema, 2013). The finding that investigative approaches were associated with expedient help-seeking is also consistent with other researchers. Page (2006) found that children who admitted to struggling when solving challenging mathematical problems were often reticent to seek help, or they sought help to verify that they had found the correct answer. McCaslin (2004) argued that students' perceptions of the relative difficulty of a task can lead to their persistence being focused on the pursuit of process objectives rather than learning objectives.

The finding that investigative approaches can encourage undesirable help-seeking behaviours, supports claims made in the literature that teachers need to provide students with more explicit guidance about learning strategies that complement perseverance while engaging with challenging problems, in addition to promoting the benefits of perseverance and effort (DiNapoli, 2019). Carreira, Ferreira, and Amado (2013) found that students are more likely to benefit from their engagement with challenging tasks when help seeking was viewed as a legitimate problem-solving strategy. Almeda, Baker, and Corbett (2017) recommended that help be best sought early in the process of tackling unfamiliar challenging tasks

Cooperation and Students' Help-Seeking Behaviours

The social climate factor called Cooperation had a positively moderate effect on students' behaviours associated with Instrumental Help-seeking, and no significant effect on students' non-adaptive help-seeking behaviours. That is, when holding other factors constant, students who perceived the classroom as supporting the use of cooperative learning approaches were more likely to seek help in order to improve their understanding. This finding adds to the social climate literature, which has previously focused on the relationship between Cooperation and students' affective outcomes, with mixed results. Social climate researchers have found that secondary students' perceptions that their classroom supported cooperative learning approaches had a positive effect on their attitudes towards mathematics in the USA (Hoang, 2008), a negative effect in Indonesia (Wahyudi, 2010), and had no effect on students' attitudes towards mathematics in rural China (Yang, 2015).

While this finding is new to the social climate literature, it is consistent with findings from the academic help-seeking literature. Previous help-seeking researchers have focused on the extent to which traditional versus cooperative learning approaches (Lavasani & Khandan, 2011), and cooperative versus collaborative group dynamics (Kempler & Linnenbrink, 2006; Webb, 1992; Webb, Ing, Kersting, & Nemer, 2006), influence the help seeking behaviours of secondary mathematics students. For example, Lavasani and Khandan (2011) found that Grade 7 mathematics students were more likely to seek instrumental help, and less likely to avoid seeking help, when taught using cooperative learning approaches compared to a traditional approach. Thus the current study provides only partial support for the hypothesised direct relationships between students' perception of cooperative learning approaches and their help-seeking behaviours; that is, while the effect on instrumental help-seeking is supported the expected direct negative effect on students' avoidant help-seeking behaviour was not.

Nevertheless, the finding that Cooperation positively influences students' instrumental help-seeking behaviours supports claims that secondary mathematics students will benefit from instructional approaches that integrate a range of cooperative learning approaches (Terwel, 2003). However, it is important to keep in mind that the type of help sought is likely to be dependent on the quality of the social interactions amongst students during small group work (Kempler & Linnenbrink, 2006; Webb, 1992; Webb et al., 2006). Webb et al. (2006) argued that teachers needed to provide cooperative settings that facilitate peer interactions, rather than just focusing on improving communication within small groups.

Teacher Support and Students' Help-Seeking Behaviours

The WIHIC factor referred to as Teacher Support had a relatively small positive effect on students' behaviours associated with expedient help-seeking but had no effect on behaviours associated with instrumental help-seeking or avoidance help-seeking. That is, when holding other factors constant, students who perceived their teacher as being supportive were more likely to seek expedient help but were not more likely to avoid seeking help or to seek help in order to consolidate their understanding. These findings differ in part from those expected based on the review of previous studies of students' help-seeking behaviours in secondary and primary mathematics classes.

The finding that teacher support does not influence secondary mathematics students' intentions to avoid seeking help is consistent with Kiefer and Shim (2016) who found that primary students' perceptions of teacher support predicted subsequent help-seeking, but not help-avoidance, in a domain-general learning context. However, Arbreton (1998) found that primary students' perceptions that their teacher was supportive, in terms of asking questions, did reduce the likelihood that they would avoid seeking help during mathematics. Similarly, Ryan et al. (2005) found that primary mathematics students identified by their teacher as help-seeking avoiders were less likely to view their teachers as providing adequate emotional or academic support compared to appropriate help-seekers.

The finding that secondary mathematics students' perceptions of teacher support did not influence their intentions to seek instrumental help is consistent with the findings of Schenke et al. (2015). However, other researchers have mostly found that teacher support increases the likelihood that students will seek instrumental help in domain-general learning contexts (Kiefer & Shim, 2016; Parker et al., 2019), primary mathematics classrooms (Arbreton, 1998; Newman & Schwager, 1993), and secondary mathematics classrooms (Federici & Skaalvik, 2014; Skaalvik et al., 2015).

The finding of a positive relationship between teacher support and expedient help-seeking is new to the help-seeking literature. Previously researchers (Kiefer & Shim, 2016; Ryan & Shim, 2012) had found that primary students' perceptions of their teacher as supportive reduced the likelihood that they would seek expedient help from peers. In contrast, Schenke et al. (2015) found that for secondary mathematics students (Grades 7-11), teacher emotional support had no effect their intentions to seek expedient help. One possible reason for these differences is that different measures of teacher support were used, such as general teacher support (Kiefer & Shim, 2016) and emotional support (Ryan & Shim, 2012; Schenke et al., 2015). In this study, Teacher Support measured the extent to which students perceived their teacher as interested in helping them understand when they have trouble with the work. Researchers (Karabenick & Sharma, 1994; Kozanitis et al., 2007) have found that students who perceived their teacher as actively supporting questions were less inhibited and therefore more likely to ask questions when they were confused. However, these studies did not differentiate between students' help-seeking behaviours. Marais et al. (2013) found that a key reason students gave for avoiding help-seeking was whether questions were welcomed by the teacher. In the current study, Help-Seeking Expedient was moderately correlated with Help-Seeking Avoidance (+0.383), but not Help-Seeking Instrumental. Therefore, a plausible explanation for the positive relationship between Teacher Support and students' expedient help-seeking is that students had fewer inhibitions about asking for help, even if it was focused on process rather than learning outcomes.

However, it is important to note that previous studies have predominantly used teacher support as the sole measure of the social climate of the mathematics classroom (e.g. Ryan & Shim, 2012; Sakiz, 2012; Schenke et al., 2015; Skaalvik et al., 2015). Therefore, it is plausible that differences between previous findings and those of the current study reflect the fact that more than one measure of social climate was used and that these measures were positively correlated. For example, Teacher Support was moderately correlated with Task Orientation (0.553) and Cooperation (0.579). Whereas teacher support was not directly associated with instrumental help-seeking as expected, both task orientation and cooperation were found to have a positive effect on students' instrumental help-seeking behaviours. In addition, while Teacher Support had a small positive effect (+0.197) on Help-Seeking Expedient, Task Orientation had a significantly stronger negative effects on Help-seeking Expedient (-0.706) and Help-Seeking Avoidance (-0.626). Students were also more likely to seek instrumental help in classrooms that where they could cooperate with their peers. This is important as it suggests that the importance of teacher support, as the sole indicator of the social climate of the traditional secondary mathematics classroom, has been overrated.

Research Question 2

> *To what extent does students' academic and social self-efficacy mediate the influence of the social climate on their help-seeking behaviour?*

In response to the second research question, the influence of the social climate on students' academic and social self-efficacy was explored. Then, the extent to which students' academic and social self-efficacy influenced their help-seeking behaviours was explored.

From Social Climate to Self-Efficacy

The structural path model of the relationships between Social Climate and Self-Efficacy (Figure 6.2) was a good fit for the data (χ^2 = 645.883 (N = 551, *df* = 288, *p*=0), RMSEA = 0.048 [0.043, 0.052], Pr(RMSEA<0.05) = 0.792, CFI = 0.932, TLI = 0.923, and SRMR = 0.049). Social climate accounted for 35.2% and 46.7% of variance in the self-efficacy factors. This suggests that the social climate dimensions of the mathematics classroom are important factors that influence the academic and social self-efficacy of students during class. Consistent with prior social climate research, Task Orientation and Investigation had a positive influence on secondary students' academic self-efficacy in mathematics classrooms (Dorman, 2001; Dorman & Adams, 2004; Kelly, 2010).

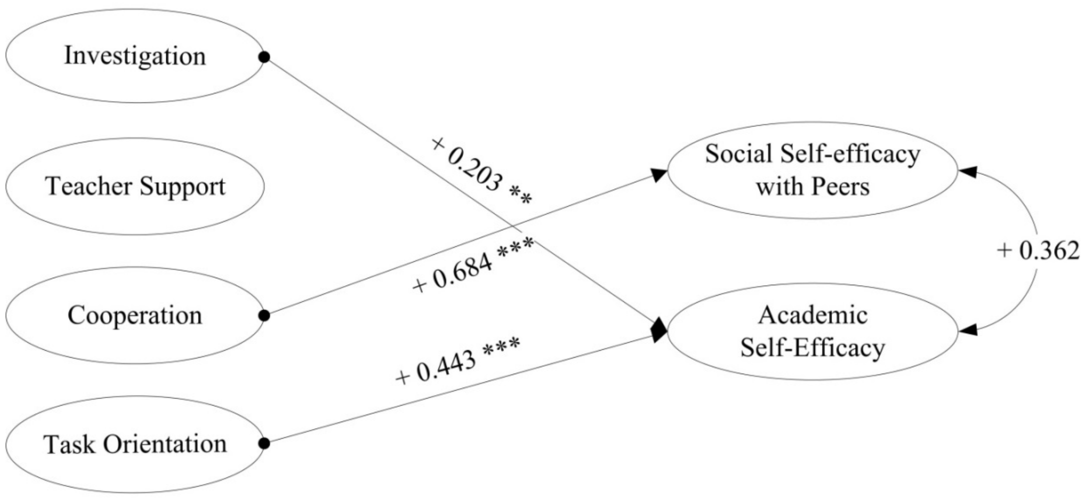

Figure 6.2 Structural model of the relationships between the social climate and self-efficacy factors.

Cooperation had a direct influence on secondary students' social self-efficacy with peers. This is a new finding. Patrick et al. (2007) found that primary mathematics students' perceptions of the classroom's social climate (promotion of mutual respect, promotion of task-related interaction, and student academic support) had a positive effect on their social self-efficacy with peers. However, no previous studies have found the expected relationship between secondary mathematics students' perceptions of the social climate and social self-efficacy with peers (Ryan & Patrick, 2001; Stewart, 2014). The current finding is in line with social cognitive theory, that self-efficacy is developed in social environments that provide mastery experiences and is influenced by social modelling and social persuasion (Bandura, 2012a). Classrooms that support cooperation between peers are likely to enhance students' social skills and social self-efficacy through increased social interaction, potentially resulting in a more effective learning environment (Patrick et al., 2012).

From Self-Efficacy to Help-Seeking Behaviours

The structural path model of the relationships between Self-efficacy and Academic Help-seeking (Figure. 6.3) was an adequate fit for the data (χ^2 = 581.370 (N = 551, *df* = 179, *p*=0), RMSEA = 0.064 [0.058, 0.070], CFI = 0.905, TLI = 0.889, and SRMR = 0.064). Academic and social self-efficacy accounted for 12.6% of the variance for Help-seeking Avoidance, 7.6% for Help-seeking Expedient, and 42.2% for Help-seeking Instrumental.

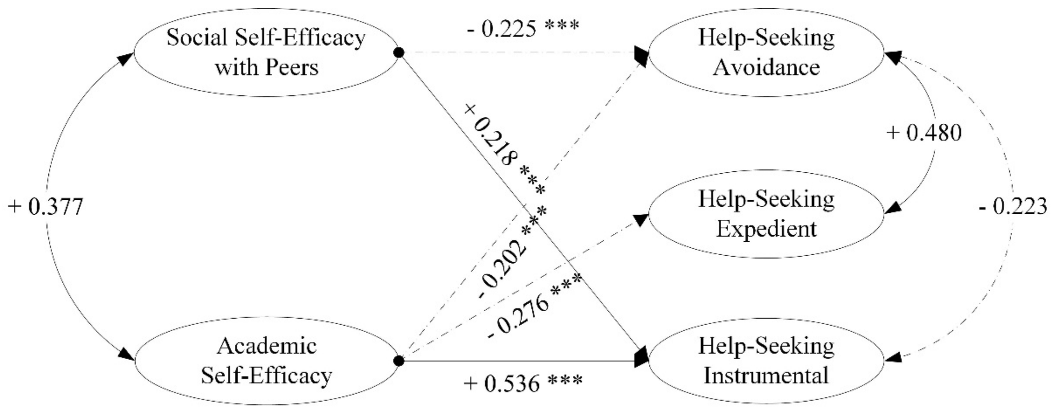

Figure 6.3 Structural model of the relationships between the self-efficacy and help-seeking factors.

In the current study, both Academic Self-efficacy and Social Self-efficacy with Peers were found to have independent statistically significant negative effects on students' help-seeking avoidance, and positive effects on their instrumental help-seeking behaviours. The relationships between social self-efficacy and secondary students' help-seeking behaviours are new findings. Previously this relationship has been explored only in primary school or university contexts. Consistent with the current study, Ng (2014) found that for university students in Hong Kong, Social Self-efficacy with Peers reduced help-seeking avoidance and had a positive effect on their instrumental help-seeking from peers but had no effect on expedient help-seeking. Kiefer and Shim (2016) found in primary schools, students' social self-efficacy had a negative effect on their avoidance of help seeking but did not have an effect on their instrumental help-seeking behaviours.

Studies with primary school students have also found that Academic Self-efficacy is associated with an increase in help seeking to improve understanding, and a reduction in avoiding seeking help when help is needed (Ryan, Gheen, & Midgley, 1998; Ryan et al., 2005). Similarly, studies of secondary mathematics students have mostly found that academic self-efficacy is associated with increased use of help-seeking to improve understanding (Skaalvik et al., 2015) or a reduction in help-seeking avoidance when help is needed (Bong, 2008). However, most studies of secondary students' academic help-seeking behaviours have focused on a single measure of help-seeking, either adaptive help-seeking (Parker et al., 2019; Skaalvik et al., 2015) or avoidance help-seeking (Bong, 2008; Middleton & Midgley, 1997; Ryan, Shim, Lampkins-uThando, Kiefer, & Thompson, 2009). Few studies have used a multi-factor approach to explore the extent to which students' academic self-efficacy influences their academic help-seeking behaviours. Of the few studies that have, Luo and Zhang (2015) found that for junior secondary mathematics students in Singapore, Academic Self-efficacy had a positive effect on their instrumental help-seeking behaviours, but no effect on expedient or avoidant help-seeking behaviours. Similarly, Won, Hensley, and Wolters (2019) found that for university students in the USA, students' self-efficacy for self-regulated learning had a positive effect on their adaptive help-seeking behaviours, but no effect on expedient help-seeking behaviours. One possible reason for finding different results in the current study is that previous studies have included other motivational factors, such as utility value (Won et al., 2019) and goal orientation (He, Chang, Chen, & Gou, 2012; Luo & Zhang, 2015), in addition to academic self-efficacy as an independent variable. Only one other study (Ng, 2014) has explored the relationship between students' self-efficacy and their help-seeking behaviours. However, Ng (2014) found that for Hong Kong university students, their social self-efficacy with peers and the teacher fully mediated the effect of academic self-efficacy on their help-seeking behaviours. Rather than assume a causal relationship, the current study explored the independent effects of Academic Self-Efficacy and Social Self-Efficacy with Peers on students' help-seeking behaviours. The two self-efficacy measures had a small positive correlation (+0.377).

Research Question 3

To what extent does students' self-theory of intelligence mediate the influence of the social climate on their help-seeking behaviour?

In response to the third research question, the influence of the social climate on students' self-theory of intelligence was explored. Then, the extent to which students' self-theory of intelligence influenced their help-seeking behaviours was explored.

From Social Climate to Self-Theory of Intelligence

The structural path model of the relationships between Social Climate and Self-Theory of Intelligence (Figure 6.4) was a good fit to the data (χ^2 = 480.578 (N = 551, *df* = 238, *p*=0), RMSEA = 0.043 [0.037, 0.049], Pr(RMSEA<0.05) = 0.982, CFI = 0.950, TLI = 0.942, SRMR = 0.043). The social climate factors, Cooperation and Task Orientation, accounted for 7.9% of the variance in the Self Theory of Intelligence factor. This suggests that social climate of the mathematics classroom had a small, though significant, effect on the students' self-theory of intelligence.

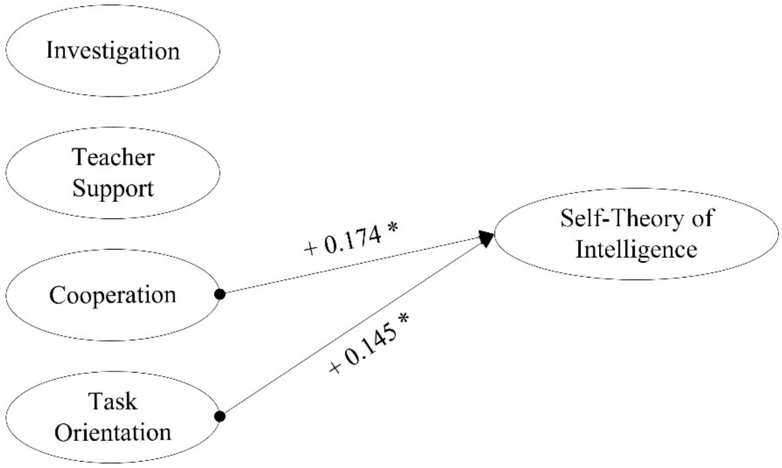

Figure 6.4 Structural model of the relationships between social climate and self-theory of intelligence.

Cooperation and Task Orientation had a positive influence on students' incremental view of intelligence. This is a new finding, as no previous quantitative studies have explored how secondary students' perceptions of specific social climate factors might promote the adoption of a growth mindset. In a small-scale study Francome and Hewitt (2018), using a mixed methods approach, found that UK secondary students were more likely to endorse a stronger growth-mindset belief in mathematics classrooms observed emphasising more collaborative versus individual approaches to learning. It is important because it suggests that the mathematics students are taught using a cooperative learning approach may be more likely to adopt a growth mindset, in addition to experiencing less anxiety and less help avoidance (Lavasani & Khandan, 2011).

The finding that a cooperative classroom climate and a task-orientated classroom climate was associated with a growth mindset, adds to the small but growing literature on how growth mindset beliefs may be developed. Recent research suggests that the quality of Australian students' relationships with their peers and the teacher may indirectly influence students' adoption of growth-mindset beliefs (Collie, Martin, Papworth, & Ginns, 2016; Martin et al., 2019). Laurian-Fitzgerald and Roman (2016) found that primary students who were taught to work effectively in small groups displayed growth mindsets.

From Self-Theory of Intelligence to Help-Seeking Behaviours

The structural path model of the relationships between Self-theory of Intelligence and Academic Help-Seeking (Figure 6.5) was a good fit to the data (χ^2 = 346.956 (N = 551, *df* = 140, *p*=0), RMSEA= 0.052 [0.045, 0.059], Pr(RMSEA<0.05) = 0.292, CFI= 0.946, TLI = 0.935, SRMR = 0.056). Self-theory of Intelligence accounted for 6.4% of the variance for Help-seeking Avoidance, 6.9% for Help-seeking Expedient, and 13% for Help-seeking Instrumental. The findings suggested that students' self-theory of intelligence had a small, though significant, effect on the students' help-seeking goals and strategies in mathematics classrooms.

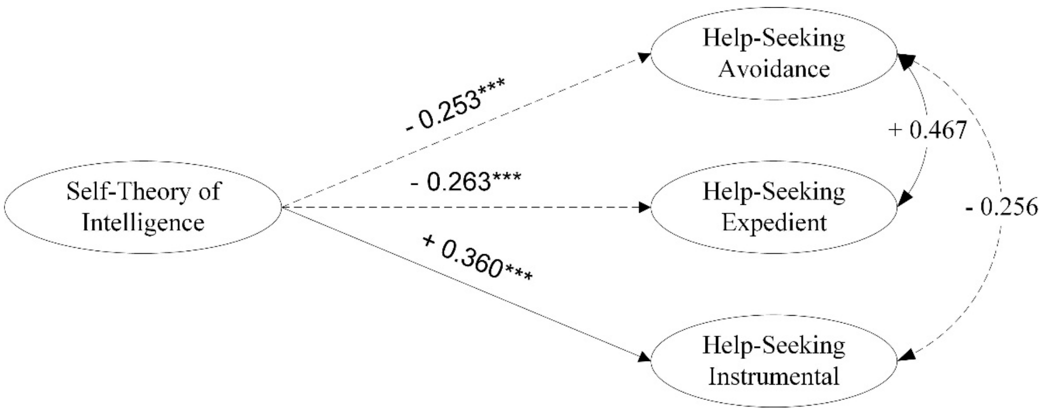

Figure 6.5 Structural model of the relationships between Self-theory of Intelligence and help-seeking.

In the current study, students who held a belief that intelligence could be developed through effort were less likely to avoid seeking help or to seek help in order to reduce effort, and more likely to seek help in order to further their understanding. This finding is consistent with, and complements, the findings from previous studies (Luo, 2017; Shih, 2007; Shively & Ryan, 2013). Shively and Ryan (2013) found that college algebra students who were incremental theorists were more likely to report seeking help than peers who were entity theorists. Similarly, Shih (2007) found that primary students with a predominantly growth mindset were less likely to avoid seeking help when needed compared to those who endorsed a combined mindset, and students with a mostly fixed mindset were more likely to report help-seeking avoidance than those with a combined mindset. However, while both these studies assessed students' self-theories of intelligence using an entity-incremental (fixed-growth) continuum, students' help-seeking behaviours were assessed using dichotomous measures of students' intentions to seek or not seek help. Nadler (1998) argued that researchers need to use tripartite measures of help-seeking, as Dweck's theorising implied that incremental theorists are likely to engage in a high degree of instrumental help-seeking and low dependent (expedient) help-seeking.

To date, only one other study has used a tripartite approach to examine how students' self-theories of intelligence influenced their instrumental, expedient, and avoidant help-seeking behaviours. Luo (2017) found that for secondary mathematics students (in Singapore), a fixed mindset was positively associated with non-adaptive help-seeking behaviours, and a growth mindset was negatively associated with students' avoidant help-seeking and positively associated with students' instrumental help-seeking. However, Luo (2017) investigated the influence of students' self-theories of intelligence using a dichotomous approach and focused on students' endorsement of a growth mindset versus a fixed mindset, effectively ignoring those students with a combined mindset. Therefore, a significant contribution of the current study is its inclusive approach with regard to students' self-theories of intelligence and their help-seeking behaviours. The results of the current study suggest that as students' transition from a fixed to a growth mindset, their help-seeking behaviours will likewise transition from a focus on avoidance to seeking instrumental help.

Research Question 4

> *What empirical model best explains the relationship between students' perceptions of the social climate and their help-seeking behaviour?*

In response to the fourth research question, a mediated structural model was constructed, which incorporated the significant paths from each of the models detailed previously. The direct and indirect effects of the four dimensions of the social climate on students' academic help-seeking behaviours were tested, using 5000 bootstrap samples to generate non-symmetric confidence intervals. The resulting structural model is presented in Figure 6.6.

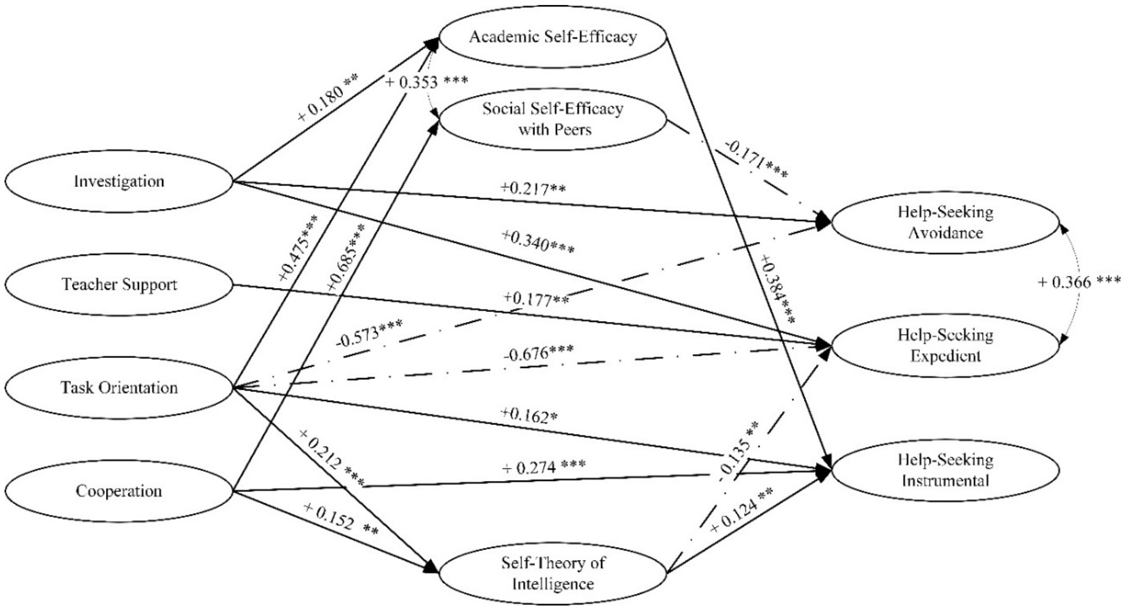

*Figure 6.6 Mediated structural model of the relationship between social climate and help-seeking behaviour. ***99%CI, **95%CI, *90%CI.*

The final structural model was a reasonable fit to the data (χ^2 = 1932.501 (N = 551, *df* = 912, *p*=0), RMSEA= 0.045 [0.042, 0.048], Pr(RMSEA<0.05) = 0.998, CFI = 0.897, TLI = 0.888, SRMR = 0.063). The social climate factors accounted for 36% and 47% of the variance in the Academic Self-Efficacy and Social Self-Efficacy with Peers factors respectively. Cooperation and Task Orientation accounted for 10% of the variance in the Self Theory of Intelligence factor. The mediated structural model accounted for 29.6% of the variance for Help-Seeking Avoidance, 26.9% for Help-Seeking Expedient, and 49.6% for Help-Seeking Instrumental.

The previously established direct effects of the social climate factors on students' academic help-seeking behaviours were retained in the final structural model. It is worth noting that results relating to direct effects based on the final mediated structure model are slightly different to the results reported earlier based on the simple path models. These differences are due to the different approaches used to determine statistical significance. The final mediated structural model used non-symmetric confidence intervals, whereas the structural models for the previous questions were based on the assumption that data was normally distributed. For example, the direct effect of Investigation on Help-Seeking Avoidance increased slightly, from +0.205 ($p<0.05$) to +0.217 (95%CI). The following discussion will focus on the relative importance of the indirect effects of the social climate factors on students' help-seeking behaviours. In the final structural model, only indirect paths with a 90% confidence interval or greater were retained. Indirect paths are highlighted in Figure 6.7.

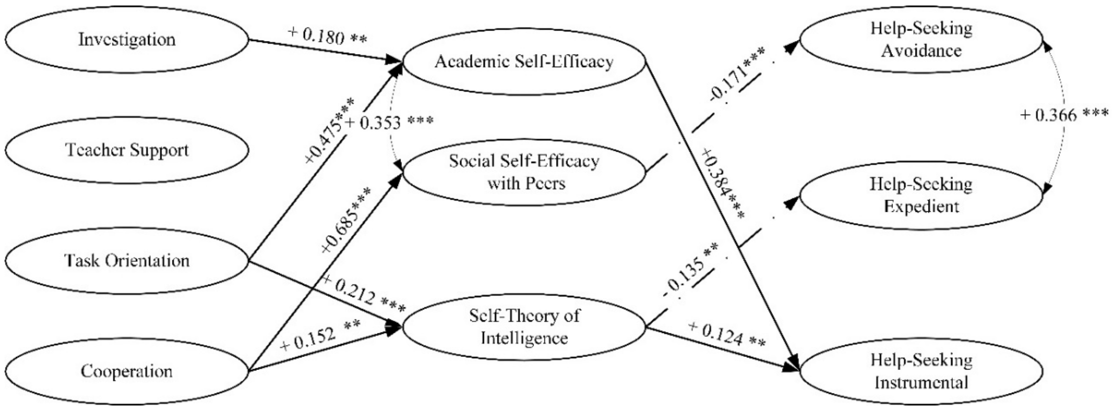

*Figure 6.7 Indirect paths between social climate and help-seeking behaviour. ***99%CI, **95%CI, *90%CI.*

The Mediating Effect of Academic Self-Efficacy

Academic Self-Efficacy mediated indirect effects of two social climate factors on students' Instrumental Help-Seeking in the secondary mathematics classroom: Task Orientation (0.183, 99%CI [0.057, 0.347]) and Investigation (0.069, 95%CI [0.011, 0.146]). These mediating effects of Academic Self-Efficacy on social climate and help-seeking represent new findings. Previous help-seeking studies have focused solely on the extent to which various teacher support constructs had influenced students' academic self-efficacy and help-seeking behaviours (Federici & Skaalvik, 2014; Kozanitis et al., 2007; Skaalvik et al., 2015). These findings from this study are consistent with Velayutham and Aldridge (2013) who found similar mediated relationships between social climate (task orientation and investigation), academic self-efficacy, and the self-regulated (effort) learning behaviours of Australian secondary science students in Grades 8 to 10.

The Mediating Effect of Social Self-Efficacy with Peers

The extent to which students perceived their class as supporting cooperative learning approaches had a specific indirect effect (-0.117, 99%CI [-0.221, -0.015]), via Social Self-efficacy with Peers, on their avoidant help-seeking behaviour. That is, the degree to which students were able to engage with cooperative learning approaches directly influenced their confidence in their ability to interact with their peers, which subsequently reduced their intention to avoid seeking help when help was needed. This pathway represents a new finding.

A distinctive feature of the current study is the inclusion of students' perceptions of the extent that cooperative pedagogical strategies are integrated into secondary mathematics classrooms across diverse school contexts and grade levels. Previous studies investigating cooperative classrooms and help-seeking have been more limited and focused on specific grade levels, including Grade 6 (Kempler & Linnenbrink, 2006) and Grade 7 (Webb et al., 2006). In terms of teacher practice, findings of the current study further highlights the benefits of integrating cooperative learning appoaches into traditional secondary mathematics classrooms (Johnson & Johnson, 2003; Lavasani & Khandan, 2011). Also, previous help-seeking studies have not considered the mediating role of social self-efficacy.

The importance of social self-efficacy highlight in the current study is consistent with related studies. Previous studies of the mathematics classroom have focused on the extent to which social self-efficacy mediated the effect of the classroom climate on students' use of self-regulated learning strategies and engagement (Madjar & Chohat, 2017; Patrick et al., 2007). Madjar and Chohat (2017) found that for Israeli students in Grade 6, perceived teacher emphasis on mastery goals had a positive effect on their social self-efficacy by the end of Grade 6, which had a subsequent positive effect on their emotional and behavioural engagement after the transition to Grade 7. Patrick et al. (2007) found that 5th Grade USA students' perceptions of the social climate of the mathematics classroom (promotion of task-related interaction, mutual respect, and student academic support) had a positive effect on their social self-efficacy with peers, which subsequently influenced their engagement in task-related interactions.

The Mediating Effect of Self-Theories of Intelligence

Self-Theory of Intelligence mediated the effects of two social climate factors on students' expedient and instrumental help-seeking behaviours. Task Orientation had specific indirect effects on Help-Seeking Expedient (-0.029, 95%CI [-0.065, -0.003]) and Help-Seeking Instrumental (0.026, 95%CI [0.002, 0.067]). Similarly, Cooperation had specific indirect effects on Help-Seeking Expedient (-0.02, 90%CI [-0.046, -0.002]) and Help-Seeking Instrumental (0.019, 90%CI [0.002, 0.04]). It appears that when secondary students are provided with opportunities to cooperate in classrooms that encourage good work habits, and have clear learning objectives, they are more likely to hold an implicit belief that intelligence is malleable and prefer seeking instrumental rather than expedient help. This is a new result. As discussed previously, this is the first study to explore a causal model of the mediated relationship between secondary students' perceptions of the social climate of the mathematics classroom, their self-theories of intelligence and subsequent help-seeking behaviours.

Research had found that students' self-theories of intelligence influenced their help-seeking behaviour in secondary (Luo, 2017) and tertiary (Shively & Ryan, 2013) learning contexts. For example, Luo (2017) found that secondary mathematics students' growth mindsets had a positive effect on their instrumental help-seeking and reduced the likelihood that they would avoid seeking help when needed, in contrast a fixed mindset promoted their non-adaptive help-seeking behaviours. The extent to which the quality of peer-peer interactions may influence students' fixed/growth mindset has also been explored (Laurian-Fitzgerald & Roman, 2016; Martin et al., 2019). For example, Laurian-Fitzgerald and Roman (2016) found that as young students (in 1st Grade) learnt and practiced social skills for effectively collaborating on a challenging group task, such as taking turns and encouraging other students, they observed that children were more often seeking help from peers (rather than the teacher) and were more likely to endorse a growth mindset. Taken together these studies suggested that students' self-theories of intelligence mediate the effect of the social climate on students' help-seeking behaviours. The findings of the current study provide support for this hypothesis.

In the present study, students' incremental theory of intelligence also mediated small but statistically significant indirect effects of the social climate (Task Orientation and Cooperation) on their expedient and instrumental help-seeking goals. This finding provides further support for the use of cooperative learning approaches in the secondary mathematics classroom. Cooperation was found to have direct and indirect positive effects on students' instrumental help-seeking and indirect negative effects on their non-adaptive help-seeking behaviours. While small, the indirect effect of the social climate (Task Orientation and Cooperation) on students' expedient help-seeking behaviour is interesting. As discussed earlier, while both Task Orientation and Cooperation had a direct positive effect on students' instrumental help-seeking behaviour only Task Orientation had a direct negative effect on their non-adaptive help-seeking behaviours. This finding suggests that the use of cooperative learning approaches during mathematics has direct and indirect effects on students' help-seeking behaviours that are complementary to teachers ensuring students have good work habits and know what they are trying to achieve during class.

Researchers have found that students' social motivation (e.g. friendship goals) and the classroom's goal structure jointly influence secondary students' adaptive/avoidant help-seeking behaviours (Roussel et al., 2011; Shin, 2018; Zander et al., 2019). Zander et al. (2019) argued that in order to reduce secondary mathematics students' perceptions of the costs of help-seeking they need to be provided with the opportunity to work cooperatively with peers outside their friendship cliques. Similarly, Resnick and Nelson-Le Gall (1997) argued that deeply held beliefs about the self, such as self-theories of intelligence, are acquired indirectly through the process of socialization as individuals cooperate and participate in communities of practice. The current findings provide further support for the subtle role that cooperative learning experiences may play in developing students' positive attitudes towards learning, including supporting the development of a growth mindset and social competencies, and their recognition of the benefits of seeking help for self-improvement.

Summary

In summary, this is the first study within learning environments research to examine comprehensively the influence of social climate (the psychosocial learning environment) on help-seeking behaviours in a secondary mathematics context. Previous research exploring how social climate influences students' help-seeking behaviours has been limited to individual measures of the social climate, such as Teacher Support (Kiefer & Shim, 2016; Parker et al., 2019; Skaalvik et al., 2015), peer friendships (Shin, 2018; Zander et al., 2019), and peer climate (Shim et al., 2013), and cooperative versus traditional classrooms (Kempler & Linnenbrink, 2006; Lavasani & Khandan, 2011;

Webb et al., 2006). However, classrooms are dynamic social systems, where multiple dimensions of the social climate interact, and "thus cannot be understood by just considering features individually" (Patrick et al., 2012, p. 461). The findings of the current study indicate the complex way students' perceptions of task orientation, cooperation, teacher support, and investigation interact with students' self-efficacy and self-theory of intelligence are associated with students' academic help-seeking behaviours.

Methodological Contributions

The main methodological contributions of the current study relate to the validation of the various constructs examined with a heterogeneous sample of secondary mathematics students from Australian secondary schools and TAFEs. The validation of the measurement models is detailed in Chapter 5. Confirmatory factor analysis (CFA) was used to determine and confirm the measurement model of related constructs. The factorial and construct validity of the three help-seeking scales and self-theory of intelligence were supported. However, the social climate and self-efficacy factors required some adjustment in order to improve construct validity. Each of the scales included in this study were conceptualised as congeneric factors and therefore items that had a significant loading on more than one factor were candidates for removal. An analysis of the item reliability was also used to inform the decision about whether to remove an item from the model or not. The construct reliability value (CR) was used to assess the convergent validity of the factors in the measurement model (Farrell & Rudd, 2009; Fornell & Larcker, 1981). The Average Variance Extracted (AVE) was used to determine discriminant validity for each factor in the model (Ping, 2004; Shiu et al., 2011).

The current study appears to be the first time that the academic help-seeking measures have been used within an Australian secondary school context. The construct reliability for each of the help-seeking measures were consistent with international studies, which have included similar items for measuring students' help-seeking goals and intentions (Arbreton, 1993; Fittrer, 2016; Luo, 2017; Luo & Zhang, 2015; Shim et al., 2013).

The current study is the first that has used the social self-efficacy measures within an Australian secondary school context. Confirmatory factor analysis of the three self-efficacy factors (Academic Self-Efficacy, Social Self-Efficacy with Peers, and Social Self-Efficacy with the Teacher) indicated a poor fit to the data. This was primarily due to the poor convergent and discriminant validity of the Social Self-Efficacy with the Teacher scale. This finding is inconsistent with previous studies, which found good construct validity for the measure when investigating student perceptions in the USA and Hong Kong contexts (Ng, 2014; Patrick et al., 2007; Ryan & Patrick, 2001). Therefore, these findings suggest the need to further evaluate the measurement invariance of this latent construct using CFA to test the configural invariance for different groups (van de Schoot, Lugtig, & Hox, 2012).

In the current study, the Self-Theory of Intelligence factor was developed as a unidimensional scale; however, some studies have found that the entity and incremental focused items load onto separate factors (De Castella & Byrne, 2015; Diseth et al., 2014; Leroy et al., 2007; Shih, 2011). In the current study, the fit of the CFA model was improved by allowing for a method effect, where freeing the correlations between the error terms for the entity items resulted in a significant improvement in the fit of the Self-theory of Intelligence construct to the data. This finding is consistent with other studies that have used different approaches for catering for method effect inherent in the self-theory of intelligence latent construct (García-Cepero & McCoach, 2009; Roskam & Nils, 2007).

In the current study, the social climate of the classroom was measured using the WIHIC instrument. The initial 7-factor measurement model was a poor fit to the sample data (χ^2 = 1957.399 (*df* = 539, *p*=0), RMSEA = 0.070 [0.067, 0.074], CFI = 0.810, TLI = 0.790, SRMR = 0.067). To address potential issues with multicollinearity, four factors were retained for further analysis using SEM. The final four factor WIHIC measurement model (Task Orientation, Cooperation, Investigation, and Teacher Support) had good convergent and discriminant validity, and had an acceptable level of fit with the data (χ^2 = 277.102 (*df* = 98, *p*=0), RMSEA = 0.059 [0.051, 0.067], CFI = 0.933, TLI = 0.918, SRMR = 0.045). The findings of this study are not consistent with the oft-quoted Dorman (2003) study, which found good support for a 42-item WIHIC CFA measurement model using cross-national sample of secondary mathematics students. However, as noted by Dorman (2003), obtaining a satisfactory fit for complex CFA models where factors have more than 4 or 5 indicators is generally problematic. The need to respecify the current WIHIC CFA measurement model, in order to achieve an acceptable model fit, is consistent with more recent studies in secondary science (Alt, 2015; Velayutham & Aldridge, 2013) and mathematics classrooms (Taylor & Fraser, 2013), and university contexts (Alzubaidi, Aldridge, & Khine, 2014). However, in comparison, the WIHIC measurement model in this study required a greater degree of respecification in order to achieve a satisfactory fit. It was not possible to do a multi-group analysis to test possible sources of measurement invariance. However, the sample was highly diverse, in terms of the students' socioeconomic status and the level of mathematics studied, and ignoring the cluster effect of macro level variables can have a significant effect on fit of single-level CFA measurement models (Pornprasertmanit, Lee, & Preacher, 2014). For example, while Dorman (2003) found support for measurement invariance for secondary mathematics students in three countries in terms of gender and year level, he did not consider the socioeconomic status (SES) of the school or students. Similar to the current study, Alt (2015) had to reduce the number of items to three or four per factor in order to achieve an acceptable model fit, for a study of senior secondary science students from diverse SES background schools in Israel. Therefore, these findings suggest the need to further evaluate the measurement invariance of the WIHIC measurement model using CFA to test the configural invariance for different groups of secondary mathematics students, particularly in terms of SES (van de Schoot et al., 2012).

Practical Implications

Ideally, we would like all mathematics students to be instrumental help-seekers, as these students are active learners who are focused on consolidating their understanding (Hattie & Donoghue, 2016). Help-seeking is an adaptive strategy which can help students reengage with difficult material through their social interactions with more competent peers or the teacher and can support their eventual development as independent learners (Skinner & Pitzer, 2012). Teachers need to know what practices effectively support the development of students' instrumental help-seeking behaviours. At the same time, teachers need strategies that are effective in reducing students' intentions to avoid seeking help when needed, as this is one approach which could help address student disengagement with mathematics during the secondary years (Duchesne et al., 2019).

Findings from the current study has some clear practical implications for teachers. First, teachers need to ensure that students have good work habits and are clear about the learning objectives of the class. When students are clear about the learning intentions of a class, this appears to help them to identify when they need help in order to overcome an obstacle to their learning. Teachers could provide less engaged students with the opportunity to identify and document their learning goals, as this can lead to an improved sense of agency and the use of self-regulated learning strategies, such as asking for help when needed (McDonough & Sullivan, 2008). This is especially important for students who are less knowledgeable and may lack the meta-cognitive insight to know that they need help (Marais et al., 2013).

Second, ensuring students have the opportunity to cooperate with peers in the mathematics classroom is important. Students' perceptions of the extent to which they are encouraged to cooperate with their peers directly influences their use of help-seeking to consolidate their learning. Students will often avoid publicly asking the teacher for help when they need it in order to minimize the perceived psychological risks, such as wanting to avoid looking foolish or feeling 'dumb' (Marais et al., 2013; Peeters, Robinson, & Rubie-Davies, 2020). When students are allowed to talk and help each other, they develop stronger beliefs in their ability to effectively communicate with peers about mathematics, which subsequently reduces their intentions to avoid help when needed. Therefore, cooperative learning practices may indirectly help normalise students' beliefs that confusion is a part of the learning process (Peeters et al., 2020), and that making mistakes and help-seeking are essential parts of what it means to be working mathematically (Azzouni, 2006; Boaler, 2013; Clarke, Goos, & Morony, 2007). Furthermore, working cooperatively supports students' development of a growth mindset, which subsequently reduces their expedient help-seeking goals and supports help-seeking in order to consolidate their learning.

Third, students require clear guidance on what is expected when using inquiry-based learning approaches during mathematics. For inquiry-based learning to be effective, students need to engage with tasks that require them to work at the edge of their zone of proximal development (ZPD). Therefore, students need to be able to balance the benefits of persistence when the problem is doable, with the need to seek assistance when the task becomes too difficult (McCaslin, 2004). Students are more likely to benefit from their engagement with challenging tasks when help-seeking is viewed as a legitimate problem-solving strategy (Carreira et al., 2013).

Lastly, teachers need to think carefully about how they show support for students who are learning mathematics. The results of the current study suggest that students who perceive their teachers to be supportive are more likely to seek expedient help. As noted by Hattie and Donoghue (2016), while help-seeking is more of a student skill it needs to be welcomed by the teacher before it can have an effect. Similar to avoidant help-seekers, expedient help-seekers tend to be more anxious and less efficacious than instrumental help-seekers (Karabenick, 2003; Ryan et al., 2005). The quality of teacher-student interactions can influence the long-term participation and learning of students (Ewing, 2004; Ryan et al., 2005).

How the teacher interacts with students can bolster or impede their self-regulated learning behaviours (Azevedo et al., 2012). Teachers who demonstrate a democratic interaction style provide a safe environment that attends to the emotional needs of low achievers, who may have poor self-perceptions about their abilities (Karabenick & Newman, 2010). However, teachers need to be careful about how they communicate with students. For example, Marchand and Skinner (2007) found that while teachers may become more supportive as the interact with students who actively seek help to improve their understanding, they may also gradually become less supportive of students who persist in engaging in non-adaptive help-seeking behaviours. One approach for addressing this issue is the use of enabling prompts as strategy to help students who are having difficulty starting a task. Sullivan (2011) argued that teachers plan for the use of enabling prompts that help students to work at their current level of understanding, and develop the skills needed to overcome the barriers to learning they had previously experienced.

Limitations and Recommendations for Future Research

The present study has some limitations. Future research can build upon this study by addressing its limitations. Firstly, as a cross-sectional study, causal relationships were inferred from fitting the data to the theoretical model and are tentatively plausible until tested through repetition and against other plausible models (Bollen & Pearl, 2013). While the causal sequencing of factors in the current study is consistent with previous help-seeking studies, it is acknowledged that there remains a potential for reciprocal relationships between the environmental, personal, and behavioural variables. Further studies could use a longitudinal approach to test the causal relationships implied by the current empirical model. Also, this study was limited to using the individual as the unit of analysis as there were insufficient classes to perform a multi-level analysis to take into account both the student and class level effects. Therefore, the student-level structural equation model is likely to confound the effects of the classroom and the individual student resulting in inflated associations among the factors (Morin et al., 2013; Watt & Parker, 2020). Further research using multilevel models is needed to permit the examination of the effect of classroom-level predictors on personal factors and outcome variables (Lüdtke, Robitzsch, Trautwein, & Kunter, 2009).

Secondly, the need to address potential issues of multicollinearity resulted in limiting the number of social climate factors included in the model. It is possible that other more plausible models exist. Marsh, Morin, Parker, and Kaur (2014) argue that

CFAs are too restrictive when assessing the discriminant validity for the measurement of some psychological constructs where non-zero cross-loadings could be logically anticipated. Such may be the case for some WIHIC factors (Charalampous & Kokkinos, 2017). Therefore, an alternate approach to addressing the issue of multicollinearity would be to include selected item cross loadings (justified by substantive theory or item content) between the social climate constructs in the measurement model. Further research is needed to investigate secondary mathematics students' interpretation of the conceptual content of the items of the WIHIC.

Thirdly, while the sample included participants from a variety of different school sectors and localities, the sample did not include participants from all grades in each of the schools and is therefore somewhat unbalanced and unlikely to be representative of the Australian school system. Therefore, there is a need for further research using a more balanced sample of secondary-aged adolescents, as well as primary-aged children and adult learners. In addition, the inclusion of a single-sex school meant that the cohort had a male gender bias and the results may not reflect the perspectives of female secondary mathematics students. Further studies are needed to test the empirical model with different groups of mathematics students in both Australian and overseas learning contexts.

Conclusion

For many students, mathematics is difficult subject that many will opt out of as they progress through school. In this study, I explored how students' perceptions of the social learning environment and their positive beliefs about their own competencies influenced their help-seeking behaviours in secondary mathematics classes. The present study makes distinctive contributions to the learning environments and academic help-seeking research fields, since few studies have explored the relations between multiple dimensions of classroom social climate and students' help-seeking behaviours. Increasingly, secondary mathematics teachers are endeavouring cater for diversity, and support the learning of their students, by integrating multiple approaches into the traditional mathematics classroom. This study highlights the importance of secondary mathematics teachers' efforts to ensure that their students develop good work habits and understand what they are trying to accomplish in class. Students who were task-oriented were less likely to engage in non-adaptive help-seeking behaviours, and more likely to feel academically competent and seek instrumental help when needed. The study also highlighted the importance of integrating student-centred learning approaches in the traditional mathematics classroom. The use of cooperative learning approach also had a significant direct effect on students' instrumental help-seeking, and indirectly reduced their help-seeking avoidance by supporting their social self-efficacy with peers. Teacher support and the use of investigative approaches also had an effect on students' help-seeking behaviours, however these results are more tenuous and warrant further study. The findings suggest practical ways educators can plan and put into practice strategies for promoting adaptive help-seeking behaviours and reducing non-adaptive help-seeking behaviours in secondary mathematics classes.

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APPENDICES

Appendix 1 – Survey (pen and paper version)

MONASH University | GROUP OF EIGHT

Education

Increasing engagement in mathematics:
Help-seeking and the psychosocial learning environment

The following information is needed to ensure your responses are grouped with the responses from your class mates and that each participant has given their informed consent (has submitted a signed consent form). No names will be recorded or used in any publications related to this study – your own responses are confidential.

Participant ID/Name: Date:

Class ID: Teacher ID/Name:

Section 1 - Background Information

This section collects information which describes you, your class, and your school.

For numbered options mark the circle which most closely matches your response like this: ① ② ❸ ④ ⑤

1. What is the name of your school?			
2. Which Mathematics class are you attending or answering question about during this survey?			
3. How many Mathematics subjects are you attending this year? For example, if you are doing both Year 10 and Year 11 Mathematics then the answer would be 2	① One maths subject	② Two maths subjects	③ Three maths subjects
4. What topic are you currently studying in this maths class?			
5. What was the previous topic you studied in this maths class?			
6. What is your Gender:	① Male		② Female
7. How old are you (in years) ?			
8. In which country were you born?			
9. Birthplace of Mother:			
10. Birthplace of Father:			

Please Turn Over

Section 2 – Your beliefs about intelligence

The following statements have been designed to investigate your ideas about intelligence. There are no right or wrong answers.

Use the scale provided to indicate the extent to which you agree or disagree with each of the following statements.

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
11. You have a certain amount of intelligence, and you can't really do much to change it	①	②	③	④	⑤	⑥
12. Your intelligence is something about you that you can't change very much	①	②	③	④	⑤	⑥
13. No matter who you are, you can significantly change your intelligence level	①	②	③	④	⑤	⑥
14. To be honest, you can't really change how intelligent you are	①	②	③	④	⑤	⑥
15. You can always substantially change how intelligent you are	①	②	③	④	⑤	⑥
16. You can learn new things, but you can't really change your basic intelligence	①	②	③	④	⑤	⑥
17. No matter how much intelligence you have, you can always change it quite a bit	①	②	③	④	⑤	⑥
18. You can change even your basic intelligence level considerably	①	②	③	④	⑤	⑥

Section 3 – Your participation during mathematics

This section of the questionnaire contains statements about your level of participation during this mathematics class. You will be asked to describe how accurately each statement describes you. Please answer all questions. Remember - There are no right or wrong answers. Your opinion is what is wanted. Your own responses are confidential.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply respond to each statement in turn.

During this mathematics class:	Not at all true				Moderately true				Very true
19. I can do even the hardest work in this maths class if I try	①	②	③	④	⑤	⑥	⑦	⑧	⑨
20. I find it easy to start a conversation with most students in my class	①	②	③	④	⑤	⑥	⑦	⑧	⑨
21. I'm certain that I can master the skills taught in maths this year	①	②	③	④	⑤	⑥	⑦	⑧	⑨
22. When I don't understand my maths work, I often guess instead of asking someone for help	①	②	③	④	⑤	⑥	⑦	⑧	⑨
23. I can explain my point of view to other students in my class	①	②	③	④	⑤	⑥	⑦	⑧	⑨
24. I don't ask questions during math, even if I don't understand the lesson	①	②	③	④	⑤	⑥	⑦	⑧	⑨
25. I can get along with most of the students in my class	①	②	③	④	⑤	⑥	⑦	⑧	⑨
26. If I have enough time, I can do a good job on all my work in this maths class	①	②	③	④	⑤	⑥	⑦	⑧	⑨
27. When I don't understand my maths work, I often put down any answer rather than ask for help	①	②	③	④	⑤	⑥	⑦	⑧	⑨
28. I can do almost all the work in this maths class if I don't give up	①	②	③	④	⑤	⑥	⑦	⑧	⑨
29. I can work well with other students in my class	①	②	③	④	⑤	⑥	⑦	⑧	⑨
30. I usually don't ask for help with my maths work, even if the work is too hard to do on my own	①	②	③	④	⑤	⑥	⑦	⑧	⑨
31. Even if the maths is hard, I can learn it	①	②	③	④	⑤	⑥	⑦	⑧	⑨
32. If my maths work is too hard for me, I just don't do it rather than ask for help	①	②	③	④	⑤	⑥	⑦	⑧	⑨

During this mathematics class:	Not at all true				Moderately true				Very true
33. I would get help in this maths class to learn to solve problems and find answers by myself	①	②	③	④	⑤	⑥	⑦	⑧	⑨
34. I'm certain I can figure out how to do the most difficult maths work	①	②	③	④	⑤	⑥	⑦	⑧	⑨
35. If I were to get help in this maths class it would be to better understand the general ideas or principles	①	②	③	④	⑤	⑥	⑦	⑧	⑨
36. No matter how hard I try, there is some maths work I'll never understand	①	②	③	④	⑤	⑥	⑦	⑧	⑨
37. Getting help in this maths class would be a way for me to learn more about basic principles that I could use to solve problems or understand the material	①	②	③	④	⑤	⑥	⑦	⑧	⑨
38. I can explain my point of view to my teacher	①	②	③	④	⑤	⑥	⑦	⑧	⑨
39. The purpose of asking somebody for help in this maths class would be to succeed without having to work as hard	①	②	③	④	⑤	⑥	⑦	⑧	⑨
40. I find it hard to get along with my teacher	①	②	③	④	⑤	⑥	⑦	⑧	⑨
41. If I were to ask for help in this maths class it would be to quickly get the answers I needed.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
42. If my teacher gets annoyed with me I can usually work it out	①	②	③	④	⑤	⑥	⑦	⑧	⑨
43. Getting help in this maths class would be a way of avoiding doing some of the work	①	②	③	④	⑤	⑥	⑦	⑧	⑨
44. I find it easy to just go and talk to my teacher	①	②	③	④	⑤	⑥	⑦	⑧	⑨

Section 4: Your Perception of this Mathematics Class

This section of the questionnaire contains statements about practices that could take place during this mathematics class. You will be asked how often each practice takes place. Please choose one answer for all questions.

Remember - There are no right or wrong answers. Your opinion is what is wanted. Think about how well each statement describes what this class is like for you. Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about each statement in turn.

In this mathematics class:	Almost never	Seldom	Sometimes	Often	Almost always
45. Getting a certain amount of work done is important to me	①	②	③	④	⑤
46. I carry out investigations to test my ideas	①	②	③	④	⑤
47. I cooperate with other students when doing assignment work	①	②	③	④	⑤
48. I give my opinions during class discussions	①	②	③	④	⑤
49. The teacher gives as much attention to my questions as to other students' questions	①	②	③	④	⑤
50. The teacher takes a personal interest in me	①	②	③	④	⑤
51. I am friendly to members of this class.	①	②	③	④	⑤
52. I am asked to think about the evidence for statements	①	②	③	④	⑤
53. I am ready to start this class on time	①	②	③	④	⑤
54. I get the same amount of help from the teacher as do other students	①	②	③	④	⑤
55. I share my books and resources with other students when doing assignments	①	②	③	④	⑤

Please Turn Over

In this mathematics class:	Almost never	Seldom	Sometimes	Often	Almost always
56. The teacher asks me questions	①	②	③	④	⑤
57. The teacher goes out of his/her way to help me	①	②	③	④	⑤
58. I work well with other class members.	①	②	③	④	⑤
59. I explain my ideas to other students	①	②	③	④	⑤
60. I explain the meaning of statements, diagrams and graphs	①	②	③	④	⑤
61. I have the same amount of say in this maths class as other students	①	②	③	④	⑤
62. I know what I am trying to accomplish in this maths class	①	②	③	④	⑤
63. The teacher helps me when I have trouble with the work	①	②	③	④	⑤
64. When I work in groups in this maths class, there is teamwork	①	②	③	④	⑤
65. I help other class members who are having trouble with their work.	①	②	③	④	⑤
66. I find out answers to questions by doing investigations	①	②	③	④	⑤
67. I learn from other students in this maths class	①	②	③	④	⑤
68. I pay attention during this class	①	②	③	④	⑤
69. I receive the same encouragement from the teacher as other students do	①	②	③	④	⑤
70. Students discuss with me how to go about solving problems	①	②	③	④	⑤
71. The teacher moves about the class to talk with me	①	②	③	④	⑤
72. Students in this maths class like me.	①	②	③	④	⑤
73. I am asked to explain how I solve problems	①	②	③	④	⑤
74. I cooperate with other students on class activities	①	②	③	④	⑤
75. I get the same opportunity to contribute to class discussions as other students	①	②	③	④	⑤
76. I solve problems by using information obtained from my own investigations	①	②	③	④	⑤
77. I try to understand the work in this maths class	①	②	③	④	⑤
78. In this maths class, I get help from other students.	①	②	③	④	⑤
79. The teacher's questions help me to understand	①	②	③	④	⑤

Thank you for completing this questionnaire.

If you would like to contact the researcher about any aspect of this study, please contact the Chief Investigator:

Roy Smalley **(Doctoral Candidate)**
Monash University
Faculty of Education - Peninsula
email: Roy.Smalley@Monash.edu

Associate Professor Jeffrey Dorman **(Supervisor)**
Monash University
Faculty of Education - Clayton
email: Jeffrey.Dorman@Monash.edu

Should you have any concerns or complaints about the conduct of the project (No.: CF13/2718 – 2013001462), you are welcome to contact the Executive Officer, Monash University Human Research Ethics (MUHREC):

Executive Officer
Monash University Human Research Ethics Committee (MUHREC)
Room 111, Building 3e
Research Office
Monash University VIC 3800

Tel: +61 3 9905 2052
Email: muhrec@monash.edu
Fax: +61 3 9905 3831

Appendix 2 – AAMT Discussion List Advertisement 1

Roy Smalley <roytsmalley@gmail.com>

I'm looking for Victorian schools to participate in a study on help-seeking in mathematics

Roy Smalley <roytsmalley@gmail.com> Mon, Feb 24, 2014 at 3:22 PM
To: discuss@aamt.edu.au

Hello,

I am a PhD candidate in the Monash University Faculty of Education. I am currently seeking to contact **Victorian schools** who may be willing to be participants in a research project, 'Increasing engagement in mathematics: help-seeking and the psychosocial learning environment', during Term 1 or Term 2, 2014.

Improving students' help-seeking behaviour is one strategy that schools could use to increase the level of engagement of secondary students in mathematics. Few international studies, and no Australian studies, have focused on how student's help-seeking behaviour is influenced by their perception of the classroom learning environment (Newman, 2002).

I am currently seeking expressions of interest from Victorian schools with students enrolled in one or more Year 9 to Year 12 mathematics classes, including CGEA and VCAL numeracy modules, to be research sites for my study. The study has been designed to allow maximum flexibility for schools in terms of the number and type of classes involved in the study and when the participating students will access the online survey.

Schools will be asked to provide some basic demographic and descriptive information for each participating mathematics class prior to data collection. Participating students, with parental consent, will be asked to complete an online questionnaire (10-20 minutes) during a mathematics class. Participation in the study is voluntary and no student or school will be identified in any subsequent publications. Participating schools will be provided with a summary of their students responses, by class/subject/year level, shortly after data collection has concluded for the school. A more detailed report will be available after the analysis of the data for all schools is concluded.

The study has been approved by Monash University Ethics Committee, the Victorian DEECD, and the Catholic Education Office Melbourne. If you think your school may be interested in participating in this study, or would like to discuss the study in more detail, then please contact me via email at Roy.Smalley@monash.edu.

Kind regards,

Roy Smalley

Monash Doctoral Candidate

Appendix 3 – MAVList Newsletter Advertisement

[MavList] Edition 14:11 | VCE | Penguins | Education Show | Women in Science | Games Days | MTQ | Conference | NMSS | Reading

1 message

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spryor@mav.vic.edu.au <spryor@mav.vic.edu.au> Wed, Jul 16, 2014 at 5:43 PM
Reply-To: spryor@mav.vic.edu.au
To: mavlist@mailserver.mav.vic.edu.au

This e-mail contains graphics, if you don't see them » **view it online.**

THE MATHEMATICAL ASSOCIATION OF VICTORIA

MAVlist - news for maths teachers

[...]

9. Improving engagement in mathematics for all

Roy Smalley, a Monash University PhD candidate is undertaking a study to develop a multilevel (student within class) model of the relationship between students' perceptions of the psychosocial learning environment, their motivational beliefs and self-reported help seeking behaviour. He writes "help seeking is a self-regulated behaviour which has both individual and social dimensions; however, few educational studies have explored how students help seeking behaviour is influenced by their perceptions of the social dimensions of the classroom learning environment". He seeks expressions of interest from Victorian schools representing diverse learning environments to participate in a large scale correlation study.

Top

[...]

Simon Pryor SAE FAIM
Chief Executive Officer
The Mathematical Association of Victoria
Cliveden, 61 Blyth Street
BRUNSWICK VIC 3056
Tel: 03-9380 2399 Fax: 03-9389 0399
http://www.mav.vic.edu.au
===================
Maths Rocks - Annual Conference
Thursday, 4 & Friday, 5 December 2014
Please consider the environment before printing this e-mail

MAILMAN_MIMEDEFANG WRAP

MAVlist mailing list
MAVlist@mailserver.mav.vic.edu.au
http://mailserver.mav.vic.edu.au/cgi-bin/mailman/listinfo/mavlist

Appendix 4 – AAMT Discussion List Advertisement 2

8/18/2015 Gmail - Current PhD study related to the work of Carol Dweck and Jo Boaler

Gmail by Google

Roy Smalley <roytsmalley@gmail.com>

Current PhD study related to the work of Carol Dweck and Jo Boaler

---

Roy Smalley <roytsmalley@gmail.com> Tue, Dec 16, 2014 at 9:47 AM
To: discuss@aamt.edu.au
Cc: roy.smalley@monash.edu

Hello all,

Recently there has been some interesting discussion about Growth Mindsets and Mathematics - the work of Jo Boaler based on the theories of Carol Dweck. I'm currently doing research in a related area using Carol Dwecks theories to explore how students perceptions of the social learning environment of the mathematics classroom is related to their strategic use of help seeking to solve problems.

Project: Increasing engagement in mathematics: help-seeking and the psychosocial learning environment (No.: CF13/2718 – 2013001462)

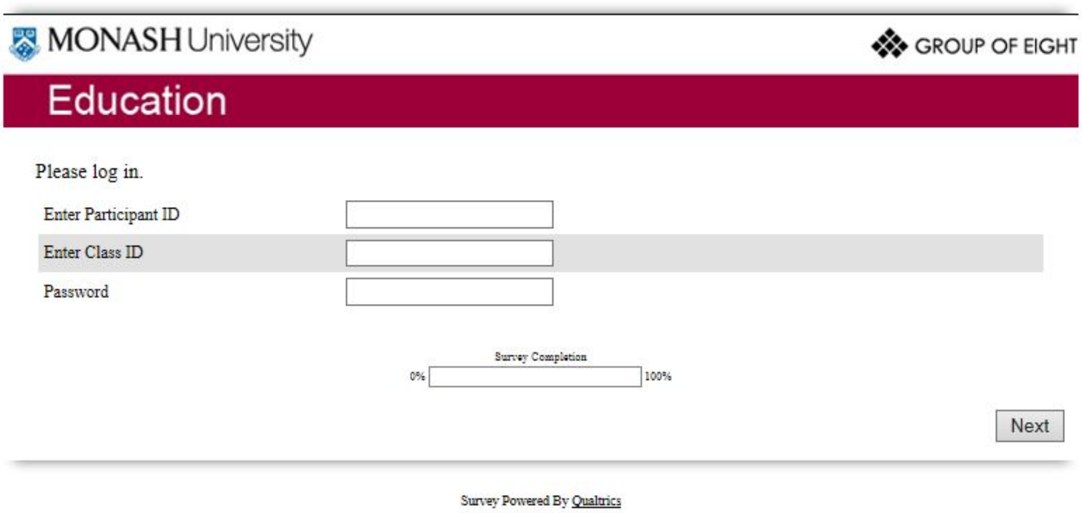
I'm looking for secondary schools in any Australian state or territory who may be interested in participating in this research during Semester 1, 2015. The study involves a single 15-20 minute student survey (online or printed) to be completed during a mathematics class (to be selected by the school). The responses will be analysed using multilevel modelling - an advanced statistical technique that can deal with the nested data generated by school research: students within classes within schools.

If you are interested and would like to know more then send me an email at Roy.Smalley@monash.edu

https://mail.google.com/mail/u/0/?ui=2&ik=72840814b3&view=pt&q=smalley%20%20aamt&qs=true&search=query&msg=14a5022b60e281e&siml=14a5... 1/1

Appendix 5 – Online Survey Screen Shots

Login Screen


MONASH University

GROUP OF EIGHT

Education

Please log in.

Enter Participant ID

Enter Class ID

Password

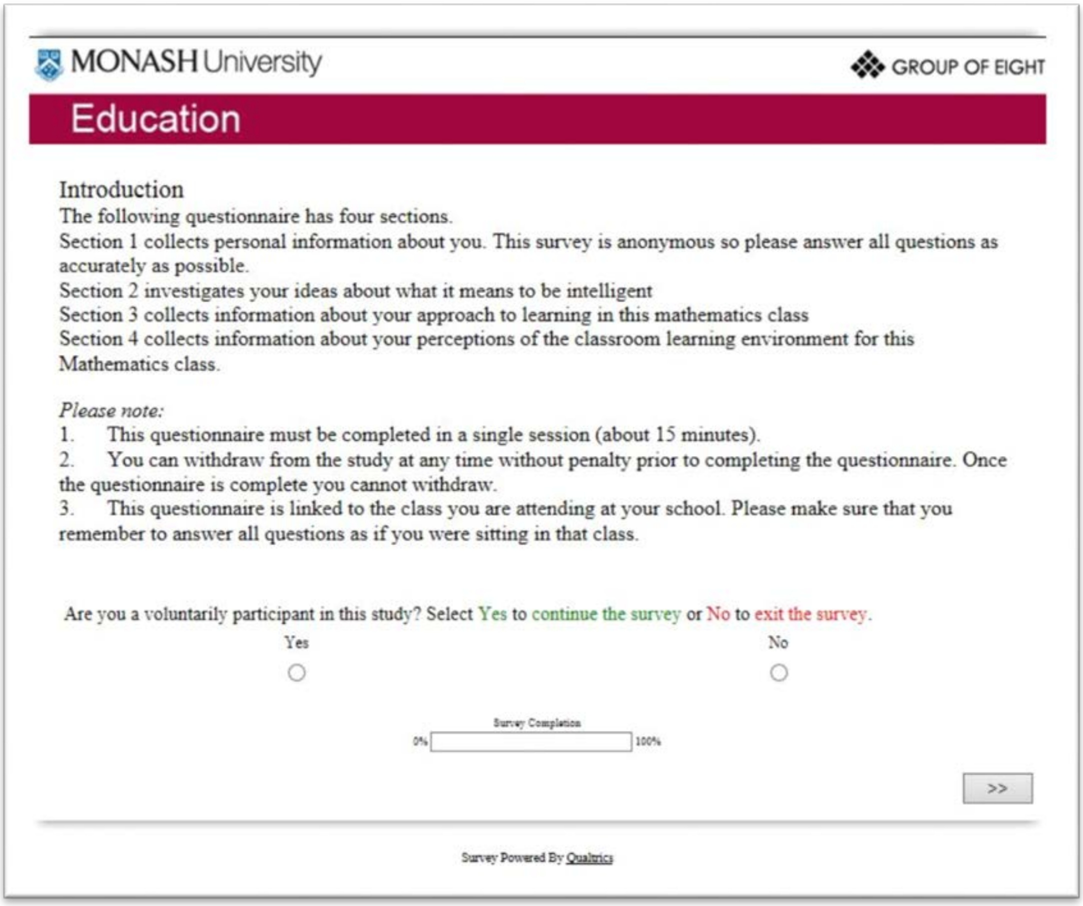
Survey Completion

0% 100%

Next

Survey Powered By Qualtrics

Confirmation of Informed Consent Screen


MONASH University

GROUP OF EIGHT

Education

Introduction

The following questionnaire has four sections.

Section 1 collects personal information about you. This survey is anonymous so please answer all questions as accurately as possible.

Section 2 investigates your ideas about what it means to be intelligent

Section 3 collects information about your approach to learning in this mathematics class

Section 4 collects information about your perceptions of the classroom learning environment for this Mathematics class.

Please note:

1. This questionnaire must be completed in a single session (about 15 minutes).
2. You can withdraw from the study at any time without penalty prior to completing the questionnaire. Once the questionnaire is complete you cannot withdraw.
3. This questionnaire is linked to the class you are attending at your school. Please make sure that you remember to answer all questions as if you were sitting in that class.

Are you a voluntarily participant in this study? Select Yes to continue the survey or No to exit the survey.

Yes No

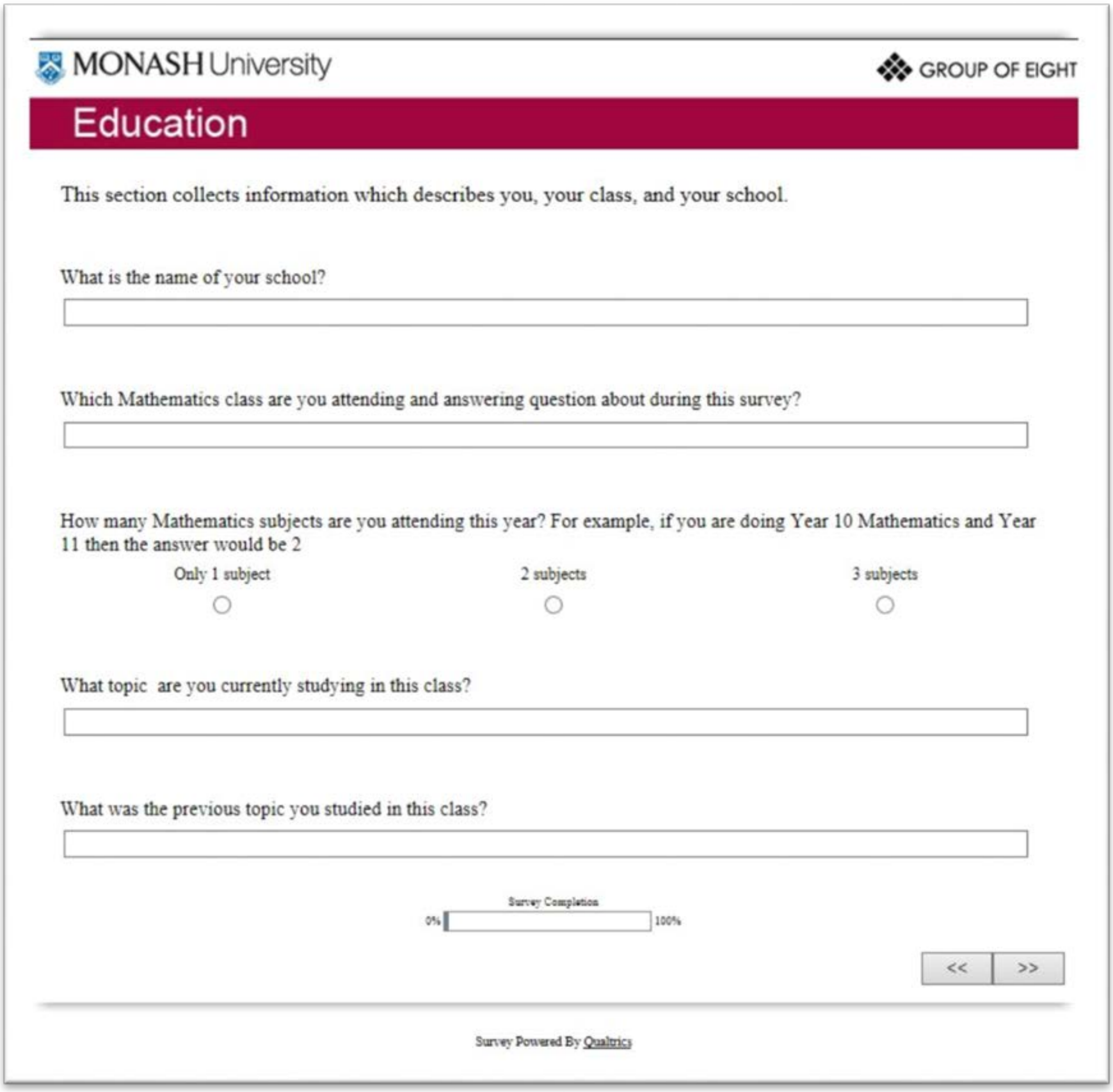
Survey Completion

0% 100%

>>

Survey Powered By Qualtrics

Section 1 – Demographic data



MONASH University

GROUP OF EIGHT

Education

This section collects information which describes you, your class, and your school.

What is the name of your school?

Which Mathematics class are you attending and answering question about during this survey?

How many Mathematics subjects are you attending this year? For example, if you are doing Year 10 Mathematics and Year 11 then the answer would be 2

Only 1 subject	2 subjects	3 subjects
○	○	○

What topic are you currently studying in this class?

What was the previous topic you studied in this class?

Survey Completion

0% 100%

<< >>

Survey Powered By Qualtrics

Appendix 6 – Class Details Form

Descriptive data for each participating mathematics/numeracy class

This study investigates the influence of the classroom climate on students' help-seeking behaviour. The CLASS is the primary 'unit of analysis' and therefore it is critical that student's responses are linked to a specific class. To achieve this all classes in the school will be assigned a Class code based on the information provided by the school prior to the distribution of the online questionnaire.

Please provide the following information for each participating mathematics and numeracy class in your school (copy as required) and email to Roy.Smalley@monash.edu as soon as possible.

School: ______________________ Year level/Course: _________________ Subject:___________________________________

NB: Description field (optional) could be used to clarify Pedagogical approach (eg traditional, constructivist, socio-cultural, cooperative, discovery) and/or identify special class characteristics such as composite classes (eg Year 11/12), mixed ability/streamed (high/medium/low) classes, or classes taught be non-specialist maths teachers etc

Class code/#/ID on timetable	Teacher code/ name	Teacher Gender	# Male students	# Female students	duration of class	session per week	Description (optional)

Additional Notes: ____

Appendix 7 – Monash University Human Research Ethics Approval

MONASH University

Monash University Human Research Ethics Committee (MUHREC)
Research Office

Human Ethics Certificate of Approval

This is to certify that the project below was considered by the Monash University Human Research Ethics Committee. The Committee was satisfied that the proposal meets the requirements of the *National Statement on Ethical Conduct in Human Research* and has granted approval.

Project Number:	**CF13/2718 - 2013001462**
Project Title:	**Increasing engagement in mathematics help-seeking and the psychosocial learning environment**
Chief Investigator:	**Assoc Prof Jeffrey Dorman**
Approved:	**From: 28 November 2013 to 28 November 2018**

Terms of approval - ***Failure to comply with the terms below is in breach of your approval and the Australian Code for the Responsible Conduct of Research.***

1. The Chief investigator is responsible for ensuring that permission letters are obtained, <u>if relevant</u>, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must include your project number.
6. **Amendments to the approved project (including changes in personnel):** Require the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Professor Nip Thomson
Chair, MUHREC

cc: Dr Timothy Lynch; Mr Roy Smalley

Postal – Monash University, Vic 3800, Australia
Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton
Telephone +61 3 9905 5490 Facsimile +61 3 9905 3831
Email muhrec@monash.edu http://www.monash.edu.au/researchoffice/human/
ABN 12 377 614 012 CRICOS Provider #00008C

Appendix 8 – Victorian DEECD Approval

Department of Education and Early Childhood Development

Strategy and Review Group

2 Treasury Place
East Melbourne, Victoria 3002
Telephone: +61 3 9637 2000
DX 210083
GPO Box 4367
Melbourne, Victoria 3001

2013_002236

Mr Roy Smalley
C/- Professor Jeffrey Dorman
Faculty of Education
Monash University
Northways Road
CHURCHILL 3842

Dear Mr Smalley

Thank you for your application of 9 December 2013 in which you request permission to conduct research in Victorian government schools and/or early childhood settings titled *Increasing engagement in mathematics: help-seeking and the psychosocial learning environment.*

I am pleased to advise that on the basis of the information you have provided your research proposal is approved in principle subject to the conditions detailed below.

1. The research is conducted in accordance with the final documentation you provided to the Department of Education and Early Childhood Development.

2. Separate approval for the research needs to be sought from school principals and/or centre directors. This is to be supported by the DEECD approved documentation and, if applicable, the letter of approval from a relevant and formally constituted Human Research Ethics Committee.

3. The project is commenced within 12 months of this approval letter and any extensions or variations to your study, including those requested by an ethics committee must be submitted to the Department of Education and Early Childhood Development for its consideration before you proceed.

4. As a matter of courtesy, you advise the relevant Regional Director of the schools or governing body of the early childhood settings that you intend to approach. An outline of your research and a copy of this letter should be provided to the Regional Director or governing body.

5. You acknowledge the support of the Department of Education and Early Childhood Development in any publications arising from the research.

6. The Research Agreement conditions, which include the reporting requirements at the conclusion of your study, are upheld. A reminder will be sent for reports not submitted by the study's indicative completion date.

Victoria

2

7. If DEECD has commissioned you to undertake this research, the responsible Branch/Division will need to approve any material you provide for publication on the Department's Research Register.

I wish you well with your research study. Should you have further enquiries on this matter, please contact Youla Michaels, Project Support Officer, Research, Evaluation and Analytics Branch, by telephone on (03) 9637 2707 or by email at michaels.youla.y@edumail.vic.gov.au.

Yours sincerely

Joyce Cleary
Director
Research, Evaluation and Analytics Branch

16/01/2014

enc

Appendix 9 – CEOM Approval

Catholic Education Office
Archdiocese of Melbourne

GE13/0009 Project# 1969

19 December 2013

Mr R Smalley
12 Keerok Avenue
SEAFORD VIC 3198

Dear Mr Smalley

I am writing with regard to your research application received on 9 December concerning your forthcoming project titled **'Increasing engagement in mathematics: help-seeking and the psychosocial learning environment'**. You have asked approval to involve a Catholic school in the Archdiocese of Melbourne, as you wish to involve students and teachers.

I am pleased to advise that your research proposal is approved in principle subject to the eight standard conditions outlined below.

1. The decision as to whether or not research can proceed in a school rests with the school's principal, so you will need to obtain approval directly from the principal of the school that you wish to involve. You should provide the principal with an outline of your research proposal and indicate what will be asked of the school. A copy of this letter of approval, and a copy of notification of approval from the organisation's/university's Ethics Committee, should also be provided.
2. A copy of the approval notification from your institution's Ethics Committee must be forwarded to this Office, together with any modifications to your research protocol requested by the Committee. You may not start any research in Catholic Schools until this step has been completed.
3. A *Working with Children* (WWC) check – or registration with the Victorian Institute of Teaching (VIT) – is necessary for all researchers visiting schools. Appropriate documentation must be shown to the principal before starting the research in the school.
4. No student is to participate in the research study unless s/he is willing to do so and informed consent is given in writing by a parent/guardian.

1 of 2

James Goold House, 228 Victoria Parade, East Melbourne VIC 3002 Tel (+61 3) 9267 0228 Fax (+61 3) 9415 9325
[illegible] www.ceomelb.catholic.edu.au
ABN [illegible]

Mr R Smalley - 2 - 19 December 2013

5. Any substantial modifications to the research proposal, or additional research involving use of the data collected, will require a further research approval submission to this Office.
6. Data relating to individuals or the school are to remain confidential.
7. Since participating schools have an interest in research findings, you should consider ways in which the results of the study could be made available for the benefit of the school community.
8. At the conclusion of the study, a copy or summary of the research findings should be forwarded to the Catholic Education Office Melbourne. It would be appreciated if you could submit your report in an ***electronic format*** using the email address provided below.

I wish you well with your research study. If you have any queries concerning this matter, please contact Ms Mirya ni Maegwin of this Office.

The email address is apr@ceomelb.catholic.edu.au.

Yours sincerely

Anna Rados
MANAGER ANALYSIS, POLICY & RESEARCH

2 of 2

Appendix 10 – Queensland Approval

Queensland Government

Department of
Education and Training

5 May 2015

Mr Roy Smalley
Monash University
12 Keerok Avenue
SEAFORD VIC 3198

Dear Mr Smalley

Thank you for your application seeking approval to conduct research titled *Increasing Engagement in mathematics: help-seeking and the psychosocial learning environment* in Queensland State schools. I wish to advise that your application to invite research participants to be involved in your study has been approved. This letter gives you approval to approach potential research participants only.

You may approach principals of the schools nominated in your application and invite them to participate in your research project. In the first instance, please provide principals of these schools with the attached letter which provides important information to help inform their decision about whether they wish to participate in this study. Your approval is conditional upon provision of this letter to each of the school principals you have nominated (you may need to photocopy the attached letter to provide sufficient copies for all principals).

As detailed in the Department's research guidelines the following applies to the study:

- You need to obtain consent from the relevant principals before your research project can commence.
- Principals have the right to decline participation if they consider that the research will cause undue disruption to educational programs in their schools.
- Principals have the right to monitor any research activities conducted in their facilities and can withdraw their support at any time.

This approval has been granted on the basis of the information you have provided in your research proposal and is subject to the conditions detailed below.

- Perusal of and adherence to the Department's standard *Terms and Conditions of Approval to Conduct Research* in Departmental sites is required as outlined in the document at: http://education.qld.gov.au/corporate/research/terms_conditions.pdf
- Any changes required by your institution's ethics committee must be submitted to the Department of Education and Training for consideration before you proceed.
- Any variations to the research proposal as originally submitted, including changes to data collection, additional research undertaken with the data, or publication based on the data beyond what is normally associated with academic studies, should be submitted to the research officer via email. Significant variations will require the submission of a new application.
- Papers and articles intended for publication that are based on data collected from Queensland state schools and/or Departmental sites should be provided to the Department for comment before release.

Education House
30 Mary Street Brisbane 4000
PO Box 15033 City East
Queensland 4002 Australia
Telephone 07 3034 5929
Website www.dete.qld.gov.au
ABN 76 337 613 647

- Under no circumstances should any publications disclose the names of individuals or schools.
- You are required to contact the Department if you are contacted by the media about research activities conducted on Departmental sites or if you intend to issue a media release about the study.
- At the conclusion of your study you are required to provide this Office and principals of participating schools with a summary of your research results and any associated published papers or materials in hard copy. You are also requested to submit the documents in electronic format, or provide a link to an online location if possible, to research.stratpol@dete.qld.gov.au. **Failure to provide a report on your research will preclude you from undertaking any future research in Queensland State schools.**

Please note that this letter constitutes approval to invite principals and teachers to participate in the research project as outlined in your research application. This approval does not constitute ethics approval or support for the general and commercial use of an intervention or curriculum program, software program or other enterprise that you may be evaluating as part of your research.

Research Services values your input into the research application process and is seeking your responses through the enclosed short feedback form. It is hoped that this feedback will enable Research Services to effectively assess whether its processes are efficiently streamlined, transparent and mutually beneficial to all stakeholders.

Should you require further information on the research application process, please feel free to contact Tanya Murray, Senior Research Officer, Strategic Policy and Intergovernmental Relations on (07) 3034 5945. Please quote the file number 550/27/1568 in future correspondence.

I wish your study every success.

Yours sincerely

Dr Angela Ferguson
A/Director
Research Services
Strategic Policy and Intergovernmental Relations
Trim ref: 15/164896

Attachment: Principals letter

Appendix 11 – New South Wales Approval

NSW Government | Education & Communities

Mr Roy Smalley
McMahons Road
Frankston
Vic - 3199

CORP15/3561
DOC15/203157
SERAP 2015048

Dear Mr Smalley

I refer to your application to conduct a research project in NSW government schools entitled *Increasing engagement in mathematics: help-seeking and the psychosocial learning environment*. I am pleased to inform you that your application has been approved.

You may contact principals of the nominated schools to seek their participation. **You should include a copy of this letter with the documents you send to principals.**

This approval will remain valid until 13-Apr-2016.

As this research does not involve face-to-face contact with children, no researchers or research assistants have been screened to interact with or observe children.

I draw your attention to the following requirements for all researchers in NSW government schools:

- The privacy of participants is to be protected as per the NSW Privacy and Personal Information Protection Act 1998.
- School principals have the right to withdraw the school from the study at any time. The approval of the principal for the specific method of gathering information must also be sought.
- The privacy of the school and the students is to be protected.
- The participation of teachers and students must be voluntary and must be at the school's convenience.
- Any proposal to publish the outcomes of the study should be discussed with the research approvals officer before publication proceeds.
- All conditions attached to the approval must be complied with.

When your study is completed please email your report to: serap@det.nsw.edu.au
You may also be asked to present on the findings of your research.

I wish you every success with your research.

Yours sincerely

Dr Robert Stevens
Manager, Quality Assurance/Research
Tuesday, 14 April 2015

Policy, Planning and Reporting Directorate
NSW Department of Education and Communities
Level 1, 1 Oxford Street, Darlinghurst NSW 2010 – Locked Bag 53, Darlinghurst NSW 1300
Telephone: 02 9244 5060 – Email: serap@det.nsw.edu.au

Appendix 12 – Participant Explanatory Statement

Page 1

MONASH University

EXPLANATORY STATEMENT

Participant

Project: Increasing engagement in mathematics: help-seeking and the psychosocial learning environment

Associate Professor Jeffrey Dorman
Faculty of Education - Clayton
email: Jeffrey.Dorman@Monash.edu

Roy Smalley
Doctor of Philosophy Candidate
Faculty of Education - Peninsula
email: Roy.Smalley@Monash.edu

You are invited to take part in this study. Please read this Explanatory Statement in full before deciding whether or not to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

- The aim of this study is to develop a better understanding about how students' approaches to seeking help during mathematics are influenced by different aspects of the classroom learning environment.
- Participants will be asked to complete an online survey (or equivalent hardcopy version) by indicating their level of agreement with a number of statements about their approach to seeking help and perceptions of the classroom learning environment. The survey will also collect some standard background and demographic data such as age, gender, year level etc. The survey will take on average between 10 and 20 minutes to complete during a mathematics class.

Why were you chosen for this research?

- Mathematics is a challenging subject where students are continually required to engage in increasingly abstract concepts. From Year 7 to Year 12 students need to become more self-motivated, and actively seek help when necessary, in order to effectively and efficiently engage in the learning process. In this study we are interested in how the student's perceptions of the mathematics classroom influenced their approaches to seeking help during class.
- To be able to find out how the classroom environment influences the help seeking behaviour of the average student I need several students in each class, and several classes in each participating school, to complete the survey. Whether you like maths or hate maths your participation in this study is essential. If enough students respond then your collective voices could help teachers improve how they engage with students during maths in the future.

Consenting to participate in the project and withdrawing from the research

- To participate in this research you must return the attached consent form, including parental/guardian consent for students under 18, to the school where they will be collated and forwarded Roy Smalley, Monash University.
- Participation in this study is strictly on a voluntary basis and all participants have the right to withdraw from further participation at any stage prior to completion of the anonymous questionnaire. It will not be possible to withdraw data after submission of the survey as personal details are not retained.

Possible benefits and risks to participants

- One possible benefit of participation in the survey is that students and teachers will be prompted to think about how they support seeking help in mathematics classes. Also, Mathematics is a critical skill for citizens of the 21st century and this project allows students to participate in a real life application of mathematics which has a potential for improving the teaching and learning of mathematics in secondary school.

Page 2

- Some student participants may be attending more than one mathematics class. Participants may choose to complete the survey for a single class or a survey for each class. As most of the survey items are subject specific choosing to complete more than one survey will increase the time and effort required. However, each survey can be completed at a different time over a two week period. Remember the survey will only take 10-20 minutes to complete the first time and should therefore take less time for subsequent surveys.
- The study has been designed to minimise inconvenience for students. There are no reasonably foreseeable risks of harm or side-effects to the potential participants. No personal information is collected, such as names or email addresses, during the survey.

Confidentiality

- All data collected by the online survey is de-identified during the data collection process. The survey will not be linked to the participant's consent form and can only be used during a single session.
- Confidentiality or anonymity is maintained during data collection by allocating each school, class and participant with a unique code. All results will be published in a de-identified summary format where school and individual data is aggregated by subject, year level, gender, etc.

Storage of data

- All data collected will be stored in accordance with Monash University regulations for a maximum of 5 years after completion of the study. After 5 years all hardcopy and electronic data will be permanently deleted.
- Data collected via the online survey will be downloaded to a secure personal computer, as per Monash University regulations, and the online data will then be deleted.

Results

- Results will be available from the researcher at the conclusion of the study.

Complaints

Should you have any concerns or complaints about the conduct of the project (No.: CF13/2718 – 2013001462), you are welcome to contact the
Executive Officer, Monash University Human Research Ethics (MUHREC):

Executive Officer
Monash University Human Research Ethics Committee (MUHREC)
Room 111, Building 3e
Research Office
Monash University VIC 3800

Tel: +61 3 9905 2052 Email: muhrec@monash.edu Fax: +61 3 9905 3831
Thank you,

Roy Smalley

Appendix 13 – Participant & Parental Consent Form

Page 1 – Invitation Letter

MONASH University

Parental Consent

Project: Increasing engagement in mathematics: help-seeking and the psychosocial learning environment

Roy Smalley
Doctor of Philosophy Candidate
email: Roy.Smalley@monash.edu

Associate Professor Jeffrey Dorman
Doctoral Supervisor
Faculty of Education - Clayton
email: Jeffrey.Dorman@monash.edu

Dear Parent/Guardian,

My name is Roy Smalley. I am a PhD candidate in the Monash University Faculty of Education. I am writing to seek your approval for your son/daughter to participate in a research project exploring approaches for improving engagement in mathematics. Mathematics is a critical skill for citizens of the 21st century, however, many students continue to find mathematics challenging. This study aims to develop a better understanding about how students' perceptions of different aspects of the classroom learning environment influences their help seeking behaviour during mathematics. The rationale and methodology for the study are outlined in more detail in the Explanatory Statement for Participants.

Your son/daughter's participation in this study is strictly voluntary and he/she can choose to withdraw from the study at any time prior to completion of the survey. Please discuss the study with them prior to giving consent. The final decision to participate will rest with the child/young person.

Participants will complete an online, or printed, survey during a mathematics/numeracy class. All surveys are de-identified prior to analysis and the publication of any reports. The survey will take approximately 15 minutes to complete. The survey collects standard demographic data, such as age and gender, and information about their participation and perceptions of their role in the mathematics class. For example

Getting a certain amount of work done is important to me

Almost never	Seldom	Sometimes	Often	Almost always
○	○	○	○	○

The study has received approval from the Monash University Human Research Ethics Committee (CF13/2718 – 2013001462). If you would like to discuss the study in more detail then please contact me via email at Roy.Smalley@monash.edu. If you consent to your son/daughter's participation in this study then please complete the enclosed Parental Consent form and return it to me via the school.

Kind regards,

Roy Smalley

Page 2 – Consent Form

MONASH University

PARENTAL CONSENT FORM

Project: Increasing engagement in mathematics: help-seeking and the psychosocial learning environment

Investigator: Roy Smalley, Faculty of Education, Monash University

School: ___________________________________ Year level: __________________

Subject: __________________________________ Teacher: _______________________

Class: ____

My son/daughter, __________________________ has been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to his/her participation in this project.

I consent to my son/daughter:	Yes	No
Completing a questionnaire about their engagement during Mathematics.	☐	☐

Student Consent to participate

Name of Participant ______________________________

Participant Signature ______________________________ Date __________

Age: ☐ Over 18 years old
☐ Under 18 (parental consent required except for ☐ TAFE student living independently)

Parental Consent for Student under 18 to participate

Name of Parent/Guardian ______________________________

Parent/Guardian Signature ______________________________ Date __________

Appendix 14 – Teacher Script

Page 1

Increasing engagement in mathematics: Help-seeking and the psychosocial learning environment

Teacher Script for school run data collection

School: AAA Secondary School — Year level: 7-12

Subject: Mathematics Title — Class ID: ClassName

Teacher ID or Name: As provided by school

Thank you for your assistance in this research study. Your participation is greatly appreciated as it allows for a greater diversity of schools and students to participate in the study. The following guidelines are provided to assist you in adhering to the ethical requirements for the conduct of the study and the collection of high quality data.

Please remember that the following conditions apply

- The survey can only be completed by those students who have returned the parental consent form.
- Each student will require a username and password to access the survey (see attached table). Please record the student's name next to their allocated access code (only used for verification of receipt of consent form).
- Participation is **Voluntary** and all participants have the right to withdraw from the study at any time prior to completion.
- Please allow up to 20 minutes for completion from the time the students access the online survey (Survey URL: http://monasheducation.az1.qualtrics.com/SE/?SID=SV_512TuIJ83R78aEd)
- The survey can be completed over multiple sessions. Incomplete surveys are automatically saved and students can use their access code to continue the survey until it is completed.
- The survey can be accessed using a range of ICT platforms with internet connectivity. For example, some participants have successfully accessed the survey on a Samsung Galaxy or 'iPhone'.

Please read the following script to the participating students (Optional)

This survey is part of a research study being conducted by researchers at Monash University. We are interested in finding ways to improve engagement in mathematics for all students. To find out what you think, we would like you to answer some questions about your approaches to seeking help during mathematics and different aspects of the classroom learning environment.
Many of the questions may sound similar, but it is very important that you answer all questions. It is also important that these are your answers. There are no right or wrong answers we are interested in what **You** think. So please answer as honestly as you can.
Participation is voluntary, and you are free to choose not to participate if you don't want to.

Notes

- A few participants have asked what is meant by particular words such as Intelligence and Investigation. Please don't provide a definition – the student should use their own understanding of the term.
- If the student doesn't know an answer for any item on the first screen, eg Birth place of parent, they can type "Don't Know" or something similar

Page 2

Survey URL: http://monasheducation.az1.qualtrics.com/SE/?SID=SV_512TuIJ83R78aEd

Access codes and password for participating students in **Class ID:** Class9

Once started the survey remains accessible for 7 days until completed. This allows the participants to incrementally complete the survey over a number of sessions (if needed).

Class ID	Participant ID	Password	Participant's Name (for verification of Parental Consent)
Aaaaa	test	ba	Dummy access code for Teacher – data will be deleted
Aaaaa	AAASS1550	aa	
Aaaaa	AAASS1551	ab	
Aaaaa	AAASS1552	ac	
Aaaaa	AAASS1553	ad	
Aaaaa	AAASS1554	ae	
Aaaaa	AAASS1555	af	
Aaaaa	AAASS1556	ag	
Aaaaa	AAASS1557	ah	
Aaaaa	AAASS1558	ai	
Aaaaa	AAASS1559	aj	
Aaaaa	AAASS1560	ak	
Aaaaa	AAASS1561	al	
Aaaaa	AAASS1562	am	
Aaaaa	AAASS1563	an	
Aaaaa	AAASS1564	ao	
Aaaaa	AAASS1565	ap	
Aaaaa	AAASS1566	aq	
Aaaaa	AAASS1567	ar	
Aaaaa	AAASS1568	as	
Aaaaa	AAASS1569	at	
Aaaaa	AAASS1570	au	
Aaaaa	AAASS1571	av	
Aaaaa	AAASS1572	aw	
Aaaaa	AAASS1573	ax	
Aaaaa	AAASS1574	ay	
Aaaaa	AAASS1575	az	