HOMEWORK: HOW CAN IT BE 'APPLIED?'

by

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Abstract

Homework provides an opportunity for practice and learning to occur outside the classroom, and research has consistently shown that it can have a positive influence on achievement. However, the preponderance of this research in high schools has been in higher-level Academic classrooms. The purpose of this study is to compare the perspectives of students and teachers with respect to homework, and student learning in Applied math classrooms in Ontario. It builds on recent research by Pang and Rogers (2013) who found that while homework completion was a strong predictor of achievement in Academic math classes, it was a weak predictor in Applied math classes. This result suggests that the current model of homework may not provide strong support for learning in Applied math classes.

This study employed a multiple-method, non-experimental design. The sample consisted of 165 students and 21 teachers in Grade 9 and Grade 10 Applied math classes in Ontario. Students completed surveys, and teachers completed surveys and in-depth interviews. After the data were collected, students were separated into two groups (high achieving and not-high achieving) based on average EQAO math achievement in their schools. An exploratory factor analysis was used to determine the factor structure of the student survey. Independent sample *t*-tests were subsequently conducted to examine between group differences among students in high achieving vs. not-high achieving classrooms. Teachers' perspectives were explored by conducting a thematic analysis of their qualitative interview and survey data. Matching items on the student and teacher surveys and interviews were compared to determine the alignment between students and teachers with respect to homework and student learning. Descriptive statistics were also used to gain overall pictures of the distributions of students and teachers who took part in the study.

Significant differences were found between students in high achieving vs. not-high achieving classrooms with respect to the assignment and completion of homework. The analysis of teacher perspectives, and the comparison of teacher and student data, resulted in implications for research and practice that highlight the need for more conversation, examination and exploration of the complex issues surrounding homework and student learning in Applied classrooms.

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List of Abbreviations

AC	Academic
AP	Applied
EQAO	Education Quality and Accountability Office
HA	High Achieving
NHA	Not-High Achieving
SES	Socio-Economic Status

Chapter 1

Introduction

Homework provides an opportunity for practice and learning to occur outside the classroom (Cooper, 2007). Homework can be defined as "tasks assigned to students by school teachers that are intended to be carried out during non-school hours" (Cooper, 2007, p. 4). The word *intended* is used because homework is sometimes completed during class time, study hall, library time, or in subsequent classes. Research has consistently shown that homework is viewed as important to teachers, parents, and students (Fisher & Frey, 2008), and that it can have a positive influence on achievement (Cooper, Robinson, & Patall, 2006; Cooper, 2007; Petty, Wang, & Harbaugh 2013). However, few studies have focused specifically on the value of homework for struggling students. These students are unique in terms of their attitudes towards school and motivating factors in school (Dunn, 2004; Ehrenreich, Reeves, Corley & Orpinas, 2012; Pang & Rogers 2012). It follows that they may also be unique in terms of how their homework should be assigned and assessed to positively influence their educational experiences and outcomes.

In Ontario, students in Grade 9 and Grade 10 take either Academic (AC) or Applied (AP) mathematics. My research builds on a recent study by Pang and Rogers (2013) who conducted a comparative examination of the influence of selected factors on achievement in Grade 9 AC and AP mathematics courses in English-language schools in Ontario. They used student and teacher 2011 EQAO questionnaire data from 67972 AC students, 22457 AP students, 2505 AC teachers and 1441 AP teachers. Achievement was measured using EQAO test scores. They found that the frequency of homework completion was the strongest predictor of achievement for the AC course but was a weak predictor for the AP course, holding all other variables constant. My

research aims to extend their work by examining the nature of homework and teaching and learning in AP math classrooms to determine how we can positively influence the learning of students in AP programs.

Students in AP math have consistently struggled to meet the provincial expectations on the Grade 9 Education Quality and Accountability Office (EQAO) Assessment of Mathematics, whereas students in the AC course have generally not faced such challenges (Pang & Rogers, 2013). The EQAO was established in 1996 to provide "students, parents, teachers and administrators with a clear and comprehensive picture of student achievement and a basis for targeted improvement planning at the individual, school, school board and provincial levels" (EQAO, 2014a, p. 1). Since 2006, 3/4 of students in AC math but only 1/3 of students in AP math have met the provincial standard (Hunter, 2011). In the most recent test, 85% of students in AC math, and 47% of students in AP math were at or above the provincial expectation (EQAO, 2014b). This is concerning, given the Ontario government's focus on improving the numeracy skills of *all* students in the province (Hunter, 2011). As recognized through previous research (Cooper et al., 2006), homework provides an opportunity to improve learning, but presently the positive effects of homework completion seem to only be realized mainly in AC classes (Pang & Rogers, 2013). Hence, more research that examines the nature of homework in AP math classrooms is needed to determine how it could be used to more positively influence and support student learning.

Purpose

My study aimed to compare the perspectives of students and teachers with respect to homework, and student learning in Applied (AP) math classrooms. It was informed by the following research questions:

1. Do students in high achieving vs. not-high achieving AP math classrooms differ in their perspectives and experiences towards learning and homework?
2. What are teachers' perspectives regarding homework, and student learning in AP math classrooms?
3. What is the alignment between students and teachers with respect to homework, and student learning in AP math classrooms?

Context

In Ontario, Grade 9 is the first year of high school. In order to graduate from high school, students must earn three credits in math, including one credit in Grade 9, one credit in Grade 10 and one credit in Grades 11 or 12 (Ontario Ministry of Education, 2015). The Grade 9 and Grade 10 curriculum offers two types of mathematics courses, Academic (AC) and Applied (AP). The AC courses "develop students' knowledge and skills through the study of theory and abstract problems" (Ontario Ministry of Education, 2005, p. 6). The Applied (AP) courses "focus on the essential concepts of the subject" (Ontario Ministry of Education, 2005, p. 6). AC courses "incorporate practical applications as appropriate" while AP courses focus on "developing students' knowledge and skills through practical applications and concrete examples" (Ontario Ministry of Education, 2005, p. 6). While the majority of the strands covered are the same in the Grade 9 and Grade 10 AC and AP math courses, they have distinct overall and specific curriculum expectations within each strand. There is a stronger emphasis on theory in the AC math course, and a stronger emphasis on practical applications in the AP math course. Students who complete the Grade 9 AC course may take either the Grade 10 AC or AP course. Students who complete the Grade 9 AP course must complete a transfer course if they wish to proceed into the Grade 10 AC course. The Grade 11 and Grade 12 math curriculum offers four types of

math courses: university preparation, university/college preparation, college preparation, and workplace preparation. The Grade 10 AC course is a prerequisite for the university preparation courses. As such, it is important for students, parents and educators to carefully consider students' strengths, needs, interests and post-secondary goals when choosing math courses in Grades 9 and 10.

In Ontario, there are no policies regulating the assignment of homework. Whether or not to assign homework is at the discretion of the teacher. However, the *Growing Success* document (Ontario Ministry of Education, 2010), which outlines policies regarding assessment, evaluation and reporting in Ontario schools, contains information on the completion and assessment of homework. In the section on learning skills and work habits, completing and submitting homework according to agreed-upon timelines is listed as a responsibility of students. Homework should not be used as an assignment for summative evaluation. However, the completion of homework can be noted on the report card as part of the evaluation of students' work habits and learning skills (Ontario Ministry of Education, 2010). The document does highlight homework as a formative assessment tool. It describes how:

> Homework tasks designed to help students practice and consolidate new learning can also provide assessment information that both teachers and students can use to adjust instruction and focus learning. (p. 34)

Overview of Thesis

This thesis is structured in five chapters. The current chapter (Chapter one) presents the research questions, and introduces the research context for the thesis. Chapter two is a literature review that provides a theoretical basis for this research. Chapter three outlines the methods I used to answer my research questions. Chapter four describes the results of my data analysis.

Chapter five provides a discussion of key findings, outlines recommendations for future research and teaching practices, and discusses limitations.

Chapter 2

Literature Review

This literature review focuses on two primary areas of research to provide a theoretical basis for my study into the perspectives of students and teachers with respect to homework, and teaching and learning in Applied (AP) math classrooms. The first area of research reviewed is homework and includes research relating to the purposes of homework, the impact of homework, and effective homework practices. The second area of research reviewed focuses on struggling students, and includes research relating to what they need to be successful, how schools and teachers have responded to these needs, and the challenges schools and teachers face in meeting these students' needs. The available research provides a rationale for continued efforts to better understand the needs of students in AP programs. An increased understanding of their needs will enable us to better support their educational goals, and to improve their educational experiences and outcomes.

Homework

Homework is deeply embedded in beliefs about schooling, and it is valued by students, parents and teachers (Fisher & Frey, 2008). The *MetLife Survey of the American Teacher, 2007: The Homework Experience*, revealed that homework is viewed as "important" or "very important" by teachers (83%), parents (81%), and students (77%) (Markow, Kim, & Liebman, 2007). However, despite this agreement regarding the value of homework, there remains much debate among scholars, educators and the general public regarding other issues surrounding homework. *The Battle over Homework* (Cooper, 2007) highlights the difficulties in finding a common ground for students, administrators, parents and teachers with respect to the assignment and assessment of homework. Too often, they fall into ways of thinking that view schools and

families as adversaries. Parents claim that assignments are too long or too short, students protest the time homework takes from their leisure activities, and teachers complain about a lack of time to prepare assignments and a lack of support from parents and administrators (Cooper, 2007). As with many issues in education, homework is a complex topic. Homework is used for a variety of purposes, there are a number of factors that influence the impact of homework on achievement, and a substantive body of research exists that examines effective homework practices.

Purposes of homework.

Before examining the impact of homework, it is important to consider the various purposes of homework. Two purposes of homework are commonly discussed in the research literature: (a) the practice of concepts covered in class; and (b) the preparation for upcoming material (Epstein & Van Voorhis, 2001; Markow et al., 2007; Xu & Yuan, 2003). Fisher and Frey (2008) recommend that teachers use homework for fluency building (providing opportunity for practicing one or two skills), application (using skill to solve a problem, or applying to a new situation), spiral review (confirming understanding), and extension (using variety of skills and/or resulting in new understandings). Homework can also be used as an opportunity for generating new understandings; this is a purpose for which homework is increasingly being used (Markow et al., 2007). Sparks (2011) describes the recently popular movement of "flipping" the classroom where students watch online videos presenting them with new material as homework before they learn it in class. These videos present the content and students are then responsible for learning the basics of that content on their own before engaging in related activities during subsequent in-school class periods.

In addition to increasing content knowledge, teachers also intend for homework to help develop good work habits and life skills. On the basis of open-ended interviews in one urban

middle school, Xu and Yuan (2003) examined how teachers, students and parents perceived homework. Teachers stressed the development of personal responsibility and study skills as important goals of assigning homework. In the *MetLife Survey of the American Teacher, 2007: The Homework Experience* (Markow et al., 2007) teachers' top two objectives for homework were improving skills for the classroom and improving skills for life beyond school. Markow et al., (2007) also found that secondary school teachers commonly used homework to develop students' critical thinking skills and to develop students' interests. Lastly, Markow et al. (2007) noted that in the case of secondary school teachers, homework was used (25% of the time) because there was not enough time during class to cover all the material. This is worrisome because it suggests that secondary school students may regularly face homework assignments that they are inadequately prepared to complete (Markow et al., 2007).

Impact of homework.

One significant advantage of homework is that it extends the opportunity for learning beyond the school day. This characteristic is important because students in North America spend much less time studying academic content than students in other countries (Marzano & Pickering, 2007). Given the positive impact of time on task as a predictor of achievement, it is not surprising that the opportunity for learning to occur outside the classroom through homework positively affects academic achievement (Cooper et al., 2006; Maltese, Tai, & Xitao, 2012; Petty et al., 2013). In their most recent meta-analysis examining 76 studies from 1987 to 2003, Cooper and colleagues (2006) found that "with only rare exceptions, the relationship between the amount of homework students do and their achievement outcomes was found to be positive and statistically significant" (p. 48). Of the 69 correlations between homework and achievement reported in 32 documents, 50 correlations were in the positive direction. In the six studies that

examined the relationship between experimental (homework) and control (no homework) groups, all six revealed that homework had a positive effect on unit tests (Cooper et al., 2006). These researchers also found that homework had a positive effect on non-academic achievement. Homework develops study skills, student responsibility, communication skills and other factors that are more difficult to measure (Cooper et al., 2006).

Research also suggests that homework has a stronger correlation with achievement as students get older. As concepts become more complex and continue to build on previous skills, students require more practice. Buell (2004) found that while a correlation exists for older students, for younger students, there was no correlation between homework completion and any meaningful measure of achievement (see also Cooper et al., 2006). The size of the effect at the secondary level varied depending on where the homework was completed and the achievement measure used. Keith, Diamond-Hallam, and Fine (2004) examined the longitudinal effects of completing homework in or out of school using the National Education Longitudinal Study (NELS) dataset. They found that time spent completing homework in school had a relatively large effect on student achievement whereas time spent completing homework outside of school had an insignificant effect on standardized test achievement. This suggests that teachers should look for and encourage opportunities for students to begin homework during school hours. With respect to different achievement measures, Maltese et al. (2012) assessed survey and transcript data from two nationally representative samples of high school students collected in 1990 and 2002. Their purpose was to investigate how much variance in science and math course grades, and achievement test scores, could be explained by time spent on homework in those classes. They found that while there was no consistent significant relationship between time spent on homework and grades, there was a consistent significant positive relationship between

homework and performance on standardized exams (Maltese et al., 2012). Petty et al. (2013) also demonstrated the positive impact of homework on standardized test achievement. In their study, they measured the achievement of 57897 North Carolina students in Grades 9-12 who took Algebra II in 2006. They used standardized Algebra II End of Course tests as their achievement measure, and concluded that the more homework teachers assigned, the better students performed on the test.

However, more homework is not necessarily better. Too much time studying and doing homework can result in a 'saturation effect' in which overexposure to academic tasks results in frustration and reduced long-term interest in the subject matter (Buell, 2004). Even for older students, where the impact of homework on achievement is stronger, "too much homework may diminish its effectiveness or even become counterproductive" (Cooper et al., 2006, p. 53). Homework can also have negative effects on personal/family life. It takes time away from other activities, and contributes to a competitive culture that overvalues work to the detriment of personal and family wellbeing (Buell, 2004).

Effective homework practices.

With the aim of increasing the positive effects of homework, a substantive body of research exists that examines effective homework practices. First and foremost, homework needs to be purposeful and well integrated into the teachers' instructional design (Cooper, 2007; Fisher & Frey, 2008; Kohn, 2006; Markow et al., 2007; Marzano & Pickering, 2007). Simply assigning homework may not produce the desired effect, and ill-structured homework might even have a negative effect on student achievement (Cooper, 2007). Kohn (2006) pleads for a fundamental change from the current default state of assigning homework for its own sake to assigning homework only on occasions when it is truly necessary and beneficial. It should not be assigned

as an afterthought, but genuinely relevant to the course and topic (Markow et al., 2007). Many teachers assert that homework helps students assume responsibility for their learning. Fisher and Frey (2008) suggest that 'responsibility' is a two-way street, and that more attention to the role of homework as part of the teachers' overall instructional design makes it possible for more learners to assume that responsibility. Whether homework is assigned to practice a skill, to elaborate on information addressed in class, or to introduce new content, it should only be assigned with the intention of promoting student learning, and with an understanding of the educational needs of the students (Marzano & Pickering, 2007). With respect to introducing new content in the homework, Vatterott (2009) stresses that this should only be done with the goal of stimulating interest in a new concept.

Homework should also be designed to maximize the likelihood that students will complete it. It should be at an appropriate level of difficulty, and students should be able to finish it independently while still finding it challenging enough to be interesting (Marzano & Pickering, 2007). It should not be dependent on either parental or financial supports for completion (Fisher & Frey, 2011). The goal should be to "release responsibility to the students based on the teachers' knowledge about their understanding" (Fisher & Frey, 2011, p. 4). One way to accomplish this is to involve students in deciding what homework, and how much homework, they should do (Kohn, 2006). Quality homework tasks promote ownership when they allow for choice and offer students an opportunity to personalize their work (Vatterott, 2010).

A number of researchers have investigated the effectiveness of homework based on time spent completing homework. Cooper (2007) suggested following the "10-minute rule" (p. 92), in which the daily homework assignments combined should take as long to complete as 10 minutes multiplied by the students' grade level. So, a student in Grade 9 would have 1.5 hours of

homework. Maltese et al. (2012) found that students completing one to two hours of daily homework earned the best grades and highest test scores. Cooper et al. (2006) discovered that the optimum amount of homework might lie between 1.5 and 2.5 hours per night. While these times could be used as a guideline, researchers caution against relying on any hard-and-fast rules. Identifying an ideal amount of time to spend on homework is based on the two assumptions that students are focused on the task for the entire amount of time, and that they working with a correct understanding of the assignment and relevant concepts. If this second assumption is false, then any time spent on homework may simply be reinforcing incorrect understandings (Marzano & Pickering, 2007). Teachers should monitor the amount of time spent on homework to ensure that it is appropriate to students' age levels, and that it does not take too much time away from other home activities (Marzano & Pickering, 2007). At the Secondary level, teachers should coordinate with other teachers to ensure that the amount of homework assigned is reasonable and that students are not overwhelmed with long assignments for multiple classes on one night (Simplicio, 2005).

More important than the time students spend on homework, is the quality of homework that students engage in – that it is meaningful and contributes positively to their self-efficacy beliefs (Kitsantas, Cheema, & Ware, 2011). The findings of Kitsantas et al. (2011) highlight the importance of emphasizing mastery rather than time spent on homework. Their study used the U.S. portion of the Program for International Student Assessment (PISA) to examine how homework resources, mathematics self-efficacy, and time spent on homework impacted mathematics achievement across gender and ethnicity (sample consisted of 5200 15-year olds attending 9^{th}, 10^{th}, and 11^{th} grades in U.S. high schools in 2003). Their results indicated that appropriate homework should focus on enhancing math self-efficacy by creating mastery

experiences where students can feel successful with their work. Teachers should create homework assignments that facilitate progression from easy to more difficult, and should verify that students can solve the problems before sending them off to pursue homework. Students who have low math achievement scores may be spending more time on math homework precisely because they have low self-efficacy beliefs and low homework support resources (Marzano et al., 2007). This is consistent with the findings by Keith et al., (2004) who highlighted the potential positive effects of allowing students to get started on homework in school where they may have more resources available to support their learning.

For homework to be effective, students must have the resources they need to complete the homework. Teachers should check to make sure that students have the right support, space and tools at home to complete their homework effectively (Markow et al., 2007). This is especially relevant for economically disadvantaged students who are unintentionally penalized because their environments often make it almost impossible to complete assignments at home (Buell, 2004). Educators can take steps to increase access to resources for students to complete their homework and structure homework assignments accordingly. This may include creating a library within the classroom from which students could check out a calculator, books, dictionaries or drawing instruments (Kitsantas, Cheema, & Ware, 2011).

The necessity of having resources to complete homework highlights the importance of ongoing communication with parents about homework and student success (Buell, 2004; Cooper, 2007; Markow et al., 2007; Marzano & Pickering, 2007; Walker, Hoover-Dempsey, Whetsel, & Green, 2004; Xu, 2005). Walker et al. (2004) suggest that to increase parental involvement and maximize the positive impact, teachers should provide parents with written information about homework policies and purposes (Walker et al., 2004). Teachers should also be conscious of

involving parents in appropriate ways. For example, it is appropriate for parents to act as a sounding board to help summarize what the student learned from the homework, but they should not be required to act as teachers or to police students' homework completion (Marzano & Pickering, 2007).

Struggling Students in Mathematics Education

Struggling students are those who have difficulty meeting the learning expectations as outlined in the curriculum and consistently perform below provincial standards (Johannessen, 2004; Pang & Rogers, 2013). They have lower achievement on standardized tests than traditionally successful students (Bryan, 2004; Johannessen, 2004; Pang & Rogers, 2013; People for Education, 2014). They also come disproportionately from families with low socioeconomic status and with ethnic and linguistic minority backgrounds (Johannessen, 2004; People for Education, 2014).

Students who struggle to meet the expectations in Ontario's math classes have trouble using relevant math knowledge and skills to represent and explain their answers, especially when solving multi-step problems (Hunter, 2011). In addition to having lower achievement on standardized tests in Grade 9, more students in AP math classes have also failed to meet the standard in Grade 3 or Grade 6 (Pang & Rogers, 2012). This pattern of struggling performance in math from an early age, results in poor attitudes towards math and poor confidence in their ability to do well (Pang & Rogers, 2012; Dunn, 2004).

Mindset has been identified as an obstacle to learning that perpetuates this cycle of poor attitudes, confidence and performance. Research has shown that an individual's mindset (i.e., their view towards whether intelligence is a fixed or malleable trait) impacts their academic goals and achievement (Yeager & Walton, 2011; Dweck, 2006; Blackwell, Trzesniewski, & Dweck,

2007). Students with a 'fixed mindset' assume that intelligence is an innate quality that can't be changed. They are vulnerable to failure, afraid of challenges and unmotivated to learn. On the other hand, students with a 'growth mindset,' view intelligence as a malleable quality that can be grown through effort (Dweck, 1999). These students tend to earn higher grades (Dweck, 2006; Blackwell et al., 2007) and are able to respond resiliently when challenges arise (Yeager & Dweck, 2012). Research has thoroughly established that children's math attitudes develop as a result of environmental influences, including those that occur in interactions with teachers (Ramirez et al., 2013; Cialdini & Goldstein, 2004; Prentice & Miller, 1993). Previous studies have also shown that it is possible to change mindsets through simple and inexpensive interventions (Paunesku, 2013). Using homework effectively, as an opportunity to practice skills and to receive constructive feedback on those skills, may be a way to improve the mindsets and motivation of struggling students in math.

Struggling students in math need extra support to reach their educational goals (Egodawatte, McDougall, & Stoilescu, 2011; Hunter, 2011; Pang & Rogers, 2013). Egodawatte et al. (2011) conducted workshops and interviews for teachers and administrators in 11 schools in the Greater Toronto Area in 2009/10. The purpose was to design and implement collaborative strategies to improve teaching and learning in Grade 9 Applied math. Three key factors were identified: support to become independent learners, support to increase comfort level in math, and support to improve ability to communicate mathematical ideas clearly. This third factor (support for communicating mathematical ideas) was also highlighted in Hunter (2011) in *Preparing Students for the World Beyond the classroom: an EQAO research bulletin linking EQAO Assessments to 21st-century skills.* She also identified support to develop critical thinking skills as a key component of improving the educational outcomes of struggling students (Hunter,

2011). Homework that is assigned with the intention of improving student learning and with an understanding of the educational needs of the students could be used as a strategy to provide extra support to students struggling in math (Cooper, 2007; Marzano & Pickering, 2007).

Homework could also be incorporated into the strategy of guided instruction to provide extra support to struggling students. Guided instruction has been highlighted as an effective approach for supporting the academic achievement of struggling students (Expert Panel, 2004; Johannessen, 2004). According to *The Expert Panel on Student Success in Ontario: Mathematical Literacy, Grades 7–12* (2004), guided instruction can be used to reinforce specific skills or concepts, work on new skills, and model mathematical language, thinking, and problem solving. In guided instruction the teacher plays a supporting role by guiding the discussion, modeling thinking strategies, and helping students make connections with prior knowledge. The students should be participating, asking questions, sharing ideas, and offering suggestions (Expert Panel, 2004). The goal of guided instruction is ultimately for struggling students to experience the success of selecting and using appropriate mathematical strategies on their own (Johannessen, 2004). Integrating homework assignments that are clearly explained, modeled by the teacher, scaffolded to support the learning process, and assessed in a way that encourages students to become more self-regulated learners could be beneficial for struggling students in math. The present study, aims to explore these ideas in more detail by comparing the perspectives of students and teachers with respect to homework, and teaching and learning in AP math classrooms.

In addition to academic support, struggling students also need extra support for managing external sources of stress (Ehrenreich et al., 2012). Support that takes a holistic approach by focusing on the whole individual can encourage higher educational aspirations (Petty et al.,

2013). This support may be most important in ninth grade, as students have identified it as a turning point in academic success or failure (Ehrenreich et al., 2012).

The extra support that struggling students require does not mean that they should be held to a lower standard. High expectations actually have positive effects on the achievement of struggling students, and lead to higher educational aspirations (Dunn, 2004; People for Education, 2014; Petty et al., 2013). Students do not want to disappoint the expectations of adults that care about them (Ehrenreich et al., 2012). Classroom instruction built around high expectations should challenge students to use intuitive skills to solve problems. According to the NCTM *Overview of at-risk students and strategies for helping them increase math achievement*, classroom activities should grow out of real-world problems relevant to the learner (Bryan, 2004). Questions should provide students with opportunities to represent their knowledge in a variety of ways and to draw on the out-of-school experiences and cultures that they bring to the classroom (Hunter, 2011). If we focus on creating a climate that supports, engages, and sets high (but achievable) expectations for struggling students, their attitudes towards math will improve, and increases in achievement will follow (Pang & Rogers, 2013).

Feedback is also especially important for struggling learners (Bryan, 2004; Hattie & Timperley, 2007; Margolis & McCabe, 2003; Mithuag, Campeau, & Wolman, 2003). Instructor-based feedback supports and promotes self-regulated learning, can encourage students' persistence on assignments, and can support their motivation to take on more challenging tasks (Margolis & McCabe, 2003). According to Hattie and Timperley's (2007) synthesis of twelve previous meta-analyses that focused on feedback in classrooms, feedback was one of the top five influences on achievement. Effect sizes were highest when students received informative feedback about a task that included suggestions for doing it more effectively. Feedback should

"reduce discrepancies between current understandings and performance and a goal" (p. 86). Struggling students need formative assessments that are aligned with curriculum goals, and that include opportunities for them to self-assess and monitor their own learning (Bryan, 2004). Choice to accept or reject feedback may also be important for struggling learners. To experience choice might support the best and most positive opportunities for learning gains (Mithaug, Campeau, & Wolman, 2003). As identified by Pang & Rogers (2013), students in AP math classrooms are struggling to meet provincial expectations, and their homework completion is not currently a strong predictor of their achievement on provincial tests. In the present study, I will explore the perspectives of students and teachers in AP math classrooms with respect to the assignment, completion, and assessment of homework with the aim of identifying approaches to homework that will better support the learning of this group of students. Homework that is purposefully assigned with clear expectations, and formatively assessed with specific suggestions for improvement and opportunities for students to monitor their own learning, may increase the motivation and efforts of struggling students to complete and persist on challenging homework tasks.

How schools and teachers respond to the needs of struggling students

One of the ways that The Ontario Ministry of Education has responded to the needs of struggling students is by developing distinctive curriculum expectations for AC and AP courses. The AC curriculum focuses more on theory and abstract problems, while the AP curriculum focuses on practical applications and concrete examples (Ontario Ministry of Education, 2005).

There is some concern from researchers and lobbyists that this intended curriculum is not being enacted and experienced in a way that best supports the learning of students in AP programs. They assert that lessons seldom begin with real-world problems, and that teachers tend

to approach AP classes with negative perceptions regarding the motivation and mathematical abilities of their students (Bryan, 2004; Dunn, 2004; Johannessen, 2004, People for Education, 2014). Lower expectations from teachers subsequently result in lower expectations and lower performance from students in their AP courses. This in turn causes decreased self-esteem and even lower performance which ultimately creates an inequality of opportunity between AP and AC courses (Dunn, 2004).

There are also concerns regarding how well teachers are currently meeting the needs of students in AP classes. Teachers in AP classes are on average less experienced than teachers in AC classes (Pang & Rogers, 2013). The average number of years teaching at the secondary level for AP teachers in 2011 was 2.83 (Pang & Rogers, 2013). According to Bryan (2004), this is problematic because teachers with less experience may lack the pedagogical knowledge of the learning process, as well as the mathematical skills and confidence, that struggling students could benefit most from. Inexperienced teachers may also be less prepared to manage the social, cultural and economic diversity that exists in AP classrooms (Bryan, 2004). There is also a higher turnover rate in teachers that teach AP classes (Egodawatte et al., 2011). This higher turnover rate may make it difficult to maintain consistency and momentum in developing positive relationships with students and in collaboration with other teachers (Egodawatte et al., 2011).

There may also be conflict between teachers and parents of struggling students. Parents tend to focus on wanting their child to pass the credit, while teachers want the child to appreciate the subject and think critically (Egodawatte et al., 2011). Parents are also used to the teaching methods that they grew up with. This can create tension when teachers do try to move towards using a more problem-solving approach as outlined in the curriculum (Johannessen, 2004).

Another challenge is that even though the AP math curriculum calls for a stronger emphasis on practical applications, math is not seen as practical or meaningful from the perspective of struggling students (Hunter, 2011). This lack of meaning, combined with lower teacher expectations, results in lower educational aspirations (Petty et al., 2013). Struggling students are absent more often and their achievement further suffers (Pang & Rogers, 2013). More absences also result in less teacher-student contact and less opportunity for the teacher to build a positive relationship with the struggling student. Poor interpersonal relationships affect self-determination, and there is a strong correlation between low self-determination and low achievement (Mithaug, Campeau, & Wolman, 2003). Because external sources of stress are also particularly prominent in the lives of struggling students, it becomes even more difficult for them to focus on achieving academic goals (Ehrenreich et al., 2012).

Regardless of whether or not the majority of stakeholders in education agree with the concerns and challenges mentioned above, these challenges encourage reflection of teaching practices and highlight the importance of meeting the needs of students in AP programs. The present study aims to expand the body of knowledge with respect to the nature of teaching and learning in AP math classrooms. The more knowledge we gain with respect to current teachers' and students' perspectives, the more equipped we will be to foster practices that positively influence student learning in AP programs.

Homework and Struggling Students in Math Education

Teachers often assign homework with the goals of providing an opportunity for students to practice concepts covered in class, to prepare them for upcoming material, and to develop good work habits and life skills (Epstein & Van Voorhis, 2001; Markow et al., 2007; Xu & Yuan, 2003). Research has confirmed that homework has a positive impact on academic

achievement and life skills, and that this impact is stronger at the secondary level (Buell, 2004; Cooper et al., 2006; Maltese et al., 2012). Within Secondary classrooms, the effect of homework is larger when at least some homework is completed in school, and when standardized tests are used as the achievement measure (Cooper et al., 2006; Keith et al., 2004; Maltese et al., 2012). However, homework can also have negative effects when it results in overexposure to academic tasks (Buell, 2004; Cooper et al., 2006). Effective homework practices include assignments that are purposeful, clearly explained and well-integrated into the teachers' instructional practice (Cooper, 2007; Kohn, 2006). This homework should be meaningful, lead to mastery of the content, and contribute positively to students' self-efficacy beliefs (Kitsantas et al., 2011; Markow et al., 2007; Marzano & Pickering, 2007). It should be at an appropriate level of difficulty, offer choice where possible, and be able to be completed independently (Fisher & Frey, 2011; Marzano & Pickering, 2007; Vatterott, 2010). In order to fulfill these criteria, teachers need to understand and be sensitive to the needs of their students.

Research indicates that struggling students need extra support, high expectations, and formative feedback from educators (Ehrenreich et al., 2012, Hattie & Timperley, 2007; Margolis & McCabe, 2003). They also need an enacted curriculum that promotes making meaningful connections to their life experiences (Hunter, 2011; Petty et al., 2013). While the intended Ontario curriculum highlights the importance of developing students' knowledge and skills through practical applications and concrete examples, some researchers and lobbyists are concerned that lessons seldom begin with real-world problems, and that teachers tend to approach AP classes with lower expectations, and negative perceptions regarding the motivation and mathematical abilities of their students (Bryan, 2004; People for Education, 2014).

Given the characteristics and learning needs of struggling students, research on homework indicates that there are challenges in using homework to support struggling students' learning. For homework to be effective, students must have the resources they need to complete the homework (Markow et al., 2007), yet struggling students come disproportionately from families with low socioeconomic status (Johannessen, 2004; People for Education, 2014). As such, they may be unintentionally penalized if their environments make it almost impossible to complete assignments at home (Buell, 2004). Research also indicates that effective homework should be meaningful (Cooper, 2007; Markow et al., 2007); however, math is often not seen as meaningful from the perspectives of struggling students (Hunter, 2011). Effective homework should also contribute positively to students' self-efficacy beliefs (Marzano & Pickering, 2007; Keith et al., 2004). However, this may be more challenging for students who have struggled in math from an early age, and have subsequently developed poor attitudes towards math and poor confidence in their ability to do well (Pang & Rogers, 2012; Dunn, 2004). Finally, effective homework should provide students with an opportunity to master the content taught in class (Kitsantas et al., 2011). However, the frequent absences, and external sources of stress (Ehrenreich et al., 2012; Pang & Rogers, 2013) that are characteristic of struggling students could make it difficult for them to complete and understand their class work at a high level.

Although research has established the overall viability of homework as a tool to enhance student achievement, for the most part the research has been conducted on higher-level AC classrooms. The majority of research also provides recommendations articulated at a very general level (Marzano & Pickering, 2007). For recommendations to get more specific, we need to look at more specific groups of students. According to Cooper et al. (2006) gaps in our knowledge suggest that future studies should include students with varying ability levels, SES,

and sex. The present study aims to add to this body of knowledge by examining homework and students in AP mathematics. We do not know from current research, the extent to which homework is aligned with the learning needs of this group of students. We do have some evidence that it is different from AC classrooms based on the results of Pang and Rogers (2013). With respect to the predictive power of homework at the student level, they found that homework was a strong predictor of achievement for students in AC classes but a weak predictor for students in AP.

Chapter 3

Method

Research has consistently demonstrated that homework is associated with increased academic achievement at least for high-achieving students, increased development of life skills, and increased communication between parents, teachers, and students (Cooper, Robinson, & Patall, 2006; Cooper, 2007; Petty, Wang, & Harbaugh 2013; Fisher & Frey, 2008). However, the preponderance of this research in high schools has been in higher-level Academic classrooms. Pang and Rogers (2013) found that while homework completion was a strong predictor of achievement in Academic (AC) math classes, it was a weak predictor in Applied (AP) classes. This result indicates that the current model of homework may not be a strong supporter of learning in AP classes.

To investigate current homework practices, my research study employed a multiple method, non-experimental design. My first research question, which looked for differences between two groups (students in high and not-high achieving AP math classrooms), lent itself to a quantitative, comparative study design. This design allowed me to examine between group differences based on dependent variables (McMillan & Schumacher, 2010). My second research question, which aimed to gain an in-depth understanding of teachers' perspectives on homework, teaching and learning, lent itself to a qualitative methodology. This enabled me to gain a deeper understanding of the practices that a small, focused sample of teachers employed in their classrooms. My third research question, which focused on the alignment of students and teachers, required both quantitative and qualitative methods to analyze the teacher interview questions alongside the fixed- and open-ended teacher and student survey questions.

The methods as described above, provided the framework in which my research was anchored. What follows, is an outline of the procedures I used to answer my research questions.

Sample

The sample consisted of students and teachers in Grade 9 and Grade 10 AP math classes in six schools from four school boards that are part of the Eastern Ontario Staff Development Network. After the data were collected, students were separated into two groups [high achieving (HA) and not-high achieving (NHA) classrooms] for analysis based on their schools' EQAO achievement results from 2009 - 2014. The score range for the HA group was from 67% - 89% of students meeting the provincial standard. The score range for the NHA group was from 32% - 52% of students meeting the provincial standard. A total of 165 students participated in the student survey. Of these, 66 were placed in the HA group and 99 were placed in the NHA group. One board did not provide any student data, only teacher surveys. A total of 21 teachers participated in the teacher survey. Six of these teachers also participated in an in-depth interview.

Data Collection & Recruitment

Research applications were submitted to, and subsequently approved by four school boards. Once a school board granted approval, principals were contacted by email to ask permission for Grade 9 and/or Grade 10 AP math teachers (and their students) to participate. Convenience sampling, based on consent, was used to obtain teacher and student data prior to the end of February 2015. The student and teacher surveys (see Appendix C) were available in both paper and online formats. The teacher survey was available to teachers who were currently teaching or had taught AP math in the past. The teacher interviews were conducted in person with six teachers. Sizes of sample groups for all data collection strategies can be found in Table 1 below.

Table 1

Data Collection Protocols

Data Collection Strategy	Student	Teacher
Survey	n = 165	n = 21
Interview	n/a	n = 6

Teachers who were interviewed did not complete the open-response section of the teacher survey because they were asked similar questions as part of their interview. The interview questions (see Appendix C) asked teachers to describe student learning, as well as the assignment, assessment and value of homework, and their classroom mindset. The open-response questions on the student survey focused on gathering a deeper understanding of the value of homework, and the approach to teaching and learning in their classrooms. There were similarities between the questions asked of students and teachers to allow their results to be compared.

I chose to include a survey with teachers in addition to conducting interviews because I knew I would likely have fewer teacher than student participants (one teacher vs. many students per classroom) and surveys are easier and less time-consuming to administer in multiple locations. I used email to communicate with principals and teachers because it greatly simplified contacting the participants. In those cases in which I did not receive a response through email, I contacted the principal or teacher by phone. I provided the option of completing the surveys online because it is the easiest way to administer a survey to a large number of respondents across different sites (Vogt, 2007). It was also appropriate because I could logically assume that potential respondents would be comfortable reading and writing in English, and that they would understand the questions being asked. Finally, having an online survey also allowed teachers to complete it at their own pace when they had time. Some questions may have required more time

to answer than others. For all participants, I also offered the option of completing paper copies of the surveys.

Instruments

The student and teacher surveys were generated using *FluidSurvey* and contained both fixed- and open-response questions. The survey questions were answered using a 4- or 5-point Likert-type scale. To minimize threats to external validity, I drew questions from a survey of a nationally representative sample. The *MetLife Survey of the American Teacher, 2007: The Homework Experience* (Markow et al., 2007) employed a national sample of American public school students in Grades 3 through 12, public school teachers of Grades K through 12, and parents of students in Grades K through 12. The fixed-response survey questions were also drawn from the *Mindset Survey* developed by Dweck (2012) and a student survey administered by Queen's University researchers as part of a multi-year project aimed at Building Capacity in Assessment for Learning in Ontario schools (Pyper, 2014).

The questions on my surveys and the teacher interview were also informed by the research literature. For example, questions were included that addressed the value of homework, the purposes for giving homework, the types of homework assigned, and how feedback is provided to students on their homework. Schoolwork that is meaningful, and includes consistent feedback has been shown to be important for student engagement (Pang, Koslow & Rogers, 2012; Pang & Rogers, 2013).

Both the student and teacher surveys included the following components: demographics, homework assignment, homework completion, homework assessment, the value of homework, and mindset. The student survey included the following additional constructs: attitudes towards learning, and attitudes towards mathematics. The open-response questions on the teacher survey

focused on gathering a deeper understanding of the assignment and assessment of homework, the value of homework, and teachers' approaches to teaching and learning in AP math. The open-response questions on the student survey focused on gathering a deeper understanding of the value of homework, and students' perspectives on teaching and learning. The teacher interview questions focused on describing student learning in their classroom, the assignment, assessment and value of homework, and their classroom mindset. Teachers were also asked to compare these descriptions to their approaches to teaching and learning in other classes. All teachers chose to compare AP to AC, although this comparison was not explicitly asked for in the interview question.

Data Analyses

After the data were collected, existing EQAO school achievement data from 2009 - 2014 were used to separate the student data into two groups at the school-level. Students were separated into high achieving (HA) and not-high achieving (NHA) AP schools by collecting information with respect to the independent variable of Ontario school and the dependent variable of achievement. HA schools were those with the highest percentage of students in AP classes achieving above the provincial standard (Level 3 or 4) on average over the past five years (from 2009 - 2014). NHA schools were those with the lowest percentage of students in AP classes achieving above the provincial standard on average over the past five years (from 2009 - 2014). Each year, the EQAO is responsible for administering assessments in language arts and mathematics to students in Grades 3, 6, 9 (mathematics only) and 10 (literacy only). The provincial standard was used as the cut-off point because it is the benchmark that the Ontario government has set to define whether students are or are not acquiring essential numeracy skills (Hunter, 2011). I chose to take an average over time rather than using the most recent single year

of data because I was interested in examining homework practices in classrooms that had been consistently achieving at a high or not-high level. I chose to use averages of both AP and AC EQAO data to decide on high achieving vs. not-high achieving schools because one of the participating schools did not separate their classes into AP and AC. I wanted to avoid the chance that this school would fall into the high-achieving category simply because of the AC students in their class. The decision to place schools in one group or the other was completed in order to maximize the difference between groups.

Separating my convenience sample of AP math classrooms based on the above criteria resulted in two schools (n = 66) being placed in the HA group and four schools (n = 99) being placed in the NHA group. The difference between the lowest school in the HA group (at 67.4% meeting the provincial standard) and the highest school in NHA achieving group (at 52% meeting provincial standard) was 15%. For the purposes of analysis, these differences were considered sufficient to separate these schools into the HA and the NHA group.

Prior to addressing the research questions, descriptive statistics (frequencies, means and standard deviations) were calculated to obtain an overall picture of the distributions of students and teachers who took part in the study. In terms of students (n = 165), descriptive statistics were computed to describe the distribution of students in HA vs. NHA classrooms with respect to the following information: age, gender, self-report grades, and where and when they usually do homework. In terms of teachers (n = 21), descriptive statistics were used to describe their distribution with respect to the following information: current grade, teaching experience, education background, Socioeconomic Status (SES) of current school, the academic achievement of students in their school and the academic achievement of students in their AP math class. For

all descriptive and inferential analyses, Statistical Program for the Social Studies version 22 (SPSS v. 22) was used to compute the statistics.

Research question 1: Differences in the perspectives and experiences of students in high achieving vs. not-high achieving Applied math classrooms towards learning and homework

In order to determine a factor structure for my proposed survey instruments, an Exploratory Factor Analysis (principal component analysis with direct oblimin rotation) was conducted on the student survey questions containing multiple items (i.e. questions 6, 7, 9, 10, 15, 18 and 19). There had not been a factor analysis performed on the instruments from which these questions were drawn. This analysis was performed to explore patterns of items that might cluster together to provide more reliable measures of students' perspectives towards learning and homework. There were insufficient data to conduct a factor analysis on the teacher survey instrument. The names for the factors were chosen to express the underlying factor represented by the items with primary factor loadings. Factor loadings below .4 were suppressed because they did not represent substantive values (Field, 2013). The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, and Cronbach's α was used to measure the reliability of each factor. Items were removed from a factor if they improved the overall reliability of the factor while retaining high factor loadings and KMO values.

The subscale means calculated from the Exploratory Factor Analysis, as well as the means from single-item questions 8, 11 and 12, were assessed for normality (i.e. absolute value of skewness statistic less than two). Since all data were considered normal, independent sample *t*-tests were used to determine whether differences existed between students in high achieving

(HA) and not-high achieving (NHA) Applied (AP) math classes with respect to their perspectives and experiences towards learning and homework.

Null hypotheses for these analyses were as follows:

1. There are no significant differences between students in HA and NHA AP math classes with respect to their perspectives and experiences towards learning (analyses performed on subscale means from Q6, Q7, Q19).
2. There are no significant differences between students in HA and NHA AP math classes with respect to their perspectives and experiences towards the assignment of homework (analyses performed on subscale means from Q9, Q10, and means from Q8).
3. There are no significant differences between students in HA and NHA AP math classes with respect to their perspectives and experiences towards the completion of homework (analyses performed on means from Q11, Q12).
4. There are no significant differences between students in HA and NHA AP math classes with respect to their perspectives and experiences towards the assessment of homework (analyses performed on subscale means from Q15).
5. There are no significant differences between students in HA and NHA AP math classes with respect to their perspectives and experiences towards the value of homework (analyses performed on subscale means from Q18).

Where significant differences were found, Cohen's *d* was calculated as a measure of the effect size. The following categories were used: $d = 0.2$ (small), 0.5 (medium), 0.8 (large) (Cohen, 1988).

For the questions asking students to identify their main reason for doing, and their main reason for valuing, homework (i.e. questions 16, 17), Pearson's chi-square tests (Fisher, 1922) were conducted. Null hypotheses for these analyses were as follows:

1. There is no relationship between student group (HA vs. NHA) and their main reason for doing homework.
2. There is no relationship between student group (HA vs. NHA) and their main reason for valuing homework.

Research question 2: Teachers perspectives regarding homework, and student learning in Applied math classrooms.

Teacher interviews were transcribed. For analysis, qualitative data from the open-response teacher survey questions and teacher interviews were grouped and analyzed with respect to their approaches to teaching and learning, the assignment of homework, the assessment of homework, the value of homework, and their approaches to homework in AP vs. AC math classes. These data were then analyzed using a standard thematic coding process (Namey, Guest, Thairu, & Johnson, 2008; Patton, 2002). From an initial analysis of data, an axial code list was generated and then these codes were grouped into broader thematic categories based on logical coupling. Direct participant quotations were used where possible to explain and highlight themes.

Research question 3: Alignment between students and teachers with respect to homework and student learning in Applied math classrooms.

Quantitative and qualitative data from questions that matched on the student and teacher surveys and teacher interviews were compared with respect to teaching and learning, the assignment of homework, the completion of homework, the assessment of homework, and the

value of homework. Frequencies or subscale means (for factors identified from the Exploratory Factor Analysis) were compared for the fixed-response questions that matched on the student and teacher surveys. For the qualitative data, open-response student survey data were analyzed using a standard thematic coding process (Namey, Guest, Thairu, & Johnson, 2008; Patton, 2002). Codes were compared and logically grouped into themes. The resulting themes were then compared to the teacher data to determine how well the responses of students and teachers aligned. Triangulating my data by using more than one data source (students and teachers), adds credibility to my findings (Patton, 2002).

Chapter 4

Results

This study focused on Grade 9 and Grade 10 Applied (AP) Ontario math classrooms in order to compare the perspectives of students and teachers with respect to homework and teaching and learning. Three research questions guided this research. The results of this study are presented below, organized by research question. Prior to addressing the research questions, descriptive statistics were calculated to present distributions of students and teachers who took part in the study. For the first research question, an Exploratory Factor Analysis was used to determine the factor structure of the student survey. Independent sample *t*-tests were subsequently conducted to determine if there were differences in the perspectives of students in high achieving (HA) vs. not-high achieving (NHA) AP math classrooms towards learning and homework. These students had been separated after the data were collected, into HA and NHA groups based on the average EQAO math achievement in their schools.

For significant differences, Cohen's *d* was calculated as a measure of the effect size. The following categories were used: $d = 0.2$ (small), 0.5 (medium), 0.8 (large) (Cohen, 1988). A Pearson's chi-square test (Fisher, 1922) was conducted to determine if there was a relationship between student group (high vs. not-high achieving) and what they chose as their main reason for *doing* homework. A Pearson's chi-square test (Fisher, 1922) was also conducted to determine if there was a relationship between student group (high vs. not-high achieving) and what they chose as their main reason for *valuing* homework. For the second research question, qualitative analyses were conducted on data from the teacher interviews and open-response surveys to gain insights into teachers' perspectives regarding homework and teaching and learning in Applied math classrooms. For the third research question, matching items from the student and teacher

surveys and interviews were compared to determine the alignment between students and teachers with respect to homework and teaching and learning.

Students in both high achieving (HA) and not-high achieving (NHA) classrooms were on average nearly 15 years old (M = 14.6, M = 14.8 respectively). HA classrooms had more girls than boys (45% girls vs. 36% boys). NHA classrooms had more boys than girls (61% boys vs. 53% girls). A higher percentage of students in HA classrooms reported getting A's on their report card (50% vs. 31%), and a higher percentage of students in NHA classrooms reported getting B's (58% vs. 47%) or C's (10% vs. 3%). Both groups indicated that they usually do homework at home (82% of HA and 68% of NHA) or at school (76% of HA and 65% of NHA) and when they do homework outside of school hours it is usually done after school as opposed to before school.

The percentages of teachers currently teaching Grade 9 vs. Grade 10 were similar (42.9% vs. 57.1% respectively). The teachers, on average, had high levels of math teaching experience. The average total years of teaching experience was 15 years, and the averages for teaching math and for teaching AP math were 10.65 and 9.84 years respectively. Teachers were also experienced at their current school with an average of 10.65 years. Teachers also had a high level of math content knowledge with 30% having a Bachelor's degree with a math major, 45% with a math minor, and 25% with an AQ specialist in math. Teachers reported that the SES and academic achievement of students in their school and in their AP math class were average (M = 2.45, M = 2.95, and M = 2.75 respectively on a 5-point scale). The academic achievement of students in their AP math class was reported as slightly lower than students in their school (M = 2.75 and M = 2.95 respectively).

Research Question 1: Differences in the Perspectives and Experiences of Students in High Achieving vs. Not-High Achieving Applied Math Classrooms Towards Learning and Homework

Factor analysis.

An Exploratory Factor Analysis (principal component analysis with direct oblimin rotation) was conducted on student survey questions 6, 7, 9, 10, 15, 18, and 19. A total of 14 factors were identified (see Table 2). Seven of these factors reflected students' perspectives towards learning. Three of these factors reflected students' perspectives towards the assignment of homework. Two of these factors reflected students' perspectives towards the assessment of homework, and the remaining two factors reflected students' perspectives towards the value of homework. The names for the factors were chosen to express the underlying factor represented by the items with primary factor loadings. The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, and all KMO values for the factors were greater than .67, which is above the acceptable limit of .5 (Field, 2013). Factor loadings below .4 were suppressed because they did not represent substantive values (Field, 2013). The reliability of each factor was measured using Cronbach's α, and items were removed if they improved the overall reliability of the factor while retaining high factor loadings and KMO values. The majority of the factors had reliability values around .8, indicating good reliability (Field, 2013). Tables containing the factor loadings can be found in Appendix A.

Table 2

Factors, Items and Reliabilities for Exploratory Factor Analysis Performed on Student Data

Factor	Items in Factor	Internal Consistency (α)
Perspectives towards learning (Q6, 7, 19)		
Positive attitudes towards myself as a learner	6a. I like learning at school	.84
	6b. I enjoy learning new things at school	
	6d. I like learning on my own	
	6f. I am willing to ask my teacher questions to help with my learning	
	6h. I think about how I learn and how to improve	
	6m. I set realistic goals for myself as a learner	
Expression of ideas and teachers' role in facilitating learning	6e. I am able to express my ideas in class	.81
	6g. My teacher helps with my learning	
	6i. My teacher has high expectations for me as a learner	
	6j. My teacher clearly communicates his/her expectations for me as a learner	
	6k. My teacher consistently communicates his/her expectations for me as a learner	
	6l. My teacher sets realistic goals for me as a learner	
Learning with others	6c. I like learning with others	n/a
Positive attitudes and growth mindset towards math	7a. I like mathematics	.92
	7b. I am good at mathematics	
	7c. I am able to answer difficult mathematics questions	
	7d. Mathematics is one of my favorite subjects	
	7e. I understand most of the mathematics I am taught	
	7f. Mathematics is an easy subject	
	7g. I try to do my best in mathematics class	
	7h. I can get better at mathematics	
Fixed mindset towards math	7i. I have a certain amount of math intelligence, and I can't do much to change it	n/a
Growth mindset towards learning	19a. No matter how much intelligence you have, you can always change it a good deal	.75

Factor	Items in Factor	Internal Consistency (α)
	19c. I like my work best when it makes me think hard	
	19e. I like work that I'll learn from even if I make a lot of mistakes	
Fixed mindset towards learning	19b. You can learn new things, but you cannot really change your basic level of intelligence.	.61
	19d. I like my work best when I can do it really well without too much trouble	
	19f. I like my work best when I can do it perfectly without any mistakes	
Perspectives towards the assignment of homework (Q9, 10)		
Teachers' uses of homework to support student learning	9a. To assess students' skills and knowledge	n/a
	9b. To develop students' interests	
	9c. To develop students' critical thinking skills	
	9d. To motivate students to learn	
	9e. To help students develop good work habits	
	9f. Because there was not enough time during class to cover all the material	
	9g. To help students practice skills or prepare for tests	
Positive attitudes and persistence on challenging homework assignments	10a. My homework assignments are interesting	.77
	10d. I enjoy completing homework assignments that are challenging	
	10e. If I am challenged by a homework assignment, I keep trying because I believe that I can learn from it	
	10f. If I am challenged by a homework assignment, I keep trying because it will look bad if it's not done	
	10g. If I am challenged by a homework assignment, I keep trying because I don't want to look dumb	
Negative attitudes and giving up on challenging homework assignments	10b. My homework is just busywork and is not related to what I am learning in school	.67
	10c. I only complete homework assignments that are easy	
	10h. If I am challenged by a homework assignment, I give up because I don't think I can figure it out	
	10i. If I am challenged by a homework assignment, I give up because I will get the answers in class	
	10j. If I am challenged by a homework assignment, I give up because the teacher won't check it anyways/it won't affect my grade	

Factor	Items in Factor	Internal Consistency (α)
Perspectives towards the assessment of homework (Q15)		
Assessment *for* Learning	15b. Provide feedback, other than grades, on homework assignments 15c. Explain the purpose of specific homework assignments to students 15d. explain the expectations/how to be successful on homework assignments 15e. Review completed homework assignments in class discussions	.85
Assessment *of* Learning	15a. Provide students with a grade on their homework	n/a
Perspectives towards the value of homework (Q18)		
Positive attitudes towards the value of doing homework	18a. I have enough time to do all of my homework 18c. Doing homework helps me learn more in school 18d. Doing homework helps me reach my goals for after high school 18e. Homework develops my sense of responsibility 18f. Homework makes learning fun 18g. My homework assignments are interesting	.84
Students who do homework get teased	18b. Students in my school make fun of those students who always do their homework	n/a

Inferential analysis.

A series of independent sample *t*-tests were conducted to determine if differences existed between students in high achieving (HA) and not-high achieving (NHA) AP math classes with respect to their perspectives towards learning and homework. This analysis was done on the factors extracted from questions 6, 7, 9, 10, 15, 18, and 19 above, as well as on single item questions 8, 11, and 12, which were not part of the factor analysis. Significant differences are indicated by a * in Table 3 below. Pearson's chi-square tests (Fisher, 1922) were conducted on questions 16 and 17 to determine if there were relationships between student group (HA vs. NHA) and what they chose as their main reasons for doing and valuing homework.

Table 3

Means and Standard Deviations of Students and Teachers on Factors from Exploratory Factor Analysis, and on Single Item Questions not Included in Factor Analysis

Factor	*M (SD)*		
	Students in high achieving (HA) classrooms (n = 66)	Students in not-high achieving (NHA) classrooms (n = 99)	Teachers (n = 21)
Perspectives towards learning (Q6, 7, 19)			
Positive attitudes towards myself as a learner	3.39 (0.72)	3.20 (0.90)	n/a
Expression of ideas and teachers' role in facilitating learning	3.71 (0.69)	3.58 (0.80)	n/a
Learning with others	3.42 (0.93)	3.41 (1.15)	n/a
Positive attitudes and growth mindset towards math	2.80 (0.73)	2.73 (0.76)	n/a
Fixed mindset towards math	2.20 (0.93)	2.37 (0.94)	n/a
Growth mindset towards learning	2.73 (0.71)	2.56 (0.76)	2.50 (0.91)
Fixed mindset towards learning	2.71 (0.68)	2.53 (0.78)	3.58 (0.52)
Perspectives towards the assignment of homework (Q8, 9, 10)			
How often are you assigned homework	2.78 (0.74)*	2.35 (1.00)*	
Teachers' use of homework to support student learning	3.47 (0.84)*	3.25 (1.01)*	
Positive attitudes and persistence on challenging homework assignments	2.36 (0.63)*	2.13 (0.66)*	n/a
Negative attitudes and giving up on challenging homework assignments	1.98 (0.59)	2.08 (0.63)	n/a
Perspectives towards the completion of homework (Q11, 12)			
How often do you complete your math homework	3.61 (1.03)*	2.78 (1.32)*	
How much time do you usually spend on math homework	2.52 (0.78)*	1.92 (0.85)*	
Perspectives towards the assessment of homework (Q15)			
Assessment *for* Learning	2.95 (1.02)	3.15 (1.12)	3.22 (0.88)
Assessment *of* Learning	2.02 (1.30)	2.08 (1.26)	1.47 (0.51)
Perspectives towards the value of homework (Q18)			
Positive attitudes towards the value of doing homework	2.42 (0.70)	2.33 (0.70)	3.01 (0.33)
Students who do homework get teased	1.73 (0.81)	1.68 (0.88)	3.32 (0.58)

The first set of analyses focused on students' perceptions of learning. No significant differences were found between students in HA and NHA classrooms. However, in general, students in HA classrooms had more positive attitudes towards themselves as learners, towards their abilities to express their ideas in class and towards their teachers' role in facilitating their learning compared to students in NHA classrooms. Both achievement group enjoyed learning with others some of the time and were neutral with respect to their attitudes towards mathematics. Neither group demonstrated a strong tendency towards either a growth or fixed mindset.

The second set of analyses focused on students' perspectives towards the assignment of homework. Significant differences were found between students in HA and NHA classrooms on three factors. All effect sizes were in the small to medium range. A significant difference was found with respect to how often students were assigned homework in their AP math class ($t_{(158)}$ = 3.17, p = .002, d = .47). Students in HA classrooms (M = 2.78, SD = 0.74) indicated that they were assigned homework more often than students in NHA classrooms (M = 2.35, SD = 1.00). A significant difference was also found regarding teachers' uses of homework to support student learning ($t_{(161)}$ = 2.12, p = .035, d = .25). Students in HA classrooms (M = 3.47, SD = 0.84) perceived that their teachers used homework for a wider variety of purposes than students in NHA classrooms (M = 3.25, SD = 1.01), although students in both HA and NHA classrooms indicated that their teachers most often used homework to practice skills or prepare for tests. A significant difference was also found with respect to students' positive attitudes and persistence on challenging homework assignments, ($t_{(160)}$ = 2.38, p = .019, d =.38). Students in HA classrooms indicated that they had more positive attitudes towards their homework assignments

and were more likely to persist on challenging homework tasks ($M = 2.38$, $SD = 0.63$) than students in NHA classrooms ($M = 2.13$, $SD = 0.66$).

The third set of analyses focused on students' perspectives towards the completion of homework. Significant differences were found between students in HA and NHA classrooms on two factors. All effect sizes were in the medium to large range. A significant difference was found regarding students' completion of their math homework ($t_{(154)} = 4.31$, $p < .001$, $d = .69$). Students in HA classrooms ($M = 3.61$, $SD = 1.03$) indicated that they completed their homework more often (i.e. between sometimes and usually) than students in NHA classrooms ($M = 2.78$, $SD = 1.32$). A significant difference was also found with respect to the amount of time students usually spent on their math homework ($t_{(158)} = 4.50$, $p < .001$, $d = .73$). Students in HA classrooms ($M = 2.52$, $SD = 0.78$) reported that they spend more time on homework than students in NHA classrooms ($M = 1.92$, $SD = 0.85$).

The fourth set of analyses focused on students' perspectives towards the assessment of homework. No significant differences were found between students in HA and NHA classrooms. However, in general**,** both groups indicated that their teachers used Assessment for Learning (i.e. formative assessment) to assess homework more often than Assessment of Learning (i.e. summative assessment).

The fifth set of analyses focused on students' perspectives towards the assessment of homework. No significant differences were found between students in HA and NHA classrooms. However, in general, neither group indicated that they perceived homework as very beneficial.

The final set of analyses focused on students' reasons for doing homework and students' reasons for valuing homework. No significant associations were found between achievement group and their reasons for doing or valuing homework. However, in general, practice was given

as the main reason for doing homework by both students in HA and NHA classrooms (55% of HA and 52% of NHA chose it as the main reason), χ^2 (2) = 0.157, p = .925. Practice was also given as the main reason for valuing homework by both groups (60% of HA and 55% of NHA chose it as the main reason), χ^2 (2) = 1.230, p = .541.

Research Question 2: Teachers Perspectives Regarding Homework, and Student Learning in Applied Math Classrooms

In the interview and survey, teachers were asked to describe their approaches to teaching and learning and their approaches to the assignment and assessment of homework in their AP math classrooms. They were also asked to describe their perspectives with respect to the value of homework. Finally, they were asked to compare their approaches to homework in AP vs. AC math classes. In response to this research question, the following eight themes were identified: (a) Unique learning needs of students in AP, (b) Teaching that responds to unique learning needs of students in AP, (c) Balance (achievement of curriculum expectations with external influences), (d) Assessment *for* Learning, (e) Making homework meaningful is challenging, (f) Homework is meaningful if it increases understanding, (g) Motivation is important, and (h) Responding to the unique needs of AP students.

With respect to their approaches to teaching and learning, teachers spoke of the unique needs of AP learners, and the importance of integrating teaching practices that were responsive to those needs. They highlighted learning issues, lack of interest, external influences, low self-efficacy, and lack of skills as unique characteristics of their students. One teacher described, "...a lot of learning issues. Right from ability to focus, ADD, issues around home-life, that kind of thing, so the engagement is often very different in an Applied class than in an Academic class." They also emphasized the wide range of abilities in their AP math classrooms. "I have a full

range of kids in this class. I have a group that's 95 and above every test and a group that's at 40%." In response to the learning issues, lack of skills, and lack of engagement, teachers indicated that slowing down the pace of lessons often helped. "I go much slower and chunk down concepts much smaller in an Applied classroom." Teachers also stressed the importance of building positive student-teacher relationships, providing extra support, making math relevant, and maintaining high expectations, to encourage their students and build their confidence in math. One teacher described her determination to "just keep trying... even if I can get the student who's shut down to do one or two questions then that's success for that day for that kid."

With respect to the assignment of homework, teachers emphasized a need for balance. They highlighted that they expected homework to be completed, but that the amount of homework assigned varied on different days and for different students. "It's a give and a take right, you know you're trying to have them all get their homework done all the time would be your ideal goal, but you realize the constraints that you're under, and they're under, time and expectations..." Teachers stressed that they were trying to balance the achievement of curriculum expectations with sensitivity towards the external influences happening in the lives of students in their AP classes. To try and achieve curriculum expectations, teachers would often start homework in class where they could offer support to students. They also made the homework similar to classwork to provide students with an opportunity to practice the material taught in class. One teacher explained how:

> After a daily lesson, my students are assigned problems to use in order to practice the skill that was presented. If they need some overflow time, but the period is over, they are encouraged to take the time outside of class to continue to practice and refine the skill they are learning.

To demonstrate their sensitivity to the external stressors impacting the motivation and confidence of their students, teachers did not assign very much homework (less than 1 hour), and were flexible with respect to their expectations for completion. They indicated that students in their AP classes often required more leniency due to the demands that they had on their time outside of school (e.g. jobs, family stresses). As one teacher articulated, "I try to structure for each kid what I think they can handle or what I think they're willing to do for me, so I think they appreciate it and try harder if they know they don't have to go home and do all 10 of these questions." Teachers also indicated that while they appreciated the potential value of 'flipping the classroom' (i.e.: using homework for the introduction of new material), it was not realistic for students in their AP classes because they would find it frustrating to try to learn new material at home.

When asked about the assessment of homework in their AP classrooms, teachers emphasized that they focused on Assessment *for* Learning. This was defined by the Assessment Reform Group (2002, p. 2), as "the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go, and how best to get there." Teachers described that they sought evidence of learning by recording homework completion in learning skills, and by formatively checking for understanding in class. "Its all formative, I don't do marks for homework at all, ever." Teachers would ask if there were questions from the homework, and then explain and discuss those questions in class. Even if no one had a specific question, teachers would often start the class by taking up homework in case students were too shy to ask for help. One teacher explained that, "I always take up homework the next day in class, and I only ever use homework as formative assessment." Teachers would then interpret the evidence of learning they gathered

through formative assessment to determine next steps. If needed, teachers would continue with the same topic and provide extra class time and support the following day. During this additional class time, they would circulate and provide feedback to continue to gather evidence of learning.

In terms of the value of homework, the majority of teachers stressed that there were a number of challenges associated with making homework meaningful. Students lacked interest, did not see the relevance of the subject matter, and had many outside influences that took time away from doing their homework. One teacher found that, "generally the students in Applied math are not interested in the subject. I have tried to engage them with 'relevant' type problems but this too is often unsuccessful." For homework to be worthwhile, teachers believed that it had to increase the students' understanding of the subject matter and increase the teachers' understanding of the student. Students benefitted from doing homework that provided practice, repetition, reflection, and reinforcement of concepts taught in class. Teachers benefitted from using homework as an opportunity to formatively assess the knowledge of their students. One teacher summarized how, "homework allows students time to revisit the thing they have discussed in class. Revisiting taught material helps students to internalize the ideas and concepts that have been presented to them. It also allows the teacher to review how each student is doing." Teachers also highlighted the importance of motivation in making homework meaningful, and emphasized that different things motivate different students. Teachers perceived that motivation to do homework could be increased by accommodating students' interests, making homework relevant, making homework count for grades, and providing praise for completing homework. "There has to be motivation to get it done, and some are motivated by their marks, some are motivated by getting ready for a test, some aren't." Teachers also highlighted that many students, "found comfort in routine and structure" with respect to the types of homework questions

assigned. Questions that were similar to those done in class helped build students' confidence. Questions that were open-ended or based on new material often created frustration and anxiety.

When comparing their approaches to homework, two-thirds of teachers reported that their approaches were different in their Applied (AP) vs. Academic (AC) math classrooms. They stated that in general, the tasks assigned to students in AP and AC were similar but that the amount of homework and the time they were expected to spend on their homework was less in AP. Consistent with their answers to previous questions, when asked to articulate the differences in their approaches to homework in AP versus AC, teachers stressed the increased challenges they faced in their AP classrooms. These teachers explained that they wanted to support their students and that they believed homework could help provide this support, but that they were frustrated by the lack of homework completion in their AP classes. Teachers also highlighted that there was a wider range of ability and motivation in their AP classes compared to their AC classes. In response to these challenges, teachers indicated that their approaches to homework, like their general approaches to teaching and learning, had to focus on responding to the unique needs of students in their AP classes. One teacher emphasized that it was important in AP math to, "understand that many of your students are not in these classes because they are less capable of learning, but that they are in need of a specific environment." In this environment, teachers emphasized approaching homework in a way that would increase student engagement, motivation, and self-efficacy. One teacher articulated how, "students come into the Applied math class with low self esteem [and] are in the applied level because math has been a struggle for them in the past." This teacher went on to say, "I make it my goal to build their confidence and show them that they can be successful."

All teachers indicated that they assigned homework that was similar to classwork. Two thirds of teachers also highlighted that their homework assignments were in line with what each student could reasonably complete. This differed from their AC classrooms where they indicated that they assigned one set of homework questions, and expected all students to complete it. In their AP classrooms, teachers' expectations were still high for each student, but not necessarily the same. With students at a wide range of ability levels, and with different amounts of external stressors, teachers could not, "expect the same amount of homework to be completed by every student every night." To account for these unavoidable differences in homework completion, and to help build motivation and self-efficacy, teachers dedicated as much class time as possible to getting started on the homework, taking up the homework, and providing individual support to students on the homework questions.

Research Question 3: Alignment Between Students and Teachers With Respect to Homework and Student Learning in Applied Math Classrooms

To answer the third research question, matching items from the student and teacher surveys and interviews were compared with respect to teaching and learning, as well as the assignment, completion, assessment and value of homework. While some fixed-response questions were compared (Table 3), the majority of the data for this research question was qualitative and came from the open-response student and teacher survey questions, and teacher interviews. Qualitative analysis codes charts containing themes and axial codes for these data can be found in Appendix B.

Throughout their survey responses, student data were consistent with teachers' perspectives about teaching and learning in Applied (AP) math. Student data were also consistent with the range of abilities identified by teachers as a challenge in their AP classrooms.

Approximately one-third of students were happy with how things were, and indicated that their teacher was doing everything they could to support them. “My teacher can keep doing what he does.” The remaining two-thirds of students emphasized the importance of responding to their individual learning needs. Of those, a few indicated that they wanted harder questions and a faster pace. The others, who were in the majority, identified a need for help, extra support (e.g. at lunch), and specific feedback to help them improve. They also explicitly emphasized a need to help everyone, and explained that this could be achieved by providing clear explanations to the class, providing individual feedback and, “slowing down when teaching and making sure everyone understands.”

Also consistent with teacher perceptions, students reported that they wanted their teachers to have high expectations of them. They wanted to be challenged, they wanted to be held accountable, and they wanted to be given homework that provided additional practice to help them learn. One student said, “I want my teacher making sure I do my work in class and [that I] get lots of practice.” However, they also identified a need for teachers to, “give us work that matches our abilities.” It was also important for homework to be checked the next day, and taken up in class to ensure that they understood the concepts. One student asked for the teacher to, “please put all of the answers up when we are taking homework up together. I may have gotten one thing right, but I don’t know about other ones.”

When asked questions relating to mindset (fixed-response question - see Table 3) teachers and students were neutral with respect to whether they had a growth mindset towards learning. However, when asked a question related to fixed mindset (i.e. “you can learn new things but you can’t change your basic level of intelligence”), teachers agreed with the statement, while students somewhat disagreed.

Teachers' perceptions about the assignment of homework aligned with the students in HA classrooms. Two-thirds of teachers and students in HA classrooms indicated that homework was assigned most classes/every class. Only one-third of students in NHA classrooms indicated that their homework was assigned most classes/every class. When asked about teachers' uses of homework to support student learning (fixed-response question - see Table 3), students in HA classrooms perceived that their teachers used homework for a wider variety of purposes than those in NHA classrooms. Of the different purposes for homework, both groups of students and teachers indicated that homework was used least often to develop students' interests, and most often to help students practice skills or prepare for tests.

In terms of homework completion, students' perceptions aligned with teachers' perceptions that on average approximately half of students completed their homework on a daily basis. In terms of the time it took students to complete homework, 12.5% of students in HA classrooms and 6.3% of those in NHA classrooms reported that their homework took more than 45 minutes. However, no teachers indicated that they expected their students to spend more than 45 minutes on their homework. A higher percentage of teachers than students also thought that the homework would take 30 minutes or less (66.7% of teachers vs. 48.7% of students).

Both students and teachers indicated that homework was assessed more often for formative rather than summative purposes, and that formative assessment was used approximately half the time (fixed-response question - see Table 3). While both students and teachers indicated that summative assessment (e.g. giving a grade on homework assignments) was used less than half the time, students reported that it was used more often than teachers reported it being used.

Similarly, students and teachers expressed comparable opinions regarding the value of homework. Both groups conveyed that making homework meaningful is challenging. Over one-third (39%) of students indicated that they had never had a meaningful homework assignment. Almost half (46%) said that they should not have homework at all. “We already go to school for 6 hours a day, we shouldn't have to do even more work when we get home.” They explained that homework took up time at home that they needed to dedicate to other things, or that they found homework too difficult to do at home without the teachers’ support. “If I can barely comprehend what is being taught in class, how am I supposed to do it on my own? It's too stressful to do on my own without my teachers help.” Other students recognized the importance of homework, but suggested that they should not be assigned very much, that it should not be assigned everyday, and that the amount should reflect each individuals’ needs to balance their home and school life. These data are consistent with teachers’ perspectives that students in AP programs require a homework and school plan that is tailored to their individual needs. Students, like teachers, also saw increasing understanding as a key component of making homework meaningful. One student noted that, “...it made it useful because I didn’t understand and then after the homework it began to make sense.” Students also stressed the importance of motivation, and emphasized that they were more motivated to complete homework assignments when they “understood it and could do it” or “when it was something I was interested in.” They were also more motivated if they saw their homework as relevant to helping them in the future (e.g. developing their work habits, learning skills, and sense of responsibility).

When asked to rank whether they valued homework more for practice, fluency or learning new material, students (50% of HA, 30% of NHA) chose practice as the most valuable use of homework, and teachers (70%) chose fluency. According to the National Council of

Teachers of Mathematics (NCTM), fluency is more than memorizing facts or procedures. It is the ability to "transfer procedures to different problems and contexts, to build or modify procedures from other procedures, and to recognize when one strategy or procedure is more appropriate to apply than another" (NCTM, 2015). With respect to their attitudes towards the overall value of doing homework (fixed response question - see Table 3), teachers had more positive attitudes than students. However, teachers also perceived that students were getting teased for doing their homework more often than students indicated that they were.

Chapter 5

Discussion

The purpose of this study was to compare the perspectives of students and teachers with respect to homework, and teaching and learning in Applied (AP) math classrooms. This research was guided by the following questions:

1. Do students in high achieving vs. not-high achieving AP math classrooms differ in their perspectives and experiences towards learning and homework?
2. What are teachers' perspectives regarding homework, and student learning in AP math classrooms?
3. What is the alignment between students and teachers with respect to homework, and student learning in AP math classrooms?

This study employed a mixed-method, non-experimental design. The sample consisted of students and teachers in Grade 9 and Grade 10 AP math classes in schools that are part of the Eastern Ontario Staff Development Network (EOSDN). In order to answer my research questions, students completed surveys, and teachers completed surveys and in-depth interviews. After the data were collected, students were separated into two groups for analysis based on the average EQAO math achievement of their schools [high achieving (HA) and not-high achieving (NHA)]. A total of 165 students participated in the student survey. Of these, 66 were in the HA group and 99 were in the NHA group. A total of 21 teachers participated in the teacher survey. Six of these teachers also participated in the in-depth interview. An Exploratory Factor Analysis was used to determine the factor structure of the student survey. Descriptive and inferential statistics (*t*-tests and Pearson's chi-square tests) were used to analyze the quantitative data, and a thematic analysis was completed for the qualitative data.

This chapter is organized into three sections. The first section discusses the key findings for each research question. The second section outlines recommendations for future research and teaching practices. The third section describes limitations that have the potential to impact the quality of my data and the generalizability of my findings.

Discussion of Key Findings

The purpose of the first research question was to determine if there were systematic differences in the learning and homework experiences of students in AP math classrooms from high achieving (HA) and not-high achieving (NHA) schools. Both groups indicated that they usually do homework at home and after school. Both groups chose 'practice' as the main reason that they do, and value, homework. Both groups also indicated that their teachers used formative assessments more often than summative assessments on homework assignments. The use of homework for formative rather than summative purposes is one of the policies in the *Growing Success* document, and feedback has been identified as a key strategy for supporting struggling students (Hattie & Timperley, 2007; Margolis & McCabe, 2003). In terms of the benefits of homework, neither group considered homework to be very beneficial. Nevertheless, important differences were found between the students in HA and NHA classrooms. Students in HA classrooms were assigned homework more often, perceived that their teachers used homework for a wider variety of purposes (e.g. to assess students' skills and knowledge, to help students develop good work habits, to help students practice skills), and were more likely to persist on challenging homework tasks than those in NHA classrooms. The students in HA classrooms also indicated that they completed homework more often, and spent more time on their homework. This is consistent with previous research (Cooper et al., 2006; Maltese, Tai, & Xitao, 2012; Petty

et al., 2013) indicating that a positive relationship exists between the amount of homework students do and their academic achievement.

When asked about their approaches to teaching and learning in AP math (Research Question 2), teachers spoke of the unique needs of AP learners, and the importance of maintaining high expectations while integrating teaching practices that were responsive to students' needs. High expectations have been shown to have positive effects on the achievement of struggling students, and to lead to higher educational aspirations (Dunn, 2004; Petty et al., 2013). Regarding the assignment of homework, teachers stressed the challenges associated with balancing the teaching and achievement of curriculum expectations with a sensitivity towards the external influences happening in the lives of their students. When asked to describe how homework was assessed, teachers emphasized a focus on Assessment *for* Learning (i.e. formative assessment). In terms of the value of homework, teachers highlighted a number of challenges associated with making homework meaningful. For those challenges to be overcome, the homework needed to increase students' understandings of the course content, and the students needed to be motivated to complete it. Finally, these teachers noted differences in terms of their approaches to in their Applied (AP) versus Academic (AC) math classes. Teachers indicated that their approaches to homework, like their general approaches to teaching and learning, had to focus on responding to the unique needs students in their AP classes. The tasks assigned to AP and AC students were similar, but the amount of homework and the time they were expected to spend on their homework was less for their AP classes. The assignment of less homework to students in AP classrooms is consistent with previous research on struggling students. Struggling students may not have the resources at home to complete their homework

(Markow et al., 2007) and are often dealing with external sources of stress that could make it difficult to complete their homework (Ehrenreich et al., 2012).

Lastly, both teachers and students identified high expectations and extra support as key factors for responding to the unique needs, and contributing to the success, of students in AP math (i.e., Research Question 3). Two-thirds of teachers and students in HA classrooms, compared to one-third of students in NHA classrooms, indicted that homework was assigned in most classes. Further, these teachers and students agreed that homework was completed approximately half of the time. Students indicated that homework was taking them longer than teachers expected it to take. With respect to the assessment of homework, both teachers and students indicated that homework was assessed more often for formative rather than summative purposes, and that formative assessments were used approximately half of the time. Lastly, students reported a higher incidence of homework being used for summative assessments than reported by teachers. Homework being assigned more often in HA classrooms aligns with research demonstrating a positive relationship between doing homework and academic achievement (Cooper, 2006; Maltese, Tai, & Xitao, 2012). However, if homework was only completed half of the time, it may be less likely that homework completion was having a positive affect on achievement in the HA classrooms in this study. The use of homework mainly for formative purposes is consistent with research demonstrating the benefits of clear, consistent feedback for struggling students (Hattie & Timperley, 2007; Margolis & McCabe, 2003).

In terms of the value of homework, teachers indicated they found homework more valuable than what was indicated by students. Both teachers and students acknowledged that there were significant challenges to making homework meaningful, but that it was worthwhile as

an opportunity for learning if students were motivated to complete it, and thought they could be successful.

Limitations

In spite of continued and dedicated efforts, it was difficult to get into schools to collect data. In the end, only four school boards agreed to participate in the research. The result was a smaller and less diverse sample of students and schools. This reduced the power of the statistical analyses and makes it difficult to generalize the findings from the research. Similarly, the small sample of teachers (n = 21) that participated also restricted my ability to conduct statistical analyses of these data. As such, I focused more on the qualitative data from the open-response survey questions and in-depth interviews when trying to explain teachers' perspectives regarding homework and teaching and learning. Another limitation with respect to the teacher data was the ongoing challenge of relying on participants' abilities to recall. Teachers who taught AP math in the past may not have remembered their experiences as clearly as teachers who were currently teaching AP math. However, none of the teachers expressed difficulty remembering their AP math classes, and because it was so difficult to get participants, it was decided that any potential risks associated with recall would be less than the benefits of having greater teacher participation.

There were also limitations with respect to the collection of student data, and the separation of these student data into groups. Students from two school boards (44 students) were surveyed in February 2015, only a few weeks into their second semester. This lack of time and exposure may have limited their ability to describe the homework and teaching and learning practices in their classrooms. However, in the interest of balancing the benefits of collecting these additional data with the costs of further postponing the analysis and writing of my thesis, I

decided to collect data at this time. Another limitation regarding the student data was that one of the schools did not separate their math students into AP and AC classes. Because of this, some of the students who took part in my study may have been placed in an Academic class if they were in another school. Given that the majority of the students surveyed would still be from AP classes regardless of the differences in the school structures, it appears the overall student voice obtained from these data would still be reflective of students in AP programs.

Given the use of a convenience sample, the data had to be separated after it was collected. Schools were simply separated based on differences in achievement. The result is that these schools were likely not fully representative of schools at the extremes of the HA and NHA continuum. Given this, the observed differences may actually be underestimates of the actual differences. The schools were not selected based on achievement. Another limitation was that I used school-level rather than student-level data. As such, it is possible that some of the students I surveyed at a high-achieving school were not high-achieving students. Nevertheless, the purpose of the research was to look at the experiences of students in classrooms in which the average level of achievement could be classified as HA or NHA. Subsequent research would benefit from a more purposeful selection of schools, or specific students, based on achievement prior to data collection.

Implications

The results of this study have valuable implications for future research and practice. First, it would be important to expand this research into other educational jurisdictions across Ontario and the rest of Canada. Future research could also be done with less experienced teachers to see how their homework and teaching practices compare with more experienced teachers. The sample of 21 teachers in this study had an average of ten years of experience, but according to

Pang & Rogers (2013) who surveyed 1441 teachers from AP classrooms, and 2505 teachers from AC classrooms across Ontario, the average number of years of teaching experience for AP teachers was 2.83 and teachers in AP classes were on average less experienced than teachers in AC classes (Pang & Rogers, 2013). Previous research suggests that less experienced teachers may be less prepared to manage the social, cultural and economic diversity that exists in AP classrooms and may lack the pedagogical knowledge of the learning process, as well as the mathematical skills and confidence, that struggling students could benefit most from (Bryan, 2004). Additional research exploring the strategies that less experienced teachers use for this unique group of learners would be valuable in order to better understand the relationship between teaching experience and teaching practices.

Researchers could also survey a larger sample of teachers within Ontario to be able to more closely examine differences with respect to teaching, learning, and homework between teacher groups. Studies could also be expanded to include different subject areas and grade levels. One possibility here is to work with the Education Quality and Accountability Office (EQAO) to administer a more refined teacher and student survey for Grade 9 students in AP math classes. Currently, the EQAO only administers a brief survey during the administration of the Grade 9 provincial assessments.

Future studies could also further examine teachers' or students' perspectives in more depth. In the present study, significant differences were found between students in HA and NHA math classrooms with respect to the assignment and completion of homework. Focus groups and/or interviews with students would obtain more in-depth information regarding how and why homework is assigned and completed. Also, while this study focused on differences, there were some teachers who indicated that their approaches to teaching and homework were the same in

their AC vs. AP math classes. The reasoning behind, and the details of, these approaches should be explored in future research.

The results of this study highlight the need for more conversation, examination and exploration of the complex issues surrounding homework and student learning in AP classrooms. Based on my findings, the following five implications are provided for consideration: (a) Students in AP math classrooms are not a homogenous group, (b) There is misalignment between the perceptions and experiences of students and teachers in AP math classrooms, (c) There is an ongoing need to explore the value of a growth mindset, (d) There is value in the promotion and use of homework as a method to provide students with feedback, and (e) There remains a surprising need to further explore and research the nature of homework in classrooms, and specifically in AP classrooms. Admittedly, given the sample used in the study, these implications are provided for the purposes of deliberation rather than as definitive procedures, policies and practices to be implemented. That said, I further explain each below.

Students in AP math classrooms are not a homogenous group

My findings indicate that students in AP programs are a differentiated group of students that require differentiated instruction and differentiated assessment. Students identified a range of needs when asked to describe how their teachers could better support their learning. The differences in these needs, highlights the heterogeneity of students in AP classrooms. One-third of students said that they were happy with how things were, and that their teacher could not do anything differently to support their learning. The remaining two-thirds of students emphasized the importance of responding to their individual learning needs. Of those, a few indicated that they wanted harder questions and a faster pace. The others, who were in the majority, identified a need for help, extra support (e.g. at lunch), and specific feedback to help them improve.

Differences between students in AP classrooms were also apparent when they were asked to explain whether they should or should not have homework. Approximately half of students indicated that they should not have homework, because it interfered with time that they could dedicate to other things. The other half of students indicated that they should have homework because it provided them with additional practice to help them learn.

Teachers highlighted that students in their AP classes had a wider range of abilities and motivation compared to their AC classes. This finding suggests that while previous research proposes that math is not seen as practical or meaningful from the perspective of struggling students (Hunter, 2011), it is important not to paint all students in AP programs with this same brush. In their interviews, teachers stressed that not all students in their AP classes were struggling academically, or lacked motivation. In their surveys, half of the students indicated that they found their math homework meaningful. These students also demonstrated that they recognized the real-world usefulness of homework as it contributed to the development of their study skills and work habits.

Previous research has also indicated that struggling students tend to have more absences, which results in less teacher-student contact and less opportunity for the teacher to build a positive relationship with the struggling student (Mithaug, Campeau, & Wolman, 2003). Again, it is important to recognize that this is not characteristic of *all* students in AP classrooms. The results of this study indicated that many students had positive perceptions of their relationship with their teacher and were happy with the instructional and assessment practices their teachers were using to support their learning.

The results of this study have begun to identify important differences between students in AP programs. These differences may have important implications for allowing teachers to better

support the learning of all students in these classrooms. However, more research is necessary that explores these differences before concrete recommendations for policy and practice can be made.

The misalignment between the perceptions and experiences of students and teachers in AP math classrooms

Teachers stated that in general, the tasks assigned to students in AP and AC were similar, but that the amount of homework and the time they were expected to spend on their homework was less in AP. The results of this study highlighted that some students, although they were not in the majority, actually wanted more homework, and more opportunities to practice the material taught in class. Teachers also emphasized that they provided extra support to students in their AP classes compared to students in their AC classes. Yet the majority of students in this study identified a need for even more support than what was being provided in class. They emphasized a need for help, extra support (e.g. at lunch), and specific feedback to help them improve. Students also explicitly emphasized a need to help *everyone,* and explained that this could be achieved by providing clear explanations to the class, ensuring that each student understood the concepts being taught, answering questions, and providing individual feedback. Providing individualized support to students may help to increase motivation, which in turn may help to increase homework completion, learning and achievement (Margolis & McCabe, 2003; Marzano & Pickering, 2007).

In terms of homework completion, there was misalignment between students and teachers regarding the length of time students were spending on their homework. Results of this study indicated that teachers expected homework to take less time than students indicated it was taking. It is important for lines of communication to remain open to identify the reasons that students were spending more time on their homework than teachers intended. It may be because

they simply worked slowly, because they spent time checking over their answers, or because they persisted through challenging tasks. However, it could also be because they were getting frustrated and struggling with understanding. In order to be able to provide individualized support to each student, teachers and students need to communicate effectively regarding homework completion.

In addition to misalignment regarding the assignment, assessment and completion of homework, there was also misalignment regarding how students and teachers perceived the purpose and value and homework. In terms of the purpose of homework, it was not clear from the data whether students and teachers saw homework more as an assessment activity, or a practice activity. Teachers highlighted the importance of homework in increasing students' understanding of the subject matter, and teachers' understanding of the student. Students placed a greater emphasis on the value of homework as a vehicle for providing them with extra practice. The use of homework to provide students with extra practice is in line with students' reported perceptions of the use and value of homework. Students indicated that homework was meaningful if it increased their understanding, and that this understanding could be increased through practice.

classrooms in order to better support the individual needs of this differentiated group of students.

The need to continue to explore the value of a growth mindset

Previous research has found that incorporating growth mindset terminology and practices in classrooms improves academic achievement (Dweck, 2006; Blackwell et al., 2007), and the results of this study indicate that there is a lack of growth mindset in AP classrooms. In this study, neither students in HA nor NHA classrooms demonstrated a strong propensity towards either a growth or fixed mindset. The results of the teacher data were contradictory as to

teachers' mindsets (growth or fixed) towards learning. In the interview, a number of teachers indicated that they believed in the benefits of having a growth mindset and had taken part in professional development activities on the subject. However, in the survey, teachers generally agreed with the statement 'you can learn new things but you can't change your basic level of intelligence,' which is consistent with a 'fixed' mindset. Future research could build our understanding regarding teachers' perceptions of growth mindset. It could also explore the challenges associated with helping students develop a growth mindset and identify instances that may help a growth mindset develop more quickly.

In addition to research exploring the spread, understanding, and integration of growth mindset, more research is also necessary that explores how adopting a growth mindset specifically affects the self-efficacy beliefs of students in AP classrooms. In this study, students in NHA classrooms indicated that they completed their homework less often than students in HA classrooms and were less likely to persist on challenging homework tasks. With increased confidence, these students may become more willing to take risks and more motivated to persevere on challenging tasks (Keith et al., 2004). Growth mindset has been found to have positive effects on students' self-efficacy beliefs with respect to their ability to improve in mathematics (Marzano & Pickering, 2007; Yeager & Dweck, 2012). More research is required to better understand the role that mindset could play in increasing the confidence of students in AP classrooms who lack a belief in their ability to learn and be successful in math.

The value of homework as a method to provide students with feedback

While teachers stated that they rarely used homework for grades, students indicated that it was important for teachers to emphasize homework as an opportunity to increase grades, and to use it directly to provide feedback as a summative assessment some of the time. Students

identified homework directly counting for grades, or being used specifically to practice for tests, as a key motivating factor for finding homework meaningful.

That said, students stressed that most of the time, the assessment of homework should focus on providing clear, specific, and consistent feedback that was not used directly for grades, but rather to provide suggestions for improvement, and next steps for learning. In this study, teachers and students reported that providing purposeful and specific feedback on homework assignments was done approximately half of the time. As such, there may be opportunities for homework to be used more often as a vehicle to provide feedback. The importance of feedback is consistent with previous research indicating that the integration of formative assessment practices increases teachers' abilities to not only better understand their students' ongoing learning needs, but also to provide effective next steps to improve students' learning, and to increase the motivation and self-efficacy beliefs of struggling students (Egodawatte, et al., 2011; Hattie & Timperley, 2007; Margolis & McCabe, 2003). If students are given more feedback on homework assignments, they may be more likely to 'buy-in' to the value of the assignment, and may become more confident, and willing to try and persist through challenges. They may also become better at self-regulation (Hattie & Timperley, 2007). Feedback from teachers that is clear and consistent may translate into improving students' own abilities to self-assess and to identify gaps in their own learning.

The surprising need for further research into the nature of homework

The results of this study indicate that it is beneficial to allow students opportunities to explore what they have learned in class outside of class time. Teachers indicated that they valued homework, and the majority of students indicated that they should have homework. However,

how these homework opportunities exist depends on the context. There is still not a clear understanding of the nature of homework, and how it is perceived. The location of homework completion, the types of homework, and the intention of homework could be explored in future research to build on the results of this study.

Homework can be completed at home, at lunch hour, or after school. In this study, the majority of students completed homework at home, after school. Keith et al., (2004) highlighted the potential positive effects of allowing students to get started on homework in school where they may have more resources available to support their learning. However, other researchers identified the importance of students being able to complete homework assignments independently, without additional support (Marzano & Pickering, 2007).

Regarding the types of homework, teachers in this study highlighted that many students found comfort in routine and structure with respect to the types of homework questions assigned. Questions that were similar to those done in class helped build students' confidence. However, some researchers have identified that introducing new material in homework assignments can be beneficial so long as it is assigned with an understanding of the educational needs of the students (Markow et al., 2007; Marzano & Pickering, 2007; Sparks, 2011).

In terms of the intentions of homework, the student and teacher data from this study corroborates previous research that emphasizes the importance of clear explanations and ensuring that students understand the purposes of homework assignments (Cooper, 2007; Fisher & Frey, 2008). However, the results of this study indicated that there was a misalignment between teachers' purposes for assigning homework (i.e. students' development of fluency, and teachers' opportunity for assessment), and what students valued homework for (i.e. practice).

The alignment of students and teachers and the use of homework as a practice vs. an assessment device could be investigated in future research.

In summary, my research compared the perspectives of teachers and students in AP math classes with respect to homework, and student learning. This research has served as an important first step towards understanding the nature of homework, and student learning in AP programs. The results of this study highlight the significant differences that exist between students in AP programs with respect to the assignment and completion of homework. The results also demonstrate the positive influence that teachers can have on the learning of students in AP programs by responding to their unique needs. These students require a learning program that balances the achievement of curriculum expectations with sensitivity towards the academic and personal struggles that many of these students face. In terms of homework, students in AP programs require assignments that provide them with extra practice on questions that are similar to classwork and are aligned with their individual abilities. They also require consistent formative assessment and support on these assignments. Maintaining high expectations while being responsive to the unique needs of students in AP programs may help to improve student engagement, and ultimately increase homework completion, learning and achievement.

The overall goal of this research was to explore the nature of homework, and student learning in AP math classrooms in Ontario. The recommendations in this study are offered for consideration and for providing a springboard for further thinking and research. I am hopeful that the literature, methods, results and recommendations in this study will be used to initiate further research on AP programs, and ultimately to develop procedures, policies and practices that will more effectively supporting student learning.

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Appendix A

Factor Loadings for Exploratory Factor Analysis of Student Survey

Table 4

Factor Loadings for Exploratory Factor Analysis of Question 6: "About me as a learner" (attitudes towards learning)

	Rotated Factor Loadings		
Item	Positive attitudes towards myself as a learner	Expression of ideas and teachers' role in facilitating learning	Learning with others
a. I like learning at school	.86		
b. I enjoy learning new things at school	.84		
c. I like learning with others			-.80
d. I like learning on my own	.77		
e. I am able to express my ideas in class		.48	
f. I am willing to ask my teacher questions to help with my learning	.58		
g. My teacher helps with my learning		.72	
h. I think about how I learn and how to improve	.74		
i. My teacher has high expectations for me as a learner		.46	
j. My teacher clearly communicates his/her expectations for me as a learner		.82	
k. My teacher consistently communicates his/her expectations for me as a learner		.90	
l. My teacher sets realistic goals for me as a learner		.63	
m. I set realistic goals for myself as a learner	.70	.48	
% of variance	43.01	12.24	8.93
α	.84	.81	n/a

Note. Factor loadings < .40 were suppressed.

Table 5

Factor Loadings for Exploratory Factor Analysis of Question 7: "About my attitudes towards mathematics"

	Rotated Factor Loadings	
Item	Positive attitudes towards math and growth mindset	Fixed mindset
a. I like mathematics	.88	
b. I am good at mathematics	.86	
c. I am able to answer difficult mathematics questions	.86	
d. Mathematics is one of my favorite subjects	.83	
e. I understand most of the mathematics I am taught	.83	
f. Mathematics is an easy subject	.81	
g. I try to do my best in mathematics class	.69	
h. I can get better at mathematics	.56	
i. I have a certain amount of math intelligence, and I can't do much to change it		.96
% of variance	56.73	11.86
α	.92	n/a

Note. Factor loadings < .40 were suppressed.

Table 6

Factor Loadings for Exploratory Factor Analysis of Question 9: "How often do you think your teacher uses homework to do the following?"

	Rotated Factor Loadings
Item	Teachers' use of homework to support student learning
a. To assess students' skills and knowledge	.78
b. To develop students' interests	.78
c. To develop students' critical thinking skills	.92
d. To motivate students to learn	.85
e. To help students develop good work habits	.88
f. Because there was not enough time during class to cover all the material	
g. To help students practice skills or prepare for tests	. 77
% of variance	69.03

α	n/a

Note. Factor loadings < .40 were suppressed. Item 'f' was removed because it did not load well.

Table 7

Factor Loadings for Exploratory Factor Analysis of Question 10: "How much do you agree or disagree with the following statements?" (attitudes towards homework assignments)

	Rotated Factor Loadings	
Item	Positive attitudes and persistence on challenging homework assignments	Negative attitudes and giving up on challenging homework assignments
a. My homework assignments are interesting	.65	
b. My homework is just busywork and is not related to what I am learning in school		.49
c. I only complete homework assignments that are easy		.43
d. I enjoy completing homework assignments that are challenging	.79	
e. If I am challenged by a homework assignment, I keep trying because I believe that I can learn from it	.73	
f. If I am challenged by a homework assignment, I keep trying because it will look bad if it's not done	.80	
g. If I am challenged by a homework assignment, I keep trying because I don't want to look dumb	.61	
h. If I am challenged by a homework assignment, I give up because I don't think I can figure it out		.49
i. If I am challenged by a homework assignment, I give up because I will get the answers in class		.78
j. If I am challenged by a homework assignment, I give up because the teacher won't check it anyways/it won't affect my grade		.75
% of variance	30.17	20.71
α	.77	.67

Note. Factor loadings < .40 were suppressed.

Table 8

Factor Loadings for Exploratory Factor Analysis of Question 15: "How often does your math teacher do the following related to homework in your applied math classroom?" (assessment of homework)

	Rotated Factor Loadings	
Item	Assessment *for* Learning	Assessment *of* Learning

a. Provide students with a grade on their homework		.97
b. Provide feedback, other than grades, on homework assignments	.57	
c. Explain the purpose of specific homework assignments to students	.83	
d. explain the expectations/how to be successful on homework assignments	.90	
e. Review completed homework assignments in class discussions	.84	
% of variance	58.33	19.28
α	.85	n/a

Note. Factor loadings < .40 were suppressed.

Table 9

Factor Loadings for Exploratory Factor Analysis of Question 18: "Thinking about your applied math class in general, how much do you agree or disagree with the following statements?" (value of homework)

	Rotated Factor Loadings	
Item	Positive attitudes towards the value of doing homework	Negative attitudes towards the value of doing homework
a. I have enough time to do all of my homework	.56	
b. Students in my school make fun of those students who always do their homework		.83
c. Doing homework helps me learn more in school	.83	
d. Doing homework helps me reach my goals for after high school	.84	
e. Homework develops my sense of responsibility	.82	
f. Homework makes learning fun	.69	
g. My homework assignments are interesting	.76	
% of variance	48.89	17.03
α	.84	n/a

Note. Factor loadings < .40 were suppressed.

Table 10

Factor Loadings for Exploratory Factor Analysis of Question 19: "These questions will help identify what kind of "mindset" you hold right now about learning..."

	Rotated Factor Loadings

Item	Growth mindset	Fixed mindset
a. No matter how much intelligence you have, you can always change it a good deal.	.81	
b. You can learn new things, but you cannot really change your basic level of intelligence.		.64
c. I like my work best when it makes me think hard.	.83	
d. I like my work best when I can do it really well without too much trouble		.82
e. I like work that I'll learn from even if I make a lot of mistakes.	.80	
f. I like my work best when I can do it perfectly without any mistakes.		.83
% of variance	42.54	23.79
α	.75	.61

Note. Factor loadings < .40 were suppressed.

Appendix B

Qualitative Analysis: Codes Charts

Teacher Survey and Interview codes charts

Table 11

Approach to Teaching and Learning (Data from Survey Question 17b and Interview Questions 1 and 4)

Themes	Axial codes
1) Unique learning needs of students in AP	- Motivation - Spec ed - External influences - Fear - Skills - Spread of ability
2) Teaching that responds to unique learning needs of students in AP	- Pace - Expectations - Student-centered

Table 12

Assignment of Homework (Data from Survey Questions 15a, 17a and Interview Question 2)

Themes	Axial codes
1) Balance (achievement of curriculum expectations with external influences)	- Time in class - Individualized - Practice - Textbook - Worksheet - Unfinished classwork - Small amount - Similar to classwork - External influences - No flipped classroom in Applied

Table 13

Assessment of Homework (Data from Survey Question 15b and Interview Question 2)

Themes	Axial codes
1) Assessment *for* Learning	- Formative - Daily take-up - Daily check - Never - Summative - Partial check - Feedback - Individualized

Table 14

Value of Homework (Data from Survey Question 16 and Interview Question 3)

Themes	Axial codes
1) Making homework meaningful is challenging	- Challenging
2) Homework is meaningful if it increases understanding	- Understanding - Practice
3) Motivation is important	- Motivation (**maybe take this one out)** - Self-efficacy - Counts for grades - Relevance - Interest - Routine - Student teacher relationship

Table 15

Approach to Homework in Applied vs. Academic Math (Data from Survey Question 17a and Interview Question 2)

Themes	Axial codes
Responding to the unique needs of AP students	- High expectations - Motivation - Increase confidence - Interests - External influences - More time - Asking for help - Struggle - No flipped classroom in Applied

Student survey codes charts

Table 16

Approach to Teaching and Learning: Students' Perspectives (Data from Survey Question 22)

Themes	Axial codes
1) Responsiveness to individual learning needs	- Good job - Explanations - High expectations - Help everyone - Support - Feedback - Pace

Table 17

Value of Homework: Students' Perspectives (Data from Survey Questions 20 and 21)

Themes	Axial codes
1) Homework is often not meaningful	- Nothing (refers to nothing making homework meaningful) - Not a lot (refers to not wanting a lot of homework)

2) Homework is meaningful if it increases understanding	- Understanding - Practice
3) Motivation is important	- Self-efficacy - Counts for grades - Relevance

Appendix C

Instruments

Student Survey - Homework: How can it be 'Applied'

Thank you for taking the time to complete this survey.

1. Please do not write your name anywhere on the survey.
2. You can skip questions you don't feel comfortable answering, you can stop at any time without penalty, and your teacher will not see your responses.
3. **If you have any questions:** the researcher will be happy to answer them for you.
4. **When you are finished** please put your survey in the envelope provided and seal it before handing it to the researcher, or your teacher.

Part A: About me

1. I am a girl = 65 boy = 95 transgendered = 0 prefer not to say = 0

2. I am _____ years old. (*M* = 14.73)

3. I am in Grade_____. (*M* = 9.64)

4. On my report card, I receive

Mostly **90** to **100%**	A mix of **80** to **100%**	Mostly **70** to **79%**	A mix of **60** to **79%**	Mostly **60** to **69%**	Often less than **60%**
8	56	51	37	6	6

5. I have an IEP? (n = 54) Yes = 26 no = 25

6. About me as a learner

	Never	Rarely	Sometimes	Usually	Always
a. I like learning at school	13	12	72	47	21
b. I enjoy learning new things at school	11	13	62	57	21
c. I like learning with others	9	17	55	58	26
d. I like learning on my own	19	21	62	43	18
e. I am able to express my ideas in class	6	33	60	42	21
f. I am willing to ask my teacher questions to help with my learning	10	16	52	54	33
g. My teacher helps with my learning	3	11	34	63	53

h. I think about how I learn and how to improve	14	22	72	38	17
i. My teacher has high expectations for me as a learner	3	10	51	56	39
j. My teacher clearly communicates his/her expectations for me as a learner	3	15	44	64	36
k. My teacher consistently communicates his/her expectations for me as a learner	5	26	50	54	27
l. My teacher sets realistic goals for me as a learner	6	11	46	63	37
m. I set realistic goals for myself as a learner	15	24	45	48	30

7. About my attitudes towards mathematics

	Strongly disagree	Somewhat Disagree	Somewhat Agree	Strongly agree
a. I like mathematics	28	33	68	35
b. I am good at mathematics	23	30	101	38
c. I am able to answer difficult mathematics questions	30	39	78	17
d. Mathematics is one of my favorite subjects	55	38	40	30
e. I understand most of the mathematics I am taught	16	30	81	37
f. Mathematics is an easy subject	32	52	72	34
g. I try to do my best in mathematics class	6	14	81	61
h. I can get better at mathematics	9	17	60	71
i. I have a certain amount of math intelligence, and I can't do much to change it	43	46	60	13

<u>Part B: Assignment of homework</u>

8. How often are you assigned homework in your applied mathematics course?

Never	Occasionally	Most classes	Every Class
22	60	53	27

9. How often do you think your teacher uses homework assignments to do the following?

	Never	Rarely	Sometimes	Often	Very often
a. To assess students' skills and knowledge	14	21	61	49	17
b. To develop students' interests	18	47	52	30	15
c. To motivate students to learn	11	15	49	32	28
d. To help students develop good work habits	15	19	62	46	20
e. Because there was not enough time during class to cover all the material	17	21	51	40	32

f. To help students practice skills or prepare for tests	9	7	36	43	48

10. How much do you agree or disagree with the following statements?

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
a. My homework assignments are interesting	49	56	51	6
b. My homework is just busywork and is not related to what I am learning in school	62	68	25	4
c. I only complete homework assignments that are easy	45	52	43	21
d. I enjoy completing homework assignments that are challenging	55	54	38	13
e. If I am challenged by a homework assignment, I keep trying because I believe that I can learn from it	30	45	69	18
f. If I am challenged by a homework assignment, I keep trying because it will look bad if it's not done	29	55	59	18
g. If I am challenged by a homework assignment, I keep trying because I don't want to look dumb	49	56	41	14
h. If I am challenged by a homework assignment, I give up because I don't think I can figure it out	53	59	30	18
i. If I am challenged by a homework assignment, I give up because I will get the answers in class	52	44	51	13
j. If I am challenged by a homework assignment, I give up because the teacher won't check it anyways/it won't affect my grade	66	52	34	10

<u>Part C: Completion of Homework</u>

11. How often do you complete your math homework?

I am not usually assigned any math homework	Never or almost never	Sometimes	Usually	Always
27	26	39	49	22

12. How much time do you usually spend on math homework (in or out of school) on any given day?

I am not usually assigned any math homework	30 minutes or less	Between 31 and 45 minutes	More than 45 minutes
36	77	33	14

13. Where do you usually do your homework? Please check all that apply.

My home	121

School/in class	114
School bus or traveling to or from school	23
My friend's home	23
An after-school program or community center	12
Library	21
Somewhere else	21
I never do homework	30

14. When do you usually do your homework? Please check all that apply.

Before school	28
During school	84
After school	116
I never do homework	31

Part D: Assessment of homework

15. How often does your math teacher do the following related to homework in your applied math classroom?

	None of the time	Some of the time	Half of the time	Most of the time	All of the time
a. Provide students with a grade on their homework	80	29	20	24	7
b. Provide feedback, other than grades, on homework assignments	31	55	19	43	13
c. Explain the purpose of specific homework assignments to students	27	38	34	34	25
d. explain the expectations/how to be successful on homework assignments	22	26	44	47	19
e. Review completed homework assignments in class discussions	19	16	29	44	50

Part E: Value of homework

16. From 1 to 3, please rank the following based on why you do homework (1=most often, 3=least often)

	Rank 1	Rank 2	Rank 3
To practice	63	34	21
To become more fluent in my math learning	28	46	46

Learning new material	38	40	42

17. From 1 to 3, please rank the following based on when you see homework as most valuable (1=most value, 3=least value)

	Rank 1	Rank 2	Rank 3
To practice	66	30	18
To become more fluent in my math learning	25	46	44
Learning new material	28	36	47

18. Thinking about your applied math class in general, how much do you agree or disagree with the following statements?

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
a. I have enough time to do all of my homework	17	45	52	46
b. Students in my school make fun of those students who always do their homework	83	44	28	4
c. Doing homework helps me learn more in school	23	32	68	34
d. Doing homework helps me reach my goals for after high school	25	51	52	32
e. Homework develops my sense of responsibility	24	41	66	29
f. Homework makes learning fun	92	46	14	7
g. My homework assignments are interesting	71	48	34	8

<u>Part G: Mindset</u>

19. These questions will help identify what kind of "mindset" you hold right now about learning. In order for it to be helpful, it's important to respond honestly, based on your true feelings. Read each statement, and decide how much you agree or disagree with the statement.

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
a. No matter how much intelligence you have, you can always change it a good deal.	12	17	81	46
b. You can learn new things, but you cannot really change your basic level of intelligence.	51	58	42	8
c. I like my work best when it makes me think hard.	38	62	43	14
d. I like my work best when I can do it really well without too much trouble	15	26	70	46

e. I like work that I'll learn from even if I make a lot of mistakes.	22	39	64	34
f. I like my work best when I can do it perfectly without any mistakes.	23	33	54	49

Part H: Open response

20. Think back to a time when you had a meaningful homework assignment. Could you describe what made it meaningful?

21. Should you have homework? Why/why not?

22. How can your teacher better support you to meet your educational goals?

Teacher Survey - Homework: How can it be 'Applied?'

Thank you for completing this survey. My research focuses on the nature of homework in Applied Mathematics classrooms. While homework is a predictor of achievement in Academic Math, it does not predict achievement for students in Applied mathematics. This survey is intended to help us begin to understand these differences. The survey is completely confidential, and your name will never be used. Hence you are free to answer each question completely honestly, without any concern that these data will be linked to you.

Part A: My Professional Experience

1. My professional teaching experience is:

Total years:	$M = 15.05$
Years teaching applied math:	$M = 9.84$
Years teaching math:	$M = 14.45$
Years at the current school:	$M = 10.65$

2. I have completed the following:

Select all that apply.

	Frequency (n = 21)
Bachelor's degree with math major	6
Bachelor's degree with math minor	9
Additional Qualification Courses (AQs)	8
Additional Qualification Specialist Math	5
Masters Degree (M.Ed., M.Sc., M.A., etc.)	1
Doctorate Degree (Ph.D, or Ed.D.)	0
Other relevant education or training	15

Please specify 'Other relevant education or training':

3. I believe the average socio-economic level of the community my school serves is:

Far below average	Below average	Average	Above average	Far above average
1	12	4	3	0

4. I believe the average academic achievement of students in my school is:

Far below average	Below average	Average	Above average	Far above average
0	4	12	3	0

5. I believe the average academic achievement of students in my applied math class is:

Far below average	Below average	Average	Above average	Far above average
2	4	11	3	0

Part B: Assignment of Homework

6. How often do you assign homework in your applied mathematics course?

Never	Occasionally	Most classes	Every Class
2	5	13	0

7. How often do you use homework assignments to do the following?

	Never	Rarely	Sometimes	Often	Very often
a. To assess students' skills and knowledge	3	6	5	5	1
b. To develop students' interests	4	4	11	1	0
c. To develop students' critical thinking skills	3	5	9	2	1
d. To motivate students to learn	3	4	8	4	0
e. To help students develop good work habits	2	1	3	9	4
f. Because there was not enough time during class to cover all the material	4	3	9	3	1
g. To help students practice skills or prepare for tests	2	0	2	9	6

Part C: Completion of Homework

8. What percentage of your students in your Applied math class completes their homework assignments during a typical school week?

$M = 47.5$ %

9. If you assign homework, how much time, on average, would you expect an average student to spend doing this work?

30 minutes or less	Between 31 and 45 minutes	More than 45 minutes
12	6	0

Part D: Assessment of Homework

10. How often do you do the following related to homework in your applied math classroom?

	None of	Some of	Half of	Most of	All of

	the time	the time	the time	the time	the time
a. Provide students with a mark on their homework	10	9	0	0	0
b. Provide feedback, other than marks, on homework assignments	1	10	3	4	1
c. Explain the purpose of specific homework assignments to students	2	5	6	4	2
d. Explain the expectations/how to be successful on homework assignments	2	4	2	8	3
e. Review completed homework assignments in class discussions	1	1	0	13	4
f. Include homework as part of students' grades for the course	4	3	0	0	0

Part E: Value of homework

11. From 1 to 3, please rank the following based on what you see the value of homework for (1=most valuable, 3=least valuable)

	Rank 1	Rank 2	Rank 3
Practice	4	3	0
Fluency	14	1	1
Introducing new material	2	13	1

12. Thinking about what things look like on the level of daily practice in your applied math classroom, how much do you agree or disagree with the following statements?

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
a. My students have enough time to do all of their homework	0	2	14	0
b. Students in my school make fun of those students who always do their homework	0	1	11	7
c. Doing homework helps students learn more in school	5	7	7	0
d. Doing homework helps students reach their goals for after high school	0	2	9	8
e. Homework develops students' sense of responsibility	0	0	14	5
f. Homework makes learning fun	0	1	8	10
g. My homework assignments are interesting	2	9	7	0

Part F: Classroom mindset

13. Thinking about what things look like on the level of daily practice how often do the following occur in your applied math classroom?

	Never	Rarely	Sometimes	Usually	Always

a. Students are marked on assignments when learning something new	2	7	9	0	0
b. Students are provided rubrics in student-friendly language before they begin a major assignment	6	1	3	2	0
c. Students are encouraged to ask the teacher why the class is learning a topic	0	0	3	3	6
d. All students are expected to reach a common high standard but they are given different levels of support and time to accomplish it	0	1	1	1	9
e. Students receive recognition for effort in structured ways, such as awards, rewards, or grading practices	0	0	1	5	6
f. Students are told that they are smart when they perform well	0	3	5	2	2
g. When students make mistakes or give a wrong answer, they get specific feedback on how to improve	3	3	4	0	0
h. Students tease each other about poor performance, mistakes, or being slow	0	0	1	5	6

14. Thinking about your own mindset about learning, how much do you agree or disagree with the following statements?

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
a. No matter how much intelligence you have, you can always change it a good deal	1	6	3	2
b. You can learn new things, but you cannot really change your basic level of intelligence	0	0	5	7

Open Response

15. Please describe how you typically assign and assess homework in applied math?

How I assign homework (eg. type, amount)

How I assess homework (eg. formative, summative)

16. Please describe what you think makes (or would make) homework meaningful in Applied math.

17. a) Does your approach to homework differ in an Applied math course in comparison to an Academic math course? (n = 8)

Yes 6
No 2

If yes, please explain

17. b) Does your approach to teaching differ in an Applied math course in comparison to an Academic math course? (n = 12)

Yes 10
No 2

If yes, please explain

Teacher Interview - Homework: How can it be 'Applied?'

Students in applied math:

1. Think about students in your applied math classroom. How do these students' learning differ from other classes?

Assignment/assessment of homework:

2. Could you describe how you typically assign and assess homework in your applied math classroom?
   a) Does this differ from other classrooms/courses?
   b) How do you ensure that your students understand the expectations of homework assignments?

Value of homework:

3. Think back to a time when you gave a meaningful homework assignment. Could you describe what made it meaningful?

Classroom mindset:

4. Could you describe the mindset (expectations, ideas) that you bring forward with respect to the teaching and learning of students in applied math?
   a) Is this different than your mindset teaching other classes?
   b) Does your mindset with respect to the teaching and learning of students in applied math influence how you assign and assess homework in your classroom (type/amount of homework assigned, expectations for completion, follow-up/monitoring/counting as part of course grades)?

Next steps:

5. Is there anything else about homework that you think would be important for me to consider?

Appendix D

GREB Approval Letter

August 01, 2014

Ms. Adelina Valiquette
Master's Student
Faculty of Education
Queen's University
Duncan McArthur Hall
511 Union Street West
Kingston, ON, K7M 5R7

GREB Ref #: GEDUC-739-14; Romeo # 6013277
Title: "GEDUC-739-14 Homework: How can it be "Applied?""

Dear Ms. Valiquette:

The General Research Ethics Board (GREB), by means of a delegated board review, has cleared your proposal entitled **"GEDUC-739-14 Homework: How can it be "Applied?""** for ethical compliance with the Tri-Council Guidelines (TCPS) and Queen's ethics policies. In accordance with the Tri-Council Guidelines (article D.1.6) and Senate Terms of Reference (article G), your project has been cleared for one year. At the end of each year, the GREB will ask if your project has been completed and if not, what changes have occurred or will occur in the next year.

You are reminded of your obligation to advise the GREB, with a copy to your unit REB, of any adverse event(s) that occur during this one year period (access this form at https://eservices.queensu.ca/romeo_researcher/ and click Events - GREB Adverse Event Report). An adverse event includes, but is not limited to, a complaint, a change or unexpected event that alters the level of risk for the researcher or participants or situation that requires a substantial change in approach to a participant(s). You are also advised that all adverse events must be reported to the GREB within 48 hours.

You are also reminded that all changes that might affect human participants must be cleared by the GREB. For example you must report changes to the level of risk, applicant characteristics, and implementation of new procedures. To make an amendment, access the application at https://eservices.queensu.ca/romeo_researcher/ and click Events - GREB Amendment to Approved Study Form. These changes will automatically be sent to the Ethics Coordinator, Gail Irving, at the Office of Research Services or irvingg@queensu.ca for further review and clearance by the GREB or GREB Chair.

On behalf of the General Research Ethics Board, I wish you continued success in your research.

Yours sincerely,

Joan Stevenson, Ph.D.
Chair, General Research Ethics Board

c: Dr. Don Klinger, Faculty Supervisor
Dr. Don Klinger, Chair, Unit REB
Ms. Stacey Boulton, c/o Graduate Studies and Bureau of Research