Action Research Proposal

Can I Help Students More Accurately Self-evaluate Their Mathematics Understanding and Use This Knowledge to Improve Test and Quiz Performance?

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Introduction

Over the course of the last five years, I have seen students who have demonstrated real understanding of problems and concepts during homework and class discussion take a test or quiz and they are unable to show their understanding in an unsupported situation. In some cases the pressure of taking a test causes test anxiety. In other cases, the student is not motivated and does not put forth their best effort on the assessment. A third situation that I have found in some students is that they really thought they were prepared for the assessment, however, when it came time to take the test, they really didn't understand the material as well as they thought.

For many of these students, preparation for a test or quiz consists of looking over their notes or reviewing their book, but never really doing a thorough self-assessment of their own understanding. They look at example problems that are completely worked out step-by-step for them and while they may understand the steps when they are presented to them, they are unable to complete the work themselves without support. This type of review at best does not help students to focus their effort and at worst often leads students to overestimate their ability and their preparedness. They often do not know how or cannot accurately self-assess how well they understand specific topics or specific types of problems.

The question that I will be addressing with this research project is: Can I help students more accurately self-evaluate their own understanding and skill to improve their test preparation and potentially improve their test and quiz performance? My goal is to determine if the direct instruction and feedback that I provide students can help them more accurately judge their own understanding and then use that information to improve their test preparation and performance.

Literature Review

A common experience for most classroom teachers is to have a group of students who appear to show conceptual understanding in a supported context but when asked to demonstrate understanding when unsupported (i.e. test or quiz), they are unable to adequately show that understanding. There are several factors that play into how a student performs when unsupported. One such factor is the level and quality of preparation for tests and quizzes. Unfortunately, students are often unable to accurately judge their ability and level of preparedness before a test (Ramdass, & Zimmerman, 2008). The result can be inadequate review or a complete lack of effort in preparation. According to Ramdass and Zimmerman (2008), the effect is more pronounced in low-achieving students as these students are less accurate and more overconfident in their abilities than their higher-achieving counterparts.

Calibration refers to the comparison between one's perceived performance and one's actual performance and, if inaccurate, can diminish student motivation and learning (Ramdass, & Zimmerman, 2008). When students are overconfident in their abilities because of inaccurate calibration, they do not prepare for tests and quizzes because they do not feel that they need to. According to Labuhn, Zimmerman, and Hasselhorn , "Those who overestimate their performance are not likely to spend the required effort to accomplish a task; they may neither engage in effective comprehension monitoring nor deploy appropriate strategies. Moreover, they may be unwilling to change their study methods" (Laubhn, Zimmerman, & Hasselhorn, 2010, p. 176).

Research indicates that students can and should be taught how to accurately judge their own understanding and thereby improve their performance on tests and quizzes. According to Ramdass and Zimmerman (2008) students can benefit from instruction on what they do and don't know. In fact, much of the research ties accurate self-assessment to improved performance and learning. Noonan and Duncan (2005) suggest that accurate self-evaluation leads to improved achievement which, in turn, positively impacts motivation and persistence to complete tasks. They go on further to say that, "Self-assessment training was more effective than coaching, relative to content of examinations, due to the focus on general self-assessment skills for 'real life' that became student-driven with the teacher acting as facilitator" (Noonan & Duncan, 2005, p. 2). Julianna Csongor also states that, "Adolescents must be taught to assess their own performance realistically with respect to given standards and use this knowledge for optimal learning" (Csongor, 1992, p. 636).

Accurate self-evaluation has also been linked to increased self-efficacy in students which plays an important role in student motivation. According to Ramdass and Zimmerman (2008), when students accurately evaluate their own capabilities or progress in learning a concept and take steps to improve their understanding, they feel more confident that they can handle new tasks and set higher goals.

Methods for improving calibration include direct instruction in how to self-evaluate as well as outcome feedback that may motivate students to monitor their own progress and improve their confidence (Laubhn, Zimmerman, & Hasselhorn, 2010). I will be using a combination of a direct instruction intervention and a feedback and monitoring system that will encourage students to take responsibility for their own learning. To encourage self-regulated learning, students will track their own performance by graphing their results and reflecting on any trends (Laubhn, Zimmerman, & Hasselhorn, 2010). Another important aspect of improving calibration is to impress upon students the importance of self-monitoring and to deal with the misconceptions that students have about self-evaluation. According to Rolheiser and Ross (2003), students often think that self-evaluation is simply giving themselves a grade without comparison to

defined criteria. Along with giving students a definition of self-evaluation, students need to be shown how self-evaluation can be used to improve performance by comparing their current performance to the performance required to meet stated goals.

Laubhn, Zimmermand and Hasselhorn (2010) discuss a method for quantifying and documenting calibration in individual students. In their study, ninety fifth grade students were given 8 math problems initially in a pre-test and after instruction, in a post-test. For both the pre-test and the post-test, students were asked to indicate how confident they were that they solved the problems correctly after completion. Students used a 9-point scale ranging from 1 = "definitely not confident" to 9 = "extremely confident". These values were then compared to problem solving performances scores ranging from 1 (0 problems solved correctly) to 9 (8 problems solved correctly). To generate a bias score, the problem solving performance score was subtracted from the self-evaluation score provided by the student. A positive bias score indicated overestimation of ability while a negative score indicated an underestimation. A score of zero indicated and accurate estimation. This is a validated method for capturing data that is very difficult to quantify, and I will be using a similar method to identify a target group and to quantify calibration levels in my students.

While most of the current research supports the importance of self-evaluation in math education, students may not identify self-evaluation as an important piece of their learning process. Some students may not want to evaluate their work out of fear that they may not measure up, while others may not want to do the work required. Prior research also outlines unfavorable results that can result from student self-evaluation. In one study of 11th grade math students, student self-evaluation resulted in decreased motivation and a subsequent decrease in academic performance. While interviewing students in the treatment group about the self-evaluation process, Ross, Hogaboam-Gray and Rolheiser (2001) found that students did not feel that evaluating their math skills was a worthwhile endeavor since the teacher would be able to determine their skills after grading their paper, without their own evaluation. They did not see the value in evaluating their own performance and comparing it to a goal to develop a plan of improvement. Students also felt that evaluating their own skills caused them to focus too much on their weaknesses. Self-evaluation showed students that they didn't understand the mathematics they were trying to learn even though they were working hard. Students believed that they did not possess the ability to be successful in math. Some students responded by reducing effort to protect their self-esteem while other students altered their plans to take advanced math in the future.

All of the reviewed research supported the importance of accurate student self-evaluation. The next step for teachers is to find ways to help students improve their accuracy and to translate improved accuracy into improved performance.

Description of Research Context

The school where my research will be conducted is a small rural high school with approximately 830 students. The school contains grades 9-12 and is not racially diverse with 93% of the students being white, 3% Hispanic, 3% black, and 1% all other races. Approximately 33% of the students at this school are eligible for free or reduced lunch. The total number of students in the district K-12 is approximately 2800 and this is the only high school in the district.

The study will be conducted in the Algebra Skills A math class that I will be teaching fifth hour during the second trimester of the 2011-2012 school year. The Algebra Skills A class is designed for students who are at least one grade level behind in math skills. Some of the students in this class were not successful mastering this content during 8th grade while other students were not exposed to this content at this level of difficulty before this class. The students in this course will be 9th graders.

The primary learning target for this course is solving equations with one variable so I will be conducting the study during that unit. The learning target is broken into six learning objectives: 1) solve a one-step equation with one variable; 2) solve a two-step equation with one variable; 3) solve an equation with one variable that involves distribution; 4) solve an equation with one variable that has variables on both sides of the equation; 5) solve an equation with one variable that involves combining like terms before solving; 6) solve an equation with one variable that combines distribution, variables on both sides of the equation and combining like terms. This unit is taught for mastery and may take from four to six weeks depending on the skill level of the group of students. The unit will be taught using Holt Algebra 2, Chapter 2 curriculum materials.

I will be targeting a group of students to work with during this project. In order to select the students who are least accurate at assessing their own understanding level, I will be using a pre-test containing material that all students in the class had been exposed to before. For each problem in the pre-test, students will be asked to indicate how confident they are that their answer is correct. Their perceived level of accuracy will be judged against their actual level of accuracy to determine their bias score as indicated in the Methods/Treatment section of this proposal.

I will be selecting students who overestimate their abilities for this study and will not be limiting the number of students in the research group. Once a group of students has been identified, I will conduct a survey with those students to determine their level of interest in participating in the study. In order to accurately demonstrate the success or failure of the intervention used in this study, participants in the research group must be interested in improving their test and quiz performance and willing to work at making that happen. Students who express an interest in participating will be included in the

research group. Because of this selection process, it is not possible to determine the exact number or gender of the participants involved.

Methods and Treatment

This research project is an experimental intervention type project. I will be selecting a target group, training them on how to evaluate their own knowledge and understanding, and then monitoring their progress both in terms of the self-evaluation skills and academic performance in my class.

I chose to approach this project as an intervention because of the previous research I found on the subject. Much of the previous research that I reviewed approached self-evaluation in students as a skill that can be taught to and learned by students. It is not an innate or natural ability that students cannot acquire. Noonan and Duncan described self-assessment as, "a skill to be developed in high school students and that training in self-assessment may have a positive effect on students' school performance. Students can be taught to make choices about how to respond to the presented material at their own developmentally appropriate pace" (Noonan & Duncan, 2005, p. 2). And, according to Julianna Csongor, "Some people have a natural ability for self-assessment and others do not. However, I believe that this skill, just like many other skills, can be developed in students" (Csongor, 1992, p. 636).

Selecting a Target Group

In order to select a target group of students for the study, students will complete a pre-test (Appendix 1) using simple math concepts that they have learned in previous courses. Students will answer each question on the pre-test and their work will be scored using the following rubric:

Table 1: Problem Scoring Rubric

Score	Description
1	Less than 25 % of the steps and solutions have no mathematical errors or the student did not attempt to answer the problem.
2	Some (25-49%) of the steps and solutions have no mathematical errors.
3	Several (50-84%) of the steps and solutions have no mathematical errors.
4	Almost all (85-99%) of the steps and solutions have no mathematical errors.
5	100% of the steps and solutions have no mathematical errors.

For each question the student will also provide an evaluation of how confident they are that their answer is correct. Students will circle the number that corresponds to their level of confidence based on the following confidence levels:

Table 2: Student Confidence Evaluation

Score	Description
1	I feel completely unsure that my answer is correct.
2	I feel a little sure that my answer is correct.
3	I feel somewhat sure that my answer is correct.
4	I feel mostly sure that my answer is correct.
5	I feel extremely sure that my answer is correct.

For each problem of the test, a bias score will be calculated using the following formula:

$$bias = student\ confidence\ score - problem\ score$$

A positive bias would indicate that the student overestimated their performance and felt their answer was correct even though they did not answer correctly. A negative bias would indicate that the student underestimated their performance and felt that they were incorrect even though their problem score indicated that they were correct. A bias value of zero would indicate that the student had correctly estimated their performance level. I will calculate an average bias for the pre-test and students with an average bias of +4, +3, or +2 will be targeted for inclusion and will complete the Interest Survey (Appendix 2) to determine their interest in participating in the study. Students who express an interest in their survey will make-up the research group.

Intervention

Once the target group has been selected, I will work with the group of students to help them improve their self-assessment skills. I will be using both direct instruction prior to an assessment as well as feedback after the assessment.

While preparing for an assessment, students will be given a group of problems relating to each objective on the assessment. They will be asked to try the first problem for the objective they are working on without any support. Once the student has completed the problem, the student and I will discuss how the student felt while working on the problem and the student will predict how they performed on the problem using the problem scoring rubric in Table 1. The student will be asked to indicate which steps of the problem he or she feels may be incorrect and why. I will also score the problem using the problem scoring rubric in Table 1 and compare my score to the student's score. The student and I will repeat this process with this objective until the student and I both feel confident in the student's ability to complete problems for this objective without support. The entire process will be repeated until all of the objectives are completed.

In some cases, the student may not be able to complete or even start the problem without support. If the student should indicate that they need support, they will be encouraged to use their book, their notes, or any resource other than the teacher to proceed with the problem. Once the problem is complete, the same procedure as listed above will be followed. If the student is unable to attempt the problem after using other resources, I will provide additional instruction on the topic and the process described above will be followed.

There are several goals related to the intervention portion. The first goal is to provide a concrete framework in which the student can gauge his or her level of preparedness. When the student first attempts the problems in the intervention without support, it should give him or her an immediate sense of how well prepared he or she is to do a problem like the one presented. Another goal is to help the student make an immediate connection between how they feel while working on the problem and how they performed. This connection can be useful in targeting the appropriate content to review as well as the amount of review necessary. Finally, a third goal of the intervention is to give students ample opportunity to practice evaluating their own understanding.

Post-test and Feedback

After the direct instruction listed above, students in the research group will take a short quiz (example in Appendix 3) over the objectives covered during that session. Again, students will be asked to give a self-assessment for each problem using the

student confidence values in Table 2 and I will score the problems using the scoring rubric in Table 1. An average bias score will be calculated for the quiz. Students will track their own progress by graphing their individual quiz bias scores throughout the course of the study on the Student Bias Graph worksheet (Appendix 4). After each quiz, the student and I will review the Student Bias Graph, discuss how to use the results to direct their preparation efforts and set goals for the next quiz.

The goals of the post-test and feedback portion are three-fold. First, the post-test provides me an opportunity to assess where the student is at with regard to self-evaluation. It gives me quantifiable data to review to determine the progress of the student. Second, by having students graph and track their own data, they are more involved in the learning process and are more likely to reflect on their progress versus a specific test score. According to Labuhn, Zimmerman and Hasselhorn (2010), "students who graphed their learning outcomes showed a significantly greater awareness of learning progress and even a significant improvement in their actual learning" (p. 177). Finally, reviewing student progress, directing their preparation efforts, and setting goals will help keep the student motivated to improve their performance.

Data Collection

The intervention and feedback processes will be iterative over the duration of the unit. Because of the nature of the unit, learning goals 1 and 2 will be completed together with several possible intervention/feedback loops depending on the needs of the students. Learning goals 3, 4, 5, and 6 will each be completed individually with several intervention/feedback loops likely necessary for each goal.

The initial data that will be collected will be the problem solving scores, student confidence scores and bias scores for the pre-test. During the intervention portion of each loop, I will collect written student work as well as audio recordings of conversations between myself and the student. During the post-test and feedback portion, I will again collect problem solving scores, student confidence scores and bias scores as well as audio recordings of feedback and goal setting discussions. Research group member's scores will also be collected for homework, tests and quizzes that occur outside the scope of the research. A final source of data will be my own observations and reflections which will be recorded in my personal research journal.

Analysis

Student Confidence Scores, Problem Solving Scores and Bias Scores

Bias scores calculated from student confidence scores and problem solving scores collected on the pre-test and mini quizzes will be used to show how accurately

students judge their own ability. This method of determining student calibration as a measure of student self-assessment accuracy was validated in research conducted by Ross, Hogaboam-Gray and Rolheiser (2001) and again by research conducted by Labuhn, Zimmerman and Hasselhorn (2010). It is a reliable method as all students will be tested the same way and scores will be generated using defined rating scales.

Written Student Work

During the intervention students will have the opportunity to work on problems addressing the current objective and provide their own prediction for their problem solving score. They will also provide written feedback on their work as to which steps of their work are incorrect and why they feel that way. I will also score their work. This data will be used to better understand how students are assessing themselves, their level of accuracy at scoring themselves and provide opportunities for specific individualized instruction on improvement areas. Data generated from student work is valid because it is student reported and meets the research purpose of determining how students evaluate themselves. It is reliable data as scoring will be done according to the defined rating scales.

Homework, Test and Non-research Driven Quiz Scores

As the students in the research group will also be members of a larger class, they will also be completing the same assessments that the rest of the class. These assessments will include formative assessments such as homework and quizzes as well as summative tests. These assessment scores will be used to determine how the students in the research group are performing with regard to the content in general.

Audio Recordings and Teacher Journals

During the intervention and feedback sessions with the student, audio recordings will be made to capture student thinking regarding self-evaluation. I will also collect my thoughts about and reactions to these sessions in a journal that will be used to provide anecdotal evidence of outcomes that occur during the project.

For each student in the research group, a table will be generated showing their bias socres and problem solving scores over the course of the research. From the table, I will create scatter plots of bias scores over time and problem solving scores over

time. For each scatter plot, I will do a least squares regression to generate a line of best fit. From the lines of best fit, I can make observations on trends over the course of the research.

I will also create a table and scatter plot for each student recording their non-research assessment scores as well as the class average on that assessment. I will again generate a scatter plot for non-research assessment scores and a scatter plot for the class average and conduct a least squares regression to determine the lines of best fit. To determine if there is a statistically significant difference in the slopes of the two lines of best fit, I will analyze the data using the ANCOVA analysis outlined in Larsen (2002).

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Appendices

Appendix 1 – Pre-Test

The following pre-test will be used to select the target group for the study. Students with a bias score of +4, +3, or +2 will be asked to participate in the study.

Name:_____

Complete the following problems showing all of your work in the space provided. When you have completed the problem, please circle the value that represents how sure you are in your final answer according to the following choices.

Score	Description
1	I feel completely unsure that my answer is correct.
2	I feel a little sure that my answer is correct.
3	I feel somewhat sure that my answer is correct.
4	I feel mostly sure that my answer is correct.
5	I feel extremely sure that my answer is correct.

	How sure are you that your answer is correct?
1. Using a factor tree, give the prime factorization of 126.	1 2 3 4 5
2. Find the greatest common factor of 15 and 27.	1 2 3 4 5

How sure are you that your answer is correct?

3. Find the least common multiple of 15 and 18.

1 2 3 4 5

4. Simplify the following expression:

$$-4^2 + 24 \div 3 \cdot 2$$

1 2 3 4 5

5. Solve the following equation for x:

$$3x + 2 = 8$$

1 2 3 4 5

Appendix 2 – Interest Survey

This survey will be used to determine which students with bias scores of +4, +3, or +2 are interested in participating in the survey.

Name:_____

Student Interest Survey

1. In general, what are your thoughts about your math abilities and skills?

2. What level of confidence do you have in your math ability?

3. How do you prepare for a test or quiz in math class? How well does this method work to prepare you for the test or quiz?

4. Do you usually do as well as you expect to on tests or quizzes? If not, why do you think that is?

5. I am researching a new way to help students prepare for tests and quizzes. With this method you would learn how to evaluate yourself and decide how well prepared you are for the test. You would also learn how to target the specific things you need to study. Would you be interested in being part of the group of students who learn this new method? Please share your thoughts on your interest in this study.

Appendix 3 – Post-Intervention Quiz

The following is an example of a quiz for learning objectives 1 and 2 that will be used to track the student's progress at self-evaluation. Along with the student's evaluation, I will score the quiz and a bias score will be calculated for each problem. An average bias score will then be calculated for the entire quiz and tracked over the course of the research.

Name:_____

Learning Objectives: 1) I can solve a one-step equation with one variable.

2) I can solve a two-step equation with one variable.

Complete the following problems showing all of your work in the space provided. When you have completed the problem, please circle the value that represents how sure you are in your final answer according to the following choices:

Score	Description
1	I feel completely unsure that my answer is correct.
2	I feel a little sure that my answer is correct.
3	I feel somewhat sure that my answer is correct.
4	I feel mostly sure that my answer is correct.
5	I feel extremely sure that my answer is correct.

	How sure are you that your answer is correct?
1. Solve the following equation for x: $x + 5 = -3$	1 2 3 4 5

How sure are you that your answer is correct?

2. Solve the following equation for x:

$$x - 6 = 8$$

1 2 3 4 5

3. Solve the following equation for x:

$$3x = 12$$

1 2 3 4 5

4. Solve the following equation for x:

$$\frac{x}{8} = -4$$

1 2 3 4 5

5. Solve the following equation for x:

$$2x - 5 = 9$$

1 2 3 4 5

Appendix 4 – Student Bias Graph Worksheet

The following is a worksheet that students will use to graph their bias scores. They will fill in both the table and the graph to track their own progress.

Name:_____

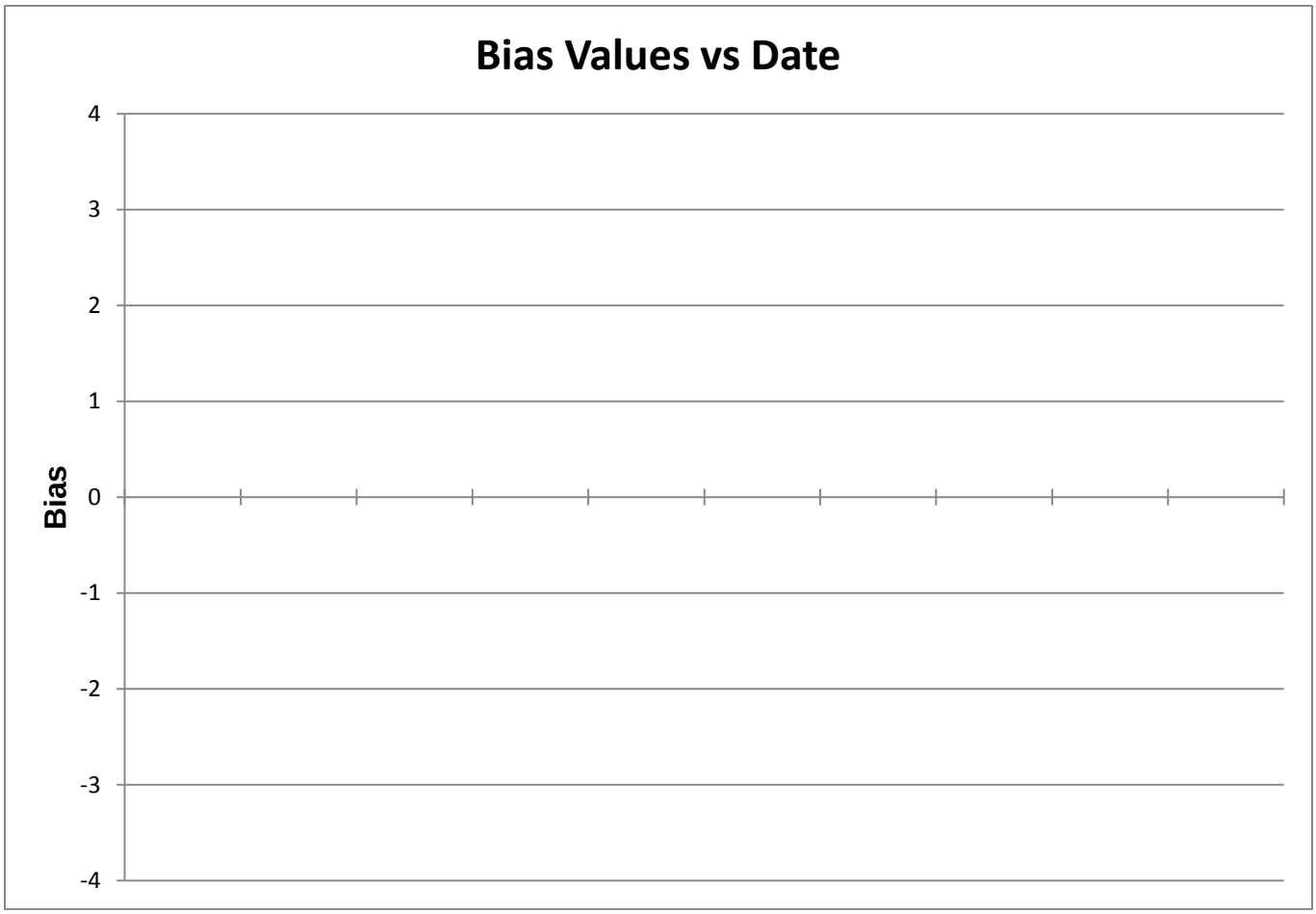
Please record your bias score on the pre-test as well as the date and bias score for each quiz you take as part of the research project. Once you have recorded your score in the table, plot your score on the graph on the back of this sheet.

Table

Date	Bias Score
Pre-test	

Graph

Plot your data on the graph below. Use the date for your x-axis labels.



Appendix 5 – School Permissions and Informed Consent

While my district does not have any specific protocol for conducting classroom research, before beginning my research, it will be important to have all of the main stakeholders on board. I will discuss my research with my Principal and with our district Curriculum Director to be sure that they will approve of and support my research plan. I will also send the following letter to parents/guardians to inform them of the project and to ask for their permission to include their student in my research.

Dear Parent/Guardian,

My name is Cristine Fisher and I am your child's Algebra Skills A teacher this trimester. I am looking forward to helping your student have a successful trimester and lay the foundation for future success in math.

During my five years of teaching Algebra, I have seen that many students do not know how to accurately judge their own preparedness when studying for tests and quizzes. The result is students who do great on homework but don't perform as well as they expect to on tests and quizzes.

I have developed a method to help students judge how prepared they are and then use that information to focus their study efforts and will be conducting research to determine its effectiveness during your student's class. I have discussed the research with the class, and your student, among others, has expressed interest in participating in my research. However, in order for him/her to participate, I need your written permission. If you are interested in having your student participate in this research, please fill out the form below and return it to school with your child.

Feel free to contact me via email or telephone should you have any questions.

Thank you,

Cristine Fisher
Math Teacher
Allegan High School
cfisher@alleganps.org
269-673-7002 ext. 5096

Student Name:_____

The above named student has my permission to participate in the research project regarding student self-evaluation conducted by Cristine Fisher in Algebra Skills A.

Parent Name (print):_____

Parent Contact Information (phone or email):_____

Parent Signature:_____

Date:_____