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Producing More Problem Solving by Emphasizing Vocabulary

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ABSTRACT

In this action research study of my Algebra 1 and Algebra 2 classrooms with ninth to eleventh grade students, I investigated word problem completion while emphasizing vocabulary. A word wall was implemented along with notes organizers, vocabulary sheets, and written definition during class. Data was gathered about attempts and completion of mathematic word problems on daily assignments, quizzes, journals and tests. Through observation of student work, surveys, interviews, and in class word problem journals, I discovered that many students are least likely to do word problems on assignments, then tests, and most likely to complete word problems on a quiz. As a result of this research, I plan to clarify expectations and emphasize vocabulary more purposefully for each student, as many students were indifferent to the word wall.

I. INTRODUCTION

The purpose of my action research was to determine if emphasizing vocabulary would result in an increase in word problem completion. I become highly frustrated when word problems are often neglected and not completed on assignments and assessments. I have a few ideas as to why students would do this that are addressed through the rubrics on the homework.

In my ideal classroom, students would be motivated to learn with a peaked curiosity of how all math concepts fit together. Since becoming a part of Math in the Middle, I learned that more meaningful and situational problem solving benefits students and often allow them to learn more deeply and cohesively. For this reason, I assign more word problems through the text I use than I previously have. Multiple students come in before school not even comprehending or understanding the word problems. Other students in the halls realize nobody in their group of friends understands it either, thus they choose to leave it completely blank. I know these problems and the solving processes involved are very important and I want all students to competently complete these problems. However, I find myself doing the problem while a few pay attention and learn one problem at a time.

This study is important to me for several different reasons. This could show me how beneficial emphasizing vocabulary is for my students. Could it increase student ability to understand word problems and then complete them? Many of my students would much rather just skip the words and complete an explained algorithm of steps to solve an explicit question. My administrator was expecting a word wall in every room. This research project could show that the time spent creating and implementing a word wall was is well worth it. My concern is that students will still not learn meaningful mathematics and will be oblivious to the mathematics surrounding them through this process.

II. PROBLEM STATEMENT

For education in general, this action research project hoped to show that making changes to incorporate more meaningful and rich in contextual mathematics would influence student performance. Teachers need to be certain students work with the knowledge they are gaining and apply it, so the information becomes a part of the long-term memory. In order to apply the information students must understand the mathematical terms used to describe and explain the process. Hopefully students will realize that teachers are not merely concerned about a correct response and sometimes the process is more important, even if a mistake is made. I believe students need to be challenged and held accountable for their thinking.

The NCTM process standards specifically address the importance of problem solving. Obviously this problem of practice deals with problem solving. Each student needs to be able to apply his or her mathematical knowledge in another context. The other four process standards are also involved in problem solving. Students must make connections between concepts and be able to apply math in the real world possibly using representation as a part of the strategies and reasoning to verify their solution, which must be communicated somehow. Problem solving solutions communicated precisely show an understanding of the situation, problem and mathematical ideas involved. These standards more likely come forward when a teacher probes students asking how they came up with a certain answer or why they took a specified step or approach.

III. LITERATURE REVIEW

Problem solving has become an area of emphasis for national mathematics standards. In order to solve a word problem, students must be able to read and understand the situation, then be able to make a plan. Poor reading comprehension and low vocabulary inhibit students' ability

to begin attacking a problem. A review of some literature involving achievement related to vocabulary and problem solving shows that this need for improvement is ongoing. Several authors noted how students and teachers communicate mathematics with its effects on mathematical comprehension. The issues causing trouble as supported by research include reading comprehension, mathematic vocabulary, vocabulary strategies, communicating mathematics, and problem solving.

Reading Comprehension

Schools all around the United States are constantly working to improve student learning and achievement. One focus already in place is reading and writing across the curriculum. Students will model what they hear and read in their writing. However, for students not reading on grade level, their success will be difficult to document. Seven schools in Iowa had students in grades 3, 4, 5, and 6 participate in a study associated with the University of Iowa. Paul of Profiles Corporation, along with Nibbelink and Hoover (1986) used readability formulas to assess word problems requiring the same computations below, on and above grade level. The study showed that students were unable to discern what information was needed and how to use the information. Overall, the students did not excel at any grade level or reading level. Even when only the minimal basic information supplied, two years below grade level, students were unable to identify the problem or solve the problem. Blessman and Muszczak (2001) researched the effect vocabulary has on reading comprehension in solving word problems. Blessman and Muszczak stated “students often search the problem for numbers rather than attempting to comprehend what is truly being asked in the problem” (p. 28). Fifteen and twenty years later, students are still unable to read a word problem and comprehend the message to solve the

problem. Sadly, students often believe they must rely on the order of the numbers alone to determine how to solve a word problem.

Fletcher (2004) conducted an action research project in Mobile, Alabama, studying how reading and vocabulary affect gifted Algebra 1 and Precalculus students. Fletcher's students would read the text and take comprehension and vocabulary quizzes. Many students struggled at first with the change in routine, but were good, motivated students whose scores improved, demonstrating a deeper understanding of the mathematical concepts. With all the language involved in mathematics, students experience overlapping vocabulary in various contexts throughout the day. Kotsopoulos (2007) made a list of sixty mathematical terms and counted their usage during 300 minutes of classroom discussion. On average, an identified term was used once every twelve seconds. When students were asked about these terms students had difficulty explaining mathematical terms upon inquiry and occupied much of the interviewing time trying to exhibit understanding.

Whether students are unable to read and comprehend a word problem is related to many ideas. After attempting to read and solve a word problem unsuccessfully, several students developed their own strategy of discarding all words, looking solely at the embedded numbers. Fletcher (2003) attempted to amend that strategy by giving quizzes and emphasizing vocabulary. Today's classrooms are very rich in mathematical vocabulary, as noted by Kotsopoulos (2007), and need to continue this development to avoid further confusion. Ultimately, I want to be sure that my students can read and understand a word problem before going on to the next step.

Vocabulary

In 1997, Yeryshalmy studied 35 seventh grade beginning algebra students in Israel. He was piloting a new curriculum called *Visual Mathematics* and using some computer software

called *The Algebra Sketchbook*. Yeryshalmy found that through discovery the students who were able to proficiently describe the concepts and terms were able to show it through the use of *The Algebra Sketchbook*. Many students were able to find the relationship between terms with numbers, words, graphs, and symbols similar to the level that a traditional teacher would demonstrate.

Schoenberger and Liming (2001) carried out a research project with sixth grade general mathematics and ninth grade special education students at two different sites. They recommend teachers challenge themselves and students with higher expectations in learning, vocabulary, and explanations. Schoenberger and Liming taught a specific list of vocabulary. They stated, "Students should be able to use and understand vocabulary in order to think about and discuss mathematical situations" (p. 27). Students must possess proficient means of communication before being immersed in the language of a word problem. Both sites demonstrated a positive effect from the vocabulary implementation through different activities. Blessman (2001) studied 42 fifth grade students and 15 fourth and fifth grade teachers. According to some surveys, all involved students commented that they would rather learn concepts and vocabulary more in depth than a breadth of material. Also a few students would like to leave the word problems out altogether as they know those problems are more challenging. The teachers wrote on their surveys that the students had a poor mathematic vocabulary and the text does not reinforce the vocabulary as much as the computations.

Vocabulary can be very challenging, especially within the context of mathematics. Many words used in mathematics are also used in daily conversation with different meanings. The resulting confusion of multi-use words halts student learning. "A student's inability to successfully minimize interference can potentially undermine his or her ability to learn"

(Kotsopoulos, 2007, p. 302). My research intended to show that further emphasizing and teaching vocabulary will clear the interference and allow students to better communicate mathematics through all medians. Yershalmy (1997) used technology to teach vocabulary. Students learn best through discovery, even the terminology and teachers need to continue challenging students whether they like the work or not (Blessman, 2001). Since teachers have more experience and know more about what is best for student learning they make this decision on delivery and engagement..

Vocabulary Strategies

Several strategies to emphasize vocabulary were suggested and shown in the research I reviewed. Holden (1999), in an opinion article, elaborates on several vocabulary activities: grouping, association, visual, physical and a word chain method. Grouping often occurs naturally within the text with terms being related to a common concept or process. Association of similarities and differences is one way of linking mathematical terminology to pre-existing knowledge. Visual and physical strategies get students more involved and the level of engagement is directly related to the amount of material learned. Students are to use a visual picture or a physical motion to coincide with each vocabulary word. These pictures and motions may be related to the meaning of the term, the spelling or some other connection. Making a word chain is a great way to get multiple exposures with a larger word bank on the wall. The last letter of one word must also be the starting letter of the next (Holden, 1999).

Roti, Trahey and Zerafa (2000) conducted an action research project while at Saint Xavier University of Chicago Illinois. Data was collected from a total of 37 special needs students in the multi-age fifth and sixth grades documenting that reading and vocabulary

contribute to the problem solving success challenge. A couple of vocabulary development ideas used in their study include: concept maps, graphic organizers, and modified cloze activities.

The research by Blessman and Myszczak (2001) was intended to show vocabulary growth. The information on the pre-test and post-test show an increase of about 15% for each research site after vocabulary and comprehension activities were implemented. Students ranked themselves as being highly knowledgeable about the vocabulary as opposed to initial responses of average or low.

Rubenstein (2007) is a professor of education at the University of Michigan - Dearborn, working with pre-service teachers and graduate students. In an informative article, she gives a few strategies to teach vocabulary. One suggestion is that teachers use the etymology of mathematical terms, and how they are related to everyday words. Another strategy is to draw a picture and be sure to repeat the new terms while teaching vocabulary. Rubenstein shared a few informative examples that illustrate how these strategies will help students make connections among words to better understand them, rather than just memorize definitions. Another strategy is to wait until after the concept has been introduced or discovered and then inform the students on the name of the process or term.

As a mathematics teacher I had never given much thought to holding students accountable for their mathematical language. As I emphasized vocabulary with hopes to improve student achievement strategies implemented for this focused instruction come from Holden (1999), Roti (2000), Blessman (2001) and Rubenstein (2007). If only one strategy is implemented students will become bored; I want an entire box of strategies to pump up their knowledge.

Communicating Mathematics

In an ever-changing world, methods and strategies used to communicate mathematics continue to evolve as well. Many researchers use journals and written language to monitor students' progress. Yerushalmy (1997) notes that the use of *The Algebra Sketchbook* would support many classroom situations and allow students to communicate through words, or graphs or computers if they choose. Technology does not necessarily inhibit students' abilities to communicate mathematically. In fact technology often requires students to communicate more as the computations are done by the calculators (Fletcher, 2003).

Teachers must continue to clear the line of communication in mathematics. "Language is a major medium of teaching and learning mathematics; we serve students well when we support them in learning mathematical language with meaning and fluency" (Rubenstein, 2007, p. 206). Teachers must first patiently model mathematical language around students and allow students to fully understand where each term fits within the concepts discussed. Students will do much better in the mathematical world once they master the language.

Vocabulary is an essential element in the language of mathematics. Being able to complete computations is meaningless without the ability to discuss its implication within a situation. Regardless of including technology, students will benefit society more with an ability to communicate mathematics.

Problem Solving

The National Council of Teacher of Mathematics (2000) continues to emphasize the importance of problem solving. More students are being challenged with open-ended mathematics questions to actively problem solve. Franke and Carey (1997) researched the perception of 36 first graders about mathematics. After being given several problems students

were interviewed about what it means to be a good problem solver. The students expressed their opinions that being good at mathematics is not just about getting the right solution the fastest. Students refer to peers as good problem solvers because they used a good strategy and they worked hard regardless of a correct answer. Only nine students even mentioned that the correct solution was important. These ideas may be perceptions on the way because of reform mathematics where the process is emphasized more than the outcome. “The children in this study have helped us to see what it means to engage in mathematics, especially in classrooms where problem solving is the focus of instruction” (Franke, 1997, p. 24). I know problem solving needs to be a larger focus within my classroom and wonder what my classes will be like when that happens.

After receiving more help with language comprehension and problem solving activities, teachers of special education students observed a marked improvement with accuracy in problem solving and doing so independently (Roti, et al., 2000). The Illinois Standards Achievement Test has changed to emphasize vocabulary comprehension and problem solving including a detailed written explanation including the used strategy (Blessman, 2001). Schoenberger and Liming (2001) implemented their own problem solving acronym ODDE. This stands for Own Words, Draw, Do work, Explain. Students are asked to use this to encourage them to show work and then a table followed for them to explain the steps and why.

The first step to being a good problem solver includes doing the problem. The shift in open-ended problem solving has become more evident and thorough explanations are expected verbally and often written. Several teachers have their own algorithm to help students complete the step to problem solving similar to Shoenberger and Liming (2001).

Conclusion

Overall, emphasizing vocabulary and the effect it has on problem solving has been found to improve student learning. A student's lower reading level may lower their achievement; however, through vocabulary activities and clarification of meanings students will be able to interpret word problems more successfully. My thought process is that my students need to comprehend and communicate the overall question contained in a word problem. If necessary, they need to translate alternatively between everyday word usage and mathematical terminology as Kotsopoulos (2007) describes. Similarly, I have a list of important vocabulary words to monitor and teach using strategies suggested from Holden (1997), Roti (2000), Schoenberger (2001) and Rubenstein (2007). The age of students for my study is closely related to the students form Fletcher's (2003) study. Even though many of the studies I referred to were for grades five through seven, the information supplied is still very helpful for my research. The topics reading comprehension, mathematics vocabulary, strategies for vocabulary acquisition, communicating mathematics and problem solving are related to improve student performance on word problems. I want students to solve word problems after emphasizing vocabulary with improved effort.

IV. PURPOSE STATEMENT

The purpose of my action research project was to observe if emphasizing vocabulary would increase students' ability to communicate mathematically and attempt word problems. In my Algebra 1 and Algebra 2 classes, I examined variables including:

- the percentage of students in each course who complete word problems on assignments / tests
- the percentage of word problems proven correctly on tests
- the amount of vocabulary activities

- the amount of visual math vocabulary words surrounding the learning environment

These variables were addressed as I searched for answers to the following research questions:

- What will happen to the number of word problems students are willing to attempt after receiving vocabulary instruction?
- What factors can students identify as reasons they do not attempt word problems?
- How does my teaching change as I emphasize vocabulary?

V. METHOD

For this action research, before a chapter would begin, I made a list of vocabulary terms that were important or new for all students. As these words were introduced I would often point out the words on the wall and use them at the beginning of class while I handed back corrected and graded work. In Algebra 2, students were required to fill out vocabulary sheets a few times and give and example with the definition.

At the beginning of the spring semester, January 4, 2008, I had students complete a survey online with a likert scale for choices of Strongly Agree, Agree, Indifferent, Disagree, and Strongly disagree and then again on April 11, 2008 with an additional question (Appendix A). I collected information from interviews with two groups, one of three Algebra 1 students and the other consisted of three Algebra 2 students with various abilities (Appendix E). The first interview was on February 15, 2008 and the last on April 16, 2008.

Intermittently, I collected a rubric on the homework anonymously to have students indicate how hard a word problem on their homework was, whether they completed the problem, and check the reason(s) why or why not, with the option of listing another reason (Appendix B). My goal was to have a weekly rubric, however with state standard testing, several days were without homework. These assessments, graded as quizzes, were not included as a quiz in the

research as students must answer all questions or the computerized system would not submit their answers. The first homework rubric was collected on January 10, 2008 and the last rubric was on April 10, 2008. The rubrics were also used to tally word problem completion as other assignments, quizzes and tests. In class, students were to write a journal once a month that included a word problem; students were to write about their problem solving process (see Appendix C for student journal format). At the bottom of the journal was a place to list three recent vocabulary words. For some students this was the only time they used the word wall. These collections were kept in separate folders for each piece and Algebra 1 was kept separate from Algebra 2.

I kept a daily journal from January 3, 2008 through April 11, 2008 with a few prompts where I noted what went well, poorly and if anything particularly interesting occurred. On Fridays I tried to mention the highlights from the week. Had I written more fluidly daily rather than making notes, my journal would be more cohesive (see Appendix D for journal prompts). I often included differences in my teaching as something interesting, or unexpected remarks from students.

I also used a spreadsheet to keep track of totals on the rubric choices being able to show the two courses and combined, similar with the percentage completed and survey results (Appendices F and G). This allowed me to see any chronological, categorical and combined implications.

VI. FINDINGS

Throughout the research period I often had a question on the board for students when they arrived. This would even include asking an Algebra 1 class to draw an inconsistent system of lines. Time at the beginning of class was when students completed the rubric, before they

knew if the word problem was correct or not. After the tasks were addressed and verified, we would begin to correct papers. Students corrected their own homework, and usually I had students share answers as we go around the room. If three students in a row did not have an answer, I would read the solution and emphasized that we may need to see that problem worked out after the remaining answers were shared. I often assigned between 15 and 20 algebra problems, but only graded four or five of them myself. Daily homework was worth five points and for completed assignments students earn 60% for doing the assignment and I did not worry if they corrected they papers accurately or not.

Students were notified of any quiz or test days in advance. A quiz consisted of five problems worth two points a piece and possibly a bonus. Tests usually had 20 questions with one or more bonus questions. Students were often given a quiz after homework had been corrected and the homework due that day was not on the quiz.

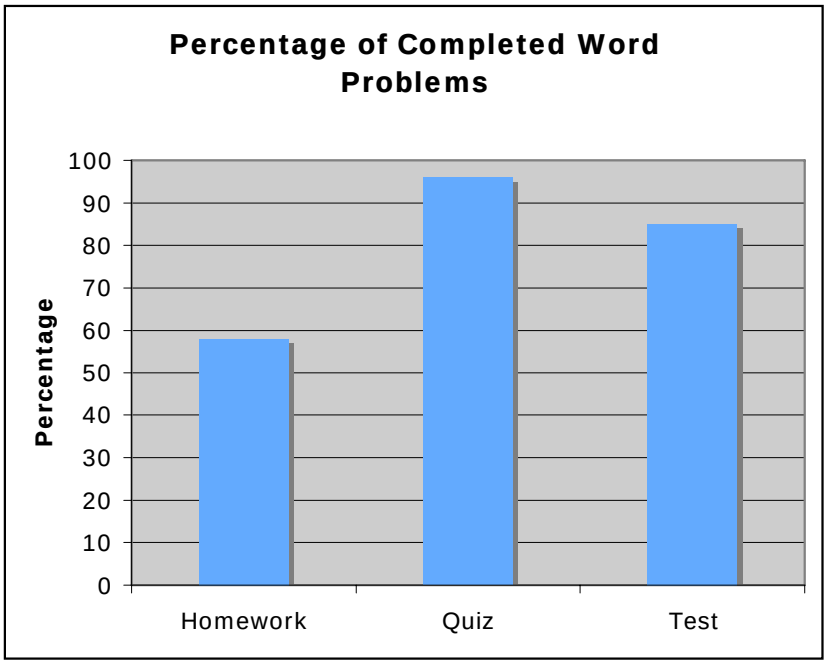
Once everybody turned in the quiz, we discussed the next topic and may or may not have assigned homework. During the discussion, I wrote out definitions on the board or overhead for students to see and copy into their own notes or vocabulary sheet. These mathematical vocabulary words were often associated with words in other context or built upon past vocabulary and gestured towards the wall to point out the relations. Some vocabulary words were defined or described orally. I showed the word on the word wall and arranged the words to show connections with other vocabulary terms. After the needed words were shared, I showed some problems and explained the process and steps included. Students then had an opportunity to complete a couple exercises on their own and then get the homework assignment due the next day.

Tests are given in a class period. Knowing some students are poor test takers and some

are poor test preparers, I normally allowed students to return until 4pm that day to complete their tests if they wanted additional time. I almost always had all regularly handed in assignments graded before class the following day so students received prompt individual feedback.

What will happen to the number of word problems students are willing to attempt after receiving vocabulary instruction?

Students completed word problems most on quizzes, then on tests and least on homework. The percentages found for completion in the graph below were 57.8% on daily homework with a standard deviation of 22.3%, 95.9% on quizzes with a standard deviation of only 3.75%, and 85.1% on tests with a standard deviation of 10.7%. I recorded a completion percentage on a single question a total of 36 times. In Chapter 12 of Algebra 2, all questions on the quizzes and test were word problems, so rather than report 35 problems I only recorded the lowest on each and all were between 95% and 100% completed. The work for this chapter showed increased completion on tests and quizzes while homework fluctuated from 50% to 100%. (See Appendix F for raw data)



In my journal on February 11, 2008 I noted “Some Algebra 2 students were complaining about writing out the definition while others admitted to just guessing, knowing they will likely get a point for trying on the test.” I noticed that often on the homework they would just leave an assigned problem blank without even trying. In the student journals, often the same words were listed as both confusing and helpful. Students still agreed that those were keywords, but not all knew how to utilize the word to help solve the word problem. The vocabulary completion was also sparse; even the students who suggested we needed more vocabulary never did that portion of the journal.

Staying after school with a teacher and not being in trouble is unusual for many high school students. During interviews some students appeared uncomfortable and did not really offer many comments. In a first interview a student in Algebra 1 answered the question “Why do you think that I am focusing on teaching math terms and vocabulary?” with “so we can better understand the words when we are reading.” In the second interview another Algebra 1 student answered, “so we have more options on a test.” Most students interviewed in Algebra 1 and Algebra 2 mentioned that they only used the word wall when directly asked and they think having the word wall will help them remember the words later on.

The overall influence of the vocabulary could not be seen in direct relation to word problem completion. I expected to see a difference between the Algebra classes, since all the word problems and concepts being taught were different. However, I did not find this. An increase in word problem completion was expected, but was not substantially supported in my findings.

What factors can students identify as reasons they do not attempt word problems?

A few findings presented themselves for reasons students do not attempt word problems. My original idea was that students did not make time to complete homework assignments because the word problems often occur towards the end. On the rubric this choice was added and turned out to be the most popular option by Algebra 2 students. Overall many more students in Algebra 1 marked that they did not know how to set up the problem. First I am going to talk about students not being able to comprehend the problem, thus unable to set up or know how to solve the problem.

In my journal on March 26, 2008, I noted a conversation with a male Algebra 2 student who has intentions of entering the Navy if he improved his ASVAB scores.

> While working with his recruiter they discovered that he has a lack of comprehension and an inability to set up the equations. He is unable to solve problems with multiple sentences but if the recruiter sets up the equation he can solve it fine.

While I have not officially heard about the Navy, I am thankful that somebody was able to take more one on one time to work with him. This same situation concerning comprehension could be true with several other students.

I noticed on the rubrics that often students marked that they did not understand the question and they were unable to set it up. Looking at a handful of rubrics from April, I noticed students marked that they did not like word problems and indicated the reason was that they were confusing; however, they did not indicate which specific words were confusing, which was the third choice on the rubric. The most commonly checked reason marked by any algebra student was not knowing how to set problems up, 121 times out of a total of 423 rubrics marked the problem was done attempted. Not knowing how to set up a problem was also the most common

among the Algebra1 students, accounting for 81 of the marks out of 260 unattempted Algebra 1 opportunities. This is exactly the factor I would hope going over vocabulary would address.

The pre and post survey data showed that the students understand knowing how to solve word problems is important, as the top choice was agree on both surveys by,42 out of 90 students in January and 34 out of 81 in April. Algebra 2 students remained to feel indifferent that vocabulary helps them understand word problems better while the Algebra 1 students increase agreement from 18 in 49 in January to only 19 in 46 in April. Several parts of the survey showed students were indifferent to the questions and an overall decrease was common. I think part of this could be that the first survey was conducted in the first two days of the semester and some students may not remember their tendencies so soon after a break, while in April students were able to draw on more recent experiences.

My other main contention that also accompanies the first research question is that students do not always have or take the time to complete assignments and word problems. On a rubric, a student marked that the problem was not done because he or she does not like word problems. Beneath was a space to state why, here the reason was because they take too much time. Not having enough time to complete assignments was the second most common reason overall on the rubrics with 89 marks, 43 of them from Algebra 2 students.

The data collected from the surveys showed a drop in homework completion, and attempting all word problems particularly. In January, 32% disagreed or strongly disagreed with always attempting word problems and 52% said the same in April. To accompany this information, in April 38 of 81 agreed or strongly agreed that assignments were completed and 59 said they had enough time on tests and 58 have enough time on quizzes. However more checked strongly agree on quizzes. During the last interview with the Algebra 2 students, one boy who

had said previously in the year “We need to do vocabulary or something” said that paying attention and actually doing the work would make him a better math student. Interestingly on the student journals this student placed question marks on the lines for vocabulary and that was all.

Several students concurred that word problems are important and admitted to submitting incomplete work. Poor reading comprehension inhibited at least one student from being able to set up the problem. This was likely true for other students according to the rubric although not specifically stated. Another common factor indicated by students was a time constraint for daily assignments. Word problems are valuable, but unfortunately even those who realized the importance did not possess all the skills needed to complete the process.

What happens to my teaching when I emphasize vocabulary?

As I emphasized vocabulary my teaching included more mathematical vocabulary and more regularly. The increased technical terms were a byproduct of the word wall and definitions. The installation of a word wall was useful for anticipatory sets and reviewing concepts. On March 7, 2008 I noted in my journal “The students do look at the word wall or at least know it exists. Yet few students know the meanings without referring to notes or the glossary.” Many students did not notice the word wall for a few weeks and the words were not clearly visible to the each student per his or her location and physical limitations of the classroom. The word wall became more than a list of words and more of another place to express relations. A week later I wrote that “more arranging and comparing vocabulary and concepts with the word wall. Permutation / Combination. Probability / odds. Square of a sum / square of difference/ product of a sum and a difference” for some comparison. A word wall was just another opportunity to present concepts and show students important mathematical vocabulary.

The mathematical vocabulary was emphasized through multiple strategies. The Algebra 1 students took notes and made graphic organizers, while the Algebra 2 class had a vocabulary sheet to turn in with definitions and examples to write for a grade. The Algebra 1 organizers served as a student dictionary when the definitions and examples were written on the board. Prior to my action research, I just gave the definition orally, if at all, and did not require students to take notes. On March 25, 2008 “I had students each write their own definition for prime a the beginning of the Algebra 1 classes” according to my teacher journal. Writing definitions forces me to think more carefully about the specific definition I intend to use for various courses.

Vocabulary began to change how students and I communicated mathematics. In my journal on January 11, 2008 I wrote “So far I have words on the walls and I find when I see them I use them more readily and point them out as a visual reference of importance.” More precise and accurate communication from me made me a better and more definite teacher. I constantly found myself thinking of new connections between topics and debated if I should unveil the relationship or allow my students the same opportunity to discover the connection on their own. The topics do not need to be related for the concept to be learned and I am withholding the additional information that could be a shortcut, more confusing for students, or a mnemonic link.

As a result, next year I will write definitions out for students and require regular vocabulary work in some form. I have become a more technical and thorough teacher when I emphasize vocabulary. My assessment of my teaching showed a positive influence through the communication and understanding about becoming more informed of behind the scenes happenings within the classroom.

VII. CONCLUSIONS

It appeared from the data that the amount of available time is related to word problem completion. The complication with finding a direct relationship to vocabulary was that the vocabulary words learned with a concept were not often the words contained in word problems. Vocabulary may help students communicate mathematically with peers to make progress. According to Schoenberger and Liming (2001), students must understand the vocabulary in order to think about mathematical situations such as word problems. Another study, Nibbleink and Hoover (1986) showed students with poor vocabulary could not identify necessary information. I think of the senior boy trying to get into the Navy and his recruiter helped identify the reasoning behind the scenes. Nibbleink and Hoover indicated that this student likely reads below grade level. Through emphasized vocabulary and various activities, students understanding and use of these terms should increase. Ideally high school graduates are more prepared and knowledgeable based on experience and retained information.

Time and grading policy appeared to be influential factors of mathematics word problem completion. Quizzes were shortest with the most time per question and guaranteed grade. Tests were longer but students still know all problems will be graded and how many points would be deducted for leaving a question blank. Students should also be able to reason that attempting a problem will earn partial credit. Daily assignments did not guarantee each problem will be graded and the involved students have little time around school activities and practices to complete all homework in each class.

IX. IMPLICATIONS

As a teacher I may shorten assignments or give word problems the following day after the process has been discussed. My thoughts are to continue to stress the importance of word problems and keep assignments about the same, then perhaps students will work hard and meet the challenges I place before them. I know I needed to implement strategies as suggested by Rubenstein (2007) better with a more detailed plan. I anticipate keeping the word wall and varying its usage. I like the grading policy but may state next year in the grading policy that one word problem will likely be graded on each assignment. Students will share how they came up with an answer so other students can see the process modeled by a peer, not just me. I also plan to continue vocabulary sheets or puzzles to encourage more vocabulary usage. Reflecting upon my teaching shows more areas for improvement than can honestly be tackled in a single year.

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Appendix A

Mark one box for each of the following statements.	**Strongly Agree**	**Agree**	**Indifferent**	**Disagree**	**Strongly Disagree**
I like math.					
I am good at math					
I often help explain math to other students.					
I complete all assignments.					
It is important to know how to solve word problems.					
I always attempt all word problems.					
I like having a word wall.					
Using the word wall is helpful.					
Learning vocabulary helps me do my homework.					
Learning more vocabulary helps my understand word problems better.					
I have enough time to complete the tests.					
I have enough time to complete quizzes (last survey only)					

*** conducted as an online survey with button choices for each answer**

Appendix B

Rubric for word problem _____

One a scale from 1 through 5, where 5 is the hardest, circle the difficulty of this problem.

1 2 3 4 5

Did you complete this problem?

If not - check the reason(s) why.

☐ I don't like to do word problems. **Why?**

☐ I did not understand what the problem was asking.

☐ The words in the problem were too confusing?
The words I did not know were:

☐ I did not know how to set up the problem.

☐ I could not think of a way to solve the problem.

☐ I did not have time or forgot.

☐ Other (please explain):

Appendix C

Student Journal

(Leave a space for the problem to be pasted before copied.)

What is the main question or task to complete?

What words if any make this problem confusing to understand?

What words if any gave you an idea on how to solve the problem?

Describe the process you used to solve this problem?

List three mathematical words you learned this month, what each word means, and an example of each word.

1._____

2._____

3_____

Appendix D

Teacher Journal Prompts

Research Questions:

- What will happen to the number of word problems students are willing to attempt after receiving vocabulary instruction?
- What factors can students identify as reasons they do not attempt word problems?

Daily Journal:

I was pleased with the progress my algebra students are making because today:

I was displeased with the progress and learning in algebra today because:

I found it interesting when:

Weekly Journal

How do the incidents from daily journal relate to overall word problem completion?

How do they relate to the factors impairing students from problem solving?

What went well this week relate to my problem of practice?

What did I learn this week about vocabulary instruction and usage?

Appendix E

Student Interview

What part of math do you like the best?

Name a math skill you feel good about or enjoy.

Name a word used in math. Can you explain it to me?

Why do you think that I am focusing on teaching math terms and vocabulary?

Why do you think I have posted a lot of vocabulary words on the wall for math class?

As I think about how much to focus on vocabulary next year in my math classes, what advice would you give me? (last interview only)

What helps you to become a better math student? Why? (last interview only)

Appendix F

Rubric data *red denotes the lowest of multiple word problem on one graded work*

Completion Alg 1	Completion Alg 2	
HW		
83	44	
64	24	
69	79	
75	100	57.78571429
24	60	22.33532329
43	50	
23	71	
55	60	
54.5	61	
22.64004038	23.071318	
QUIZ		
100	94	
93	100	
	90	
	95	95.90909091
	91	3.753785968
	100	
	97	
	100	
	95	
96.5	95.875	
4.949747468	3.80058475	
TEST		
85	88	
83	100	
62	90	85.11111111
	83	10.72898463
	80	
	95	
76.66666667	88.2	
12.7410099	7.420691792	
overall	overall	
66.077	81.7424	

Appendix G

RUBRIC Factors								Totals
Algebra1								
1. I don like word problems	4	2	4	8	5	8	3	34
2. I didn't understand the question.	7	5	13	14	17	8	3	67
3. Some words were confusing	1	0	2	4	1	3	0	11
4. I don't know how to set it up.	8	11	12	18	15	15	2	81
5. I could think of a way to solve it.	3	6	11	13	13	11	2	59
6. I did have time or didn't complete the assignment.	4	4	4	6	6	16	8	48
other				6	1		4	
Algebra 2								
1. I don like word problems	4	8	12	4	2	6	0	36
2. I didn't understand the question.	2	1	11	2	1	1	0	18
3. Some words were confusing	0	1	2	1	0	0	0	4
4. I don't know how to set it up.	4	4	18	8	3	3	0	40
5. I could think of a way to solve it.	4	1	14	7	1	3	0	30
6. I did have time or didn't complete the assignment.	8	12	6	5	5	7	0	43
other				6				
Altogether								
1. I don like word problems								70
2. I didn't understand the question.								85
3. Some words were confusing								15
4. I don't know how to set it up.								121
5. I could think of a way to solve it.								89
6. I did have time or didn't complete the assignment.								91
other								17