The Effects of Homework Assessment on Student Motivation and Achievement

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Gertrude I. Booth

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We hereby approve the project report of

Gertrude I. Booth

Candidate for the degree of Master of Education

APPROVED FOR THE GRADUATE FACULTY

__________________________  __________________________
Date  Dr. Mark Oursland

__________________________  __________________________
Date  Dr. Michael Lundin

__________________________  __________________________
Date  Dr. Jane Whitmire
ABSTRACT

The Effects of Homework Assessment on Student Motivation and Achievement

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The purpose of this research is to determine if the manner of assessing homework is associated with student motivation and student achievement. The participants are 33 students, ages 16 to 18, from two sections of Advanced Placement Calculus at a comprehensive high school. The two sections are assigned the same homework problems. The assignments in one section were submitted and assessed for a grade. The other section did not submit the assignments but took homework quizzes that were random problems taken from the homework assignment. Interventions were carried out in both groups to enlighten students as to the purpose and benefits of completing their daily homework. Some of the interventions were discussing homework protocol, encouraging study groups, scheduling after-school help sessions, ongoing contacts with parents, and distributing chapter syllabi. To determine homework beliefs and practices students and their parents completed surveys. Also, researcher/teacher-student interviews were conducted to elicit insight into student beliefs and attitudes about homework. To triangulate the study, the researcher kept a journal to record observations, student comments, after-school attendance, types of homework questions, and homework attempts/completion. The researcher/teacher was able to draw some important connections between methods of assessing homework or student motivation and achievement.
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The Effects of Homework Assessment on Student Motivation and Achievement

Purpose of the Study

The purpose of this study is to determine if the manner of assessing homework is associated with student motivation or student academic achievement.

Brief Introduction and Problem Statement

Courses such as Precalculus, Advanced Placement (AP) Calculus, and AP Statistics are rigorous and demanding courses and electives in many high school curricula. From the researcher’s experience, students who take these courses may be more motivated and focused than those who do not, but some students enroll because “it looks good on their transcripts.” Also, many students at this level of mathematics seem to be concerned with their Grade Point Average (GPA). Their focus on grades, rather than the learning, may lead students to “pad” their grades. That is, students may complete homework assignments to bolster grades, but they may not really learn or understand much from the process.

Also students may not realize the benefits from or the reasons for attempting or completing homework assignments in mathematics. During the researcher’s seventeen years of classroom teaching at all levels of mathematics, homework completion has evolved into a major issue of concern. As the teacher of two sections of Precalculus (62 students) during the 2007 – 2008 school year, the researcher noted that only about 40% of homework assignments were completed and submitted on or before the due date. A colleague in the same school, teaching the same course, ceased collecting and assessing homework assignments, since so few students were attempting the work, although he continued to assign homework. Other Precalculus teachers within the same school and within the same district have expressed their dissatisfaction with homework completion in their classes as well.
Discussions with colleagues within and across other districts have revealed that there are many philosophies, policies and methods to assessing and assigning homework. It is unknown to the researcher whether the actual method of assessing homework can effect student achievement.

**Research Questions**

Do students realize the benefits from or the reasons for attempting or completing homework assignments in mathematics? Are students using available opportunities to get needed help with homework assignments? There are resources and opportunities available for students other than the teacher and within the actual class period to receive extra help in completing homework assignments. Schools and districts often offer some sort of person-to-person tutoring service(s) and there are numerous online tutorials focused on specific concepts and levels of mathematics. Are these opportunities known to students and their parents?

Two other major questions arise from the researcher’s observations and experiences:

1. Does the method of assessing and assigning homework change the students’ beliefs in the benefits of diligently attempting homework assignments?
2. Is the method of assigning and assessing homework associated with students:
   a. homework completion?
   b. understanding of concepts?
   c. student achievement?

**Significance of Study**

This study should point to better methods of assigning and assessing homework for the purpose of increasing student learning and motivation since better grades are a natural consequence of learning. Understanding the purposes and benefits of homework should motivate students to put more effort into the assigned tasks.
The intention of this study is to limit the scope of the findings to the researcher’s own classes and the applicability is only to the homework assessment methods used in the study.
Chapter 2: Review of Literature

Mathematics and science supply basic knowledge, sustaining every nation of the world. It is paramount that students are prepared for the adult world they enter after graduation. Success in mathematics, an appreciation for mathematics, and the ability to know when, where, and what mathematical concepts and processes are needed to solve problems is critical to a student’s education.

One aspect of a traditional mathematical education is homework. Homework is an out-of-class activity that a teacher assigns to students. Homework tasks are meant to extend and supplement in-class activities (Cooper, Robinson, Patall, 2006). An effective homework assignment links to classroom content and leads students to a deeper understanding of the concepts.

Purpose and Benefits of Homework

Practice and repetition in mathematics is essential in order to build a foundation of basic knowledge and skills. Homework enables students to master a process by practice and to increase comprehension and retention of information. Students learn best when concepts are frequently reviewed and practiced. Although many students learn mathematical concepts in the classroom, mastery of some concepts demands multiple exposures over time.

Assigning homework potentially frees in-class time for more structured activities such as explorations, investigations, and cooperative learning opportunities. Practicing skills during in-class time is an inefficient use of learning time. Assigning homework is thus an ideal opportunity for students to practice skills without rigid time constraints.

There are many controversies and arguments concerning homework with debates waging for decades (Vatterott, 2009, p.1). Several references on the subject include the following:
1. The Case Against Homework, Sara Bennett and Nancy Kalish, 2006.


The traditional beliefs of the benefits of homework, especially in the elementary grade levels, are now being challenged. The authors, however, allude to some benefits of assigning homework to secondary students. In contrast, some continue to support the idea of homework, although a growing number of teachers and parents are beginning to question and criticize the practice (Vatterott, 2009, p. 2). The notion that homework will promote a higher achieving student and that it reinforces learning are challenged and discussed at length. Kohn (2006, p. 52) states the assumption that homework will teach study skills and promote responsibility does not actually pass the test of research, logic, or experience.

Among those who continue to adopt homework as an essential element of mathematics education, questions remain on how much homework to assign and methods of assessment. Concerns linger on the affects homework can have on grades, attitude and motivation. Even though there is disagreement about the value of homework, the majority of parents, educators and policymakers still support the practice of assigning homework to all grade levels (Vatterott, 2009, p. 2).

Homework that has been explained and is relevant can be indispensable to a student’s education. Homework assignments should be assigned with a reasonable length and specific goal in order to keep students focused and encourage parental support. There are a number of research supported purposes for assigning homework:
1. To give students a chance to review and practice what they are being taught (Paulu, 1998, p. 8).
2. To prepare students for the next lesson (Paulu, 1998, p. 8).
3. To encourage and allow students the opportunity to explore and use outside resources (Paulu, 1998, p. 8).
4. To extend what students have learned to new contexts (Center for Public Education, 2007).
5. To have students work incrementally and in-depth on a project (Center for Public Education, 2007).

Reading, communicating ideas, taking notes, listening skills, problem solving, planning and prioritizing are life skills that are often reinforced through homework assignments. Homework can also teach students to concentrate, write reports, spend time alone and develop a curiosity to be a continuous learner (Bishop, 2008).

There are other purposes of homework not directly related to instruction. One is to help students develop time-management, study, and organizational skills (Black, 1996). Students, especially those with learning differences or challenges, succeed in an environment that is structured. Encouraging students to keep a daily homework planner to organize work may develop important organizational skills. Students with an established homework routine strengthen and build time-management and study skills (Scholastic Parents, 1996). Assignments require students to be cognizant of time restraints and deadlines; building responsibility and accountability into the busy schedules of high school students.

Students learn to work on assignments, even when they do not want to, and thus adjust to the demand of a specific task. (Johnson, Pontius, 1989). Self-directed learning can be enhanced
with homework by requiring students to use outside resources like libraries, the internet and various reference materials. Actively engaging in homework assignments encourages students to be advocates of their own learning (Chen, 2009).

Another non-instructional purpose of assigning homework is to encourage students to work with their peers. The planning of cooperative groups or suggesting and encouraging study groups are beneficial. Cooperative efforts result in a mutual benefit for all group members since everyone gains from each others’ effort (Kagan, 1994). The benefits of study groups are likewise evident. The material is better understood and retained through multiple learning modalities. Students discuss, explain, and re-examine concepts and/or processes with their peers, thereby reinforcing their own learning. Students can also question and discuss confusing and complex concepts with each other (College Board, 2010).

**Parent/Family Involvement**

Homework can improve communication between families and the school (Center for Public Education, 2007). Discussing homework contributes to some of the immediate and frequent dialogues between families and the school (Gilliland, 2002). Parental involvement with the student and the school is a central relationship and can produce great rewards for all concerned.

Parental involvement at the secondary level of education does not necessarily mean the parent is actually on school premises. Support in the form of encouragement, sympathy, assurance, and understanding all contribute to being an involved parent at the secondary level.

Parents need to be informed and supportive when it comes to the completion of homework assignments (Paulu, 1998). Getting students to do homework can be a challenge and a concern for teachers of all grades and disciplines. Early contact with the family can establish
an open rapport for future communications. Sharing the issues, benefits, and policies of homework with parents at the onset of a course highlights its important role in the learning process by providing parents an avenue of response and opening up communication.

Often parents are reluctant or unable to help their student with homework in mathematics, especially when their child reaches a level in mathematics that exceeds that of the parents’. Parents, however, can still offer support by quizzing a child, teaching study strategies, or securing outside tutoring or other resources. A parent’s most productive “job” in the realm of homework is to be a motivational academic role model and cheerleader.

**Benefits of Parent Involvement**

Parental support and involvement will improve student success. According to Loucks (1992, p. 19), “Research shows that parental involvement in the school results in improved student achievement.” Van Voorhis (2003) noted that assignments that had a component of interacting with other students or with parents were important factors in ensuring the effectiveness of homework. Parental or family help with homework allows them to show an interest in their children’s education (Hoover-Dempsey et al., 2001). A study by Cooper, Lindsay, Nye, and Greathouse, (1998) suggests that family involvement had more behavioral benefits than academic benefits. Homework can thus serve as a window for parents to observe the education of their child. Parents spend quality time with students when helping with homework and therefore make connections with their child’s academic life.

Parental attitudes regarding homework can have a direct effect on a child’s attitude about homework and therefore their classroom achievement (Hoover-Dempsey, 2001). When a parent is willing to undergo the pain of homework along with the child, the child observes the parents willingness to share in the struggle that is life. In that parent is willing to give up valuable time
to assist the child, the child learns that time is valued and therefore, valuable. This setting aside of time in dedication to education is a way of life, that, once taught, follows the student to a lifetime of academic achievement.

**The Effects on Student Achievement**

Research offers conflicting discussions on homework. Some researchers believe homework is essential to student success, while others believe there is no consistent relationship between time spent on homework and academic achievement (The Center for Public Education, 2007). However, it has been found that homework raises achievement “substantially” for high school students (Black, 1996). Paulu (1998, p.1) states, “Student achievement rises significantly when teachers regularly assign homework and students conscientiously do it, and the academic benefits increase as children move into the upper grades”.

Does homework provide a path to help students become better learners? The positive effects of homework are more pronounced as students age (Cooper, Robinson, Patall, 2006). As a guideline, students in grades 10 – 12 should work on homework assignments for a total of 1 ½ to 2 ½ hours per night (Paulu, 1998, p. 22). Cooper, from his research, recommends the 10-minute rule, i.e. for each grade level a student should be doing 10 minutes of homework a night. As students develop and move from elementary to secondary levels, homework begins to serve a different purpose with increasing relevance and time involved.

Research conducted by psychologists Harris Cooper, Ph.D., James J. Lindsay, Ph.D., and Scott Greathouse, Ph.D. of the University of Missouri – Columbia, and Barbara Nye, Ph.D., of Tennessee State University (1998), indicates homework does help students in the upper grades. However, from this same study comes a warning that too much homework can lead to “fatigue and academic disinterest”. The more homework students complete, especially in the middle to
upper grades, the better they perform in school. Students who complete practice assignments as homework score higher on class tests. The amount of homework completed by students has a clear positive correlation to their achievement in school. This relationship was definitely stronger in the upper grades, and is more evident in the grades given by teachers rather than performance on standardized tests (American Psychological Association, 1998).

Is there a plausible link between homework completion and student achievement? Keith (1982) proposed homework completion has a causal effect on a high school student’s academic achievement. In a statistical test of school homework policies and student mathematics achievement, Keith concluded students assigned more homework, than compared to the total sample of schools did have higher math achievement than the students at schools where less homework was assigned (Philips, 1997). There are many factors involved in the relationship between homework and academic achievement including but not limited to, intellectual ability, study time, economic status and individual family situation. In a study conducted by Cooper and his colleagues in 1998, found a positive relationship between how much homework older students completed and their achievement.

**Student Attitudes toward Homework**

From the student perspective, homework should have obvious and measurable benefits. Success in high school and college is dependent on the student’s ability to study effectively and efficiently. Students get a sense of responsibility and accomplishment when homework is finished. This sense of accomplishment is even further enhanced since the student learns to complete things on their own. Homework, therefore, encourages and builds self-discipline in students (Oak, 2009).
Doing homework can lead students to develop the capacity to balance the activities in their lives. It gives them direction and practice on managing their time and planning their schedule. Homework should be a significant part of most thirteen to seventeen-year old students’ daily routines.

So why don’t more students do homework? There are a number of noted reasons and excuses including the following: (Case, 2008).

1. Boring material.
2. Instructions are unclear.
3. Too difficult.
4. Too easy.
5. Not a priority.
6. Forgotten.
7. Poor time management, extracurricular activities, and/or after-school employment.
8. Non-recognition of the benefit, goal or point of the assignment.
9. The student has no place where it is peaceful and quiet to work or study.
10. Lack of access to the equipment and/or technology needed.
11. Family obligations.
12. Lack of self-study skills and/or habits.

How can students be motivated and encouraged to complete homework assignments? Parental support in helping with homework and encouraging the completion of homework will lay a foundation that will evolve into good study habits and the acceptance of responsibility that will scaffold into many life skills (Chen, 2009). There are several suggested homework tips for both parents and teachers. Parents can establish a routine for their child. Also, helping students
designate a set time and place where they are comfortable studying without disruption(s) is essential.

Helping students organize is important. Parents can talk with their teen about setting progress goals for assignments and courses. Teachers can provide a graphic organizer or homework grid for students to record assignments and due dates.

Prioritization by both the parent and the teacher is imperative. As students progress through the upper grade levels, homework tasks can be overwhelming. Parents can assist by intervening with suggestions of resources, time lines, and homework prioritization. Also, teachers should prioritize homework assignments fairly and make sure they are goal driven and purposeful. Finally, teachers should consider homework assignment completion time since most students at the secondary level have competing obligations and activities outside the classroom.

Teachers can also help by following a few principles to encourage students to be more compliant with completion of homework assignments.

1. Assign homework activities that are aimed at learning powerful curriculum ideas.
2. Give homework assignments that are appropriate in difficulty to challenge students without causing frustration and/or confusion.
3. Provide students with the needed resources and tools to do the assignment.
4. Weigh the benefits of the assignment with the time and effort required to complete it (Black, 1996).

Paulu (1998, pp. 5 - 36) gives a number of tips, including the first three principles listed above, for teachers who give homework to their students. She suggests that the homework expectations be laid out early in the school year and that assignments be varied periodically and not be the “same-old, same-old”. Personalizing the assignment can make it more attractive and
interesting to the student and bring school and community resources into the assignment. Constructive feedback is essential for students to see the worth and the purpose of the assignment.

Student certainty in the benefits of completing their homework and informed supportive parents will encourage students to be motivated to complete homework assignments. Mathematics is not a discipline unique to the importance of practicing skills and concepts studied in the classroom, but do teachers take the time to discuss the importance of homework and its benefit at the beginning of the term? Do teachers inform parents of the homework policy and the amount of homework they should expect assigned to their child? Do parents have preconceived beliefs on homework? Students and parents will be more compliant and understanding if the purpose and the benefits of the assigned homework is discussed along with an opportunity to engage in a dialog with questions and answers.

Methods of Assessing Homework

A major purpose of homework, from the teacher’s perspective, is to obtain formative assessment from the individual work of students. Assessment of daily homework is used by the teacher for making instructional decisions, monitoring student progress and evaluating student understanding (Research Companion, 2003, p. 53). The ideal outcome of formative assessment is for teachers to gather evidence, make inferences, and then give feedback to students so homework is used to its maximum effectiveness (Research Companion, 2003, p. 56). Formative assessment occurs while students are still in the process of learning. It maximizes learning by informing the teacher of adjustments needed in the lessons (Christopher, 2007). However, homework should have little or no emphasis on a student’s grade and instead focus on the overall goal of mastery. “Although teachers may record the results of formative assessments, we
shouldn’t factor these results into summative evaluation and grading.” (McTighe, O’Connor, 2005, p. 1). A student’s mastery of a concept or unit material may not occur until the end of the instruction for that unit. Measurement of the learning at the end of the unit allows the student to continue to practice and improve without the pressure or anxiety of achieving high grades. This ongoing learning and evaluation should replace previous assessments and attempts. However, the practice of not grading homework assignments and still motivating students to complete the assignments is an unproven method and often poses a dilemma.

An innovative and effective method of assessing homework is to require students to use a journal throughout the term. Requiring students to keep such an on-going journal with record keeping, homework assignments, comments to and from the teacher, and student reflections can be an extremely organized and effective method of the assessment of learning (Potter, M., 1998). Journaling alongside the homework assignment creates both an accountability and individualized element to the homework task. Providing feedback would be convenient and effective and the communication between student and teacher would be productive. Similar methods described beforehand of assessing homework assignments could still be used with the addition of student reflection, organization, planning and self-assessment built into the method.

Using student reflection, on homework, or included on Exit Slips, Entry Tasks, or Warm-ups, is a powerful method of assessing student learning. Written student reflections, documenting frustrations, confusion, difficulties, successes or challenges is an insightful path into misconceptions and re-teaching opportunities. Assessing homework assignments that include a reflection piece relieves the pressure of evaluating only for accuracy and focuses instead on their ability to reflect on their understanding of the material.
Forming study groups gives students the opportunity to “teach” each other and is a powerful way to affirm their own learning. A student-to-student teaching forum and student participation in a study group, with a common goal of completing and understanding homework assignments, can increase motivation. After-school study programs also help bolster self-confidence and establish work habits that improve overall performance in school (The Center for Public Education, 2007).

How does the method of assessing homework effect student compliance with homework completion? Assessment can have powerful effects on motivation and learning. Teachers can assess homework using a variety of methods. These methods can range from merely checking off the assignment as completed, attempted, or not attempted, to an actual evaluation of the assignment for points and/or a grade. Often secondary mathematics teachers use a weighted grading system. For example, in such a system, assessments count highest, 70 to 80 percent of the overall grade for the term, and in-class work and homework count 20 to 30 percent (Struyk, Epstein, Bursuck, 1995).

Grades should be indicative of learning. For incomplete homework, teachers may record a zero and, if late, even a completed assignment is penalized with lesser points awarded. Depending on the weighted system used for grades, a student who does not complete homework can earn a low or failing grade in the course. Is completion of homework indicative of the measure of student learning or simply of student compliance (Vatterott, 2009, p. 126)?

Homework should not be a major factor that causes a student to fail a course. Completion of homework should also not be a major reason a student passes a course since the teacher cannot be certain the individual student completed the assignment (O’Connor, 1999). Passing a student
based on homework alone will reward compliance and not necessarily learning (Vatterott, 2009, p. 112).

Homework grades affect student attitudes. Failing grades can accumulate from incomplete homework and be seen as non-reversible by students. Eventually students may give up and see no room or possibility for recouping their chance of passing. When these grades are unchangeable with no way of readdressing them, students can become frustrated and apathetic. When homework is evaluated for points, students should be given a chance to ask questions and refine the assignment before submission for a grade. Requiring “perfection” and accuracy in mathematics without an opportunity to inquire about difficulties encountered and/or confusion on specific problems is unreasonable and detrimental to learning.

Homework can hinder students’ progress if it promotes misconceptions or misunderstandings of a mathematical process. In turn, solidification of bad habits may result in poor grades or an unproductive attitude. Homework avoidance and resentment may follow (Vatterott, 2009, p. 89).

Many students will purposefully overlook homework assignments if there is not accountability built into the grading system. Providing feedback to students is a necessary and powerful learning tool. Teachers provide feedback to students so the students know what areas they need to improve (Black, Wiliam, 1998). Feedback should be communicated so that the information is useful and the students know how to improve. Proper feedback allows students to know how to improve. Mathematics requires feedback on misconceptions and on computational errors.

It is impossible for teachers to assess and provide feedback on every homework assignment. However, students need to know that assignments matter and are important in
understanding the taught concepts. There are a variety of methods to provide feedback in an efficient way. Teachers may collect homework randomly during the week. Also, they may check off homework at the beginning of the class period. A third option involves students exchanging homework papers for peer evaluation and “pair-share” feedback.

Having students do self-assessment on homework is another efficient and productive method of assessing homework. With student self-assessment, the teacher trains the students to evaluate their own work with the intention of improving and learning from it (Bruce, 2001). Involving students in the assessment and evaluation process can be an essential part of a well balanced assessment. They reflect on their learning, their mastery, and they set goals for themselves. They prepare themselves to ask questions about specific problems and to examine their weaknesses. Additionally, teachers who encourage students to learn from their mistakes and misconceptions show trust and faith in the students’ abilities to take charge of their own learning. Self-assessment keeps students on track, focused and motivated to learn. Motivation includes developing positive beliefs and maintaining confidence when confronted with challenges (Wongsri, Cantwell, & Archer, 2002).

Homework used as a form of formative assessment is a definite motivator for students. Homework is meant to be a vehicle for practice and learning and should lead directly to summative assessments that indicate the level of student learning. Summative assessments are meant to measure student success in the learning of a unit after all instruction and practice has been completed.
Chapter 3: Methodology

The purpose of this Action Research project is to examine the researcher’s own educational practice systematically and carefully using research techniques. As an experienced classroom teacher of over seventeen years, the researcher identified homework assessment as an issue in the overall learning of students. Students often neglect homework assignments for various reasons and learning suffers. The researcher used this action research project to create change and insight into classroom practices. No generalization beyond the spectrum of the researcher’s own school is expected. To accomplish the task the researcher will employ a convenience sample of two sections of Advanced Placement (AP) Calculus in the school year 2008 – 2009. Triangulation was designed into the methodology via three complimentary procedures: 1) a qualitative procedure involving the researcher keeping an ongoing journal; 2) a qualitative procedure consisting of interviews and surveys; and 3) quantitative procedures comparing student achievement and homework completion between the two treatments of assessing students on assigned homework. The final grade in Precalculus (the entry requirement for AP Calculus) will be used as a covariate to account for beginning achievement differences.

Limitations

The researcher realizes the major limitation to the study in that the sample is not a random sample. The classes in the study were the entire population of AP Calculus students at BHS and were selected as a convenience sample therefore the findings and conclusions from this study are limited to the researcher’s own classroom. The effects of confounding variables, such as number of juniors and seniors in each class and students concurrently enrolled in Physics, were minimized by accounting for the students’ previous achievement using their Precalculus grade as a covariate.
Participants

The students participating in the study were in grades 11 or 12, between the ages of sixteen and eighteen, and were enrolled in AP Calculus at Bethel High School (BHS) in Spanaway, Washington. There were a total of thirty-three students in the study with seventeen students enrolled in third period and sixteen enrolled in fourth period. Forty-five percent of the students were male and fifty-five percent were female. Sixty-seven percent of the students were juniors (11th grade) and thirty-three percent of them were seniors (12th grade). Seventy-six percent were Caucasian, nine percent were African American, nine percent are Hispanic and six percent were Pacific Islanders.

At the time of this research, BHS was on a four-period block schedule with ninety minute class periods. Students in AP Calculus were enrolled in the course for both semesters of the school year. Seventy-two percent of the class registered for the AP Examination administered in early May with the intention of earning college credit.

Sampling Procedure

Since this is an Action Research project the researcher used a convenience sampling by designating each section of AP Calculus as a sample of the population. Since BHS offered only two sections of AP Calculus, the sample being studied is the also the entire population of AP Calculus students at BHS. The student population at BHS during the 2008 – 2009 school year was approximately 1200 students.

Research Hypotheses

1. Using a method of assigning and assessing homework that emphasizes the benefits of homework will encourage students to diligently attempt and complete homework assignments.
2. Using a method of assigning and assessing homework that emphasizes the benefits of homework completion will result in higher achievement.

**Statistical Hypotheses**

1. \( H_0: \) There is no significant difference in student motivation towards homework completion when homework is not assessed for points.

2. \( H_0: \) There is no significant difference in student homework completion or achievement when homework is not assessed for points.

**Treatments**

**Assessment of Homework Assignments:** There will be two treatments of assigning and assessing homework. First treatment, students in one section of AP Calculus (third period) will be assigned homework problems with the opportunity to ask questions for understanding and clarity. During the next class, the teacher checks off the homework assignment as completed, attempted, or not done. These assignments are not collected and no points are awarded for these assignments. Following the completion and review of two to three homework assignments, a “Homework Quiz” (Appendix A) will be administered and assessed. The problems on the “quiz” will be exact problems from the homework assignments. Students may use their homework assignments to complete the quiz but are not allowed to use the textbook.

For the second treatment, students in the other section of AP Calculus (fourth period) will be assigned the same homework problems. These students will also be given an opportunity to ask questions on problems for clarity, understanding, and completion. The homework assignment will be submitted in the following class period for assessment and points will be awarded. The same problems on the Homework Quiz for third period will be assessed on fourth
period’s submitted assignment according to a homework rubric (Appendix B).

Both classes are assigned specific problems from the textbook via a chapter syllabus (Appendix C) distributed at the beginning of each chapter. The textbook used was Paul Foerster, *Calculus, Concepts and Applications*, by Key Curriculum Press, 1998.

**Interventions**

The researcher will integrate some intervention measures at the beginning of the term to reveal the overall attitude of students toward homework. There will be a class discussion at the beginning of the term of agreeable and acceptable classroom norms (Appendix D), an emphasis on the homework as a vehicle for learning on the Class Overview and Classroom Expectations (Appendix E), and homework policies addressed within the parent letter (Appendix F). Throughout the term students will be asked to complete exit slip questions (Appendix G), reflect on quiz and examination results (Appendix H), and participate in teacher-student interviews (Appendix I). Parents will also be contacted via e-mails and a discussion regarding homework will be an item on the agenda at Open House in late August.

**Instruments**

**Quantitative Data:** Precalculus, homework, and final grades for the term will be collected along with responses to Student Survey 2.

**Quantitative Statistics:** An Analysis of Covariance (ANCOVA) will be computed to measure the effect of the independent variable (homework treatments) on two separate dependent variables (homework grades and overall grades). To control for the effect of different levels of previous achievement the Precalculus grade will be used as a covariate. An ANCOVA will be a good method of analysis since the dependent and covariate variables are continuous and mostly normally distributed. Performing an ANCOVA will adjust the means on the dependent
variables for the known influence of previous achievement.

The statements from the Student Survey 2 (Appendix J) will be divided into three categories, Student Beliefs, Homework Completion, and Resources. Student Survey 2 was administered at the beginning of the treatment and at the end of the treatment. This survey was tested for validity and reliability in a pilot test the previous year.

Student Survey 2 will also be analyzed using an ANCOVA to determine if there is a difference between the two treatment groups with respect to the three categories of student motivation toward homework. Three analyses will be performed with the dependent variables being the sum of the Likert scores for each category and the treatment groups, and levels of Student Survey 2 will be the independent variable. Precalculus will again be the covariate.

**Qualitative Analysis:** The Student Survey 1 (Appendix K), Student Survey 2 (Appendix J), Parent Survey (Appendix L), and student responses to interview questions (Appendix I) will be compared and contrasted with respect to the two treatment groups.

**Researcher’s Journal:** The researcher’s journal entries will begin on the first day of the school year, September 2, 2008. The journal (Appendix M) will be set up in a binder and a file box for collection of surveys, e-mails, and student reflections. The researcher will make entries on a regular basis. Entries will include observations of students working in class on homework assignments, number of homework questions students ask, and comments students make about their attitudes toward assignments. In order to elicit an understanding of student motivation and attitude, the researcher will ask students specific questions: 1) Do you think your work on the homework assignment attributed to your success on the unit test? 2) Did the homework assignment help you to understand the newly introduced or discovered concept? Students will respond to these questions during individual interviews, group interviews (Appendix I),
reflections (Appendix H) following a test, and class discussions. The researcher will also record and journal the types of homework problems students are not completing and asking questions about. The researcher will focus on question patterns regarding the assigned writing exercises, even numbered problems, application problems, or other types. Weekly follow-up on attendance at the Math Center (Appendix N) and the number of students seeking extra help from the teacher before and/or after-school and during lunches will be included in the journal with comments.

**Surveys:** The results of three surveys, two generated from students and one from parents, will be evaluated and analyzed. The first student survey (Appendix K) will have open-ended questions for student responses. Qualitative data supporting and indicating student attitudes towards the importance and prioritization of homework assignments will be obtained from this initial survey. The second student survey (Appendix J) will be given to students approximately three weeks into the term and will be in the form of a five-point Likert scale. The survey will contain seventeen Likert items divided into three categories: 1) the benefits of doing homework; 2) the completion of homework; and 3) resources to aid in completion of homework. This survey, with no changes, will also be administered toward the end of the semester in order to validate the survey and indicate any attitude changes in students during the term. The multiple-choice parent survey (Appendix L) will be sent via email and through the postal service. This survey will be aimed at parent attitudes and beliefs in the importance and expectations of homework assignments in mathematics. Although the researcher does not anticipate full participation from parents, a significant number of responses are expected. Students were consistently encouraged to return parent surveys.
Chapter 4: Data and Analysis

To analyze the data for the hypotheses of this study we will start with the quantitative data (Appendix P) and proceed to qualitative analysis for each hypothesis. Before analyzing the hypotheses it should be noted that the research assumption, homework completion is related to course achievement, held true in this study. Homework completion was 20% of the overall course achievement grade. The correlation between homework completion and course grade was 0.767 for the study population.

**Hypothesis #1: There is no significant difference in student motivation when homework is not assessed for points.**

A student survey was administered (Appendix J) at the beginning of the term. For analysis purposes, the seventeen statements were placed in three categories; Student Beliefs, Homework Completion, and Resources. Statement #11 was not considered since it did not fit into a category. This survey was created as a pilot study the year before and has been evaluated for validity and reliability with respect to the student attitude and motivation toward homework.

The statements were measured as Likert items. The students were asked to evaluate the statements on a typical five-level Likert scale. The students responded with a level of agreement or disagreement to each statement with five being the highest level of agreement.

To alleviate distortions that can occur with Likert scale surveys, this survey was designed with both positive and negative statements. Statements #5, 13, and 14 were considered negative and were accounted for as such in computations. The item responses were summed to create a group score for each student for each category (Appendix J).
Table 1: Description of Student Survey 2 Statements

<table>
<thead>
<tr>
<th>Category</th>
<th>Positive Statements</th>
<th>Negative Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Beliefs</td>
<td>#1, 2, 3, 4, 6, 7, 8</td>
<td>#5</td>
</tr>
<tr>
<td>Homework Completion</td>
<td>#9, 12</td>
<td>#13, 14</td>
</tr>
<tr>
<td>Resources</td>
<td>#10, 15, 16, 17</td>
<td></td>
</tr>
</tbody>
</table>

The survey was administered to both treatment groups at the beginning of the treatment and at the end of treatment. Table 2 shows the category means for this survey the first time it was given and also shows the means for the second time it was administered.

Table 2: Student Survey 2 – Administered October 16, 2008

<table>
<thead>
<tr>
<th>Number</th>
<th>Student Beliefs Summed Mean</th>
<th>Homework Completion Summed Mean</th>
<th>Resources Summed Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Period</td>
<td>17</td>
<td>28.47</td>
<td>11.65</td>
</tr>
<tr>
<td>Fourth Period</td>
<td>16</td>
<td>29.00</td>
<td>10.63</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>28.74</td>
<td>11.15</td>
</tr>
<tr>
<td>Possible</td>
<td>35</td>
<td>35</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2: Student Survey 2 – Administered January 16, 2009

<table>
<thead>
<tr>
<th>Number</th>
<th>Student Beliefs Summed Mean</th>
<th>Homework Completion Summed Mean</th>
<th>Resources Summed Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Period</td>
<td>17</td>
<td>30.06</td>
<td>12.65</td>
</tr>
<tr>
<td>Fourth Period</td>
<td>16</td>
<td>28.38</td>
<td>11.19</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>29.24</td>
<td>11.94</td>
</tr>
<tr>
<td>Possible</td>
<td>35</td>
<td>35</td>
<td>20</td>
</tr>
</tbody>
</table>

The means of all three categories increased for third period. The means in fourth period increase only in the Homework Completion category. Student Beliefs and Resources decreased very slightly in fourth period.

An analysis of the categories, Student Beliefs, Homework Completion, and Resources, was conducted to assess relationships between the two surveys and the categories. There was a
significant correlation between the survey administered in October and the survey administered in January in the Homework Completion category ($r = 0.744$, $n = 33$, $p < 0.01$, two-tailed). There was also a significant correlation between the October survey and the January survey in the Resources category ($r = 0.652$, $n = 33$, $p < 0.01$, two-tailed). There was no significance between the two surveys in the Student Beliefs category.

The researcher planned to analyze the changes in the students’ motivation toward homework using a two-factor ANCOVA with the second administration of the survey’s category sums as the dependent variable, the first administration of the survey’s Likert scale averages rounded to the nearest whole number (1 – 5) as one factor and the homework assessment method as the other factor. After preliminary analysis the first administration of the survey did not seem to relate with the second administration of the survey for either group. No statistical differences were found when a two-factor ANCOVA with the levels of the first administration of the survey and the treatment groups were the independent variables and Precalculus was the covariate.

A different ANCOVA was conducted with Student Beliefs from the second administration of the survey as the dependent variable and method of homework assessment as the factor with the covariate being their previous Precalculus grade. A preliminary analysis revealed homogeneity of slopes between the covariate, Precalculus grade, and the dependent variable, the second survey Student Beliefs total. The interaction effect was not significant, $F_{(1, 27)} = 2.73$, $p = 0.110$ and the treatment effect was not significant, $F_{(1, 27)} = 3.03$, $p = 0.09$. Since the covariate was not significant an ANOVA was conducted with Student Beliefs from the second survey without the covariate of Precalculus. However, the treatment method of assessing homework was not significant, $F_{(1, 31)} = 1.730$, $p = 0.198$. This may not be statistically
significant but the interaction between the Precalculus grade and Student Beliefs suggests a trend.

A one-factor ANCOVA was conducted with the Homework Completion sum for the second survey, the independent variable, was the method of assessing homework, and a covariate of the students’ Precalculus grade. The results of the analysis were not significant will all $p$ values greater than 0.371.

A one-factor ANCOVA was conducted with the Resources sum for the second survey, the independent variable was the method of assessing homework, and a covariate of the students’ Precalculus grade. The results of the analysis were not significant with $p$ values greater than 0.398.

**Hypothesis #2: There is no significant difference in student homework completion or student achievement when homework is not assessed for points.**

The homework for two classes of AP Calculus were assessed differently and to determine if students’ homework completion grades and overall grades for the term for these two classes were statistically different the researcher used an ANCOVA. Upon first notice, one treatment group’s (homework was collected and assessed) mean grade in the homework category was higher than the other treatment group’s (homework was not collected) by almost 11%. The treatment group’s (homework was collected and assessed) overall mean grade was higher than the other treatment group’s (homework was not collected) by about 3.5%.
To determine if the difference between the groups mean homework grades was statistically significant a one-way analysis of covariance (ANCOVA) was conducted with the Precalculus grade as the covariate. There was not a significant effect of the between treatment groups, $F_{(1, 27)} = 0.39$, $p = 0.54$ but the overall model was significant, $F_{(3, 27)} = 10.45$, $p < 0.01$ and the interaction between the assessment of homework treatment and the Precalculus covariate was significant, $F_{(2, 27)} = 12.48$, $p < 0.01$. The adjusted mean scores suggest that a student’s entry grade from Precalculus as a prerequisite to AP Calculus influenced their AP Calculus homework grade. An underlying assumption of ANCOVA analysis is that the slopes relating the covariate and the dependent variable are approximately the same (homogeneity of slopes assumption). Obviously, in this case the researcher can not make this assumption and will further analyze this relationship by graphing the Precalculus Grade versus the Homework Grade (Chart 1). Consider the graph Homework Grade vs. Precalculus Grade, both treatments representative lines have a positive slope which indicates as the students’ Precalculus grade increased so did the result of their homework grade in both classes. The regression lines are not parallel. This indicates there is some unfairness in the comparison of these two groups. The differences in the completion of

### Table 3: Homework and Overall Grade Means

<table>
<thead>
<tr>
<th></th>
<th>Overall Grade</th>
<th></th>
<th>Homework</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Third Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Not Collected)</td>
<td>15*</td>
<td>79.138</td>
<td>10.463</td>
<td>71.961</td>
</tr>
<tr>
<td><strong>Fourth Period</strong></td>
<td>16</td>
<td>82.649</td>
<td>7.767</td>
<td>82.925</td>
</tr>
<tr>
<td>(Collected)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*There were actually 17 students enrolled in the class. Two students were foreign exchange students with no Precalculus grade available. These two students were not included in the quantitative data.*
homework between the two classes are evident in the spaces between the lines. Fourth period had more incentive to complete homework since it was an actual grade for them. Third period had incentive but it was considered a gamble or a game of which homework problems might appear on the homework quiz.

Chart 1: Precalculus Grade vs. Homework Grade

To determine if the difference between the groups mean overall grades was statistically significant a one-way ANCOVA was conducted. The dependent variable is the students’ overall grade, the independent variable is the treatment of assessing homework, and the covariate is the students’ Precalculus grade. After adjusting for the students’ Precalculus grade, the overall model was significant, $F_{(3, 27)} = 14.58$, $p < 0.01$, but the treatment of assessing homework was not
significant, $F_{(2, 27)} = 20.94, p < 0.01$. The adjusted mean scores suggest that a student’s entry grade in Precalculus also influenced their AP Calculus overall grade. Just as was discussed earlier in the homework grade analysis, an underlying assumption with an ANCOVA is that the slopes relating the covariate to the dependent variable are the same for both groups. If this assumption is violated, then between-group differences in adjusted means are not interpretable. Consider the graph Precalculus Grade vs. Overall Grade (Chart 2).

**Chart 2: Precalculus Grade vs. Overall Grade**

Again both representative lines have a positive slope which is indicative that as the Precalculus grade increases so does the overall grade in AP Calculus increase. The slope of the treatment group’s line is greater than that of the control group. Since the slopes are not equal, it
is obvious there is an interaction between the Precalculus grade and levels of the factor. Is there an explanation for this result? Many students in fourth period (treatment group) were also enrolled in Physics (only offered third period). Obviously, students in third period (control group) were not enrolled in Physics. Physics is considered a rigorous and high level course and attracts students who are college bound and serious about education and their success. Was fourth period “smarter” to begin with? Did they come together as a class that was destined to do well even without the incentive or treatment of collecting and assessing their homework assignments? From the researcher’s observations, experiences, and journaling, it can be surmised that the answer is “Yes”.

There is an obvious outlier in Chart 1 for fourth period and it is definitely affecting the slope and the $r^2$ value of 0.20385. Notice the lower percentage grades in Precalculus for third period are producing higher homework grade percentages than those in fourth period but as the Precalculus grade percentages get higher the differences between third and fourth periods gets smaller. This difference does suggest a trend in the relationship between Precalculus grades and homework grades.

Looking further at Chart 2, there is no statistical difference since the regression lines intersect. The $r^2$ values do indicate an interaction with Precalculus. The slope for fourth period is higher than third period indicating that the completion of homework helped the students get a higher overall grade.

Further analysis of the treatment group and the control group were done qualitatively. Student Survey 1 (Appendix K) was administered at the beginning of the term and elicited open-ended responses from students. Approximately sixty-eight percent of fourth period responded they were willing to attend study groups, while fifty percent of third period responded positively.
Interestingly enough, 45% of the student in third period responded that they “Nearly Always” complete their homework assignments while 42.1% in fourth period choose that response.

A parent survey (Appendix L) was sent out at the beginning of the term. A total of sixteen responses were returned, eight from each class. There were no apparent differences in the responses from parents between third and fourth periods. Overall, the parent responses were positive and supportive of homework being assigned to their students on a regular basis. Eighty-eight percent from both third and fourth periods responded that they “rarely to never” help their student with math homework.

Researcher/Teacher-student interviews (Appendix I) were conducted towards the end of the term. The researcher/teacher was the facilitator and many student-to-student conversations and discussions occurred as well as questions and responses from the teacher and students. Most of the questions were aimed at both classes and the responses recorded in the researcher’s journal. There were, however, questions directed at specific classes. For example, fourth period students were asked, “Was having to submit the assignments an incentive to complete it and to be ready with questions the day before the assignment was due? The majority of the class responded with a resounding “YES!” Third period students were specifically asked, “Were the homework quizzes an incentive to make sure your assignments were completed and accurate?” The majority of the class answered “Yes”, but there were also answers such as “Not really.”; “I started to slack since I knew there was no due date.”; and “I took my chances that the problems I didn’t do would not be on the homework quiz.”. This thinking and practice was obvious to the researcher/teacher in observations and notations written in the journal.
Chapter 5: Conclusions and Recommendations

The researcher carefully compared two methods of assessing homework using two different AP Calculus classes. The differences between the two classes of AP Calculus were analyzed with respect to the students’ motivation to complete homework assignments and the homework and overall grades earned at the end of the term.

Conclusions

Both the homework and overall grades means for fourth period AP Calculus (assessed by collecting and grading each homework assignment) were higher. The statistical analysis of the homework grades mean (Third: 71.9%; Fourth: 82.9%) and the overall grades mean (Third: 79.1%; Fourth: 82.6%) did not reveal a significant difference between the two classes because of the interaction of their previous achievement (Precalculus grade). This statistical interaction of the Precalculus grade on the homework and overall grade suggested that the students’ previous academic achievement is more important than how the teacher assesses homework, but it does not indicate that the grading of homework does or does not increase achievement. Quantitative analysis revealed that the grading of homework did increase homework completion and overall achievement.

Different methods of quantitative and qualitative analysis of the student surveys and interviews were used to determine if there was a difference between the two classes with respect to student motivation to complete homework. These results were not statistically significant but the trend of the students’ Precalculus grade interacting with student beliefs toward homework suggests there is a relationship between students’ previous achievement and their beliefs about homework. The quantitative analysis revealed that students were more aware of their homework patterns and overall abilities when the homework assignment was actually assessed.
To draw a conclusion concerning the method of assessment is difficult. A definite trend to better grades with the collection and assessment of each homework assignment is apparent. The researcher/teacher views this as a dilemma. The number of papers collected and assessed can be overwhelming and daunting when a teacher has five classes with up to 34 students per class. The method used to assess the control group, homework quizzes, produced much less paper shuffling and time spent on assessment. Even though the researcher/teacher is completely dedicated to student learning, there is an element of timely feedback and teacher workload to consider in order for the best decision to be made. Class size and the level of the course should be considered before a method of assessing homework, that fits both the teacher limitations and the student needs, can be decided upon. The researcher believes an accountability system for homework assessment must be in place to motivate and give incentive to students.

The researcher believes fourth period started the course as a better prepared group of students, evident by their Precalculus grades and their concurrent registration in Physics. Students of this caliber may be predisposed to doing their homework no matter what method the teacher has in place. The researcher believes both the quantitative and the qualitative data points to the definite possibility to this conjecture.

**Recommendations**

The researcher’s highest priority is student learning. All planning, rules, activities, and actions are directed at student learning. Homework assignments should be intentional and are meant to promote student learning, especially in an AP Calculus course. The final goal in AP Calculus is, of course, learning, but for most students and their parents, their sites are set on passing the AP Calculus examination in early May. To pass this rigorous test, students must be disciplined and focused on the content and applications of calculus. To learn and truly
understand any branch of mathematics takes study and practice. This is especially true when students move to higher levels of mathematics. Many analogies have been made from playing sports or musical instruments, to that of learning mathematics: practice is the path to expertise and proficiency. Learning mathematics is a skill and an art. From the researcher’s observations and journal entries it became evident that students who practiced (completed homework assignments) were better prepared for assessments and performed better overall with reference to their final grade for the term. As a teacher in a typical high school classroom, the researcher has decided that calling homework assignments by a different title might alleviate the negative connotation that is associated with the word “homework”. Thus, the researcher has decided to change the title to the “Homework” section on the Course Overview and Classroom Expectations to “Practice Assignments”.

All of the interventions performed during the term were effective. Responses on the reflections indicated students had become more aware of the importance of completing their homework and the consequences of not doing the assignments. Insights into student understanding of a lesson and the direction of the next lesson were obtained from the exit slips, interviews, and class discussions. Class discussions, quiz and/or test reflections, parent contacts, exit slips, chapter syllabi, and individual conferences will be a continued practice of the researcher.

**Further Research**

More research is definitely called for in the arena of practice assignments (homework), as shown by this Action Research Project and also from the Review of Literature. Many factors are involved in the success of a student in any course. Those factors all play together to make a student who they are and how they learn. Being cognizant of student needs and flexible with
student issues is the teacher’s duty and responsibility. Making homework purposeful, goal oriented, applicable to in-class activities and doable is an adoptable philosophy to influence the completion of practice assignments.
REFERENCES


