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Increasing Conceptual Learning through Student Participation

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Abstract

In this action research study of my 9th grade Algebra I classroom, I investigated the idea of presenting problems at the beginning of class. Data was collected to determine if presenting problems at the beginning of class would have an effect on students' conceptual learning, verbal communication and confidence. It was also my intention that this project would have a positive impact on my students both academically and mentally with increasing their confidence with mathematical problems. I discovered that presenting problems at the beginning of class did impact my students' overall abilities and achievement. It seemed to improve their volunteerism in class, confidence in working out math problems, working with other students during class time, and overall academic achievement. As a result of this study, I plan to continue to present problems at the beginning of class. Some data may need to be collected to determine if this method needs adaptation for different students' capabilities, but it is useful in improving students' overall mathematical communication skills, speaking abilities and academic achievement.

As a participant of Cohort 2 in the Math in the Middle Institute Partnership, which is a program specifically aimed for middle school teachers to improve mathematics education, we were instructed to incorporate an action research project with one of our classes. I teach seventh and eighth grade mathematics and Algebra 1 at a Catholic Middle/High School in a small town in Nebraska. I have taught these grades for the past six years. During the past year, I taught two sections of seventh grade math, one section of eighth grade math, one section of eighth grade Algebra, one section of ninth grade Algebra and one section of seventh grade computer keyboarding. I selected my section of ninth grade Algebra in order to focus on my action research. I selected this section for a few reasons. This group was in my classroom for ninety minutes a day since we have block scheduling for the high school. The group had ten students in the classroom so I could incorporate all the students into the project at more times. Finally, the students were at about the same ability level.

Each year at our school we strive to incorporate improvement. We have an ongoing improvement plan that states different areas which need to be improved. I wanted to improve conceptual learning in my classroom by having students present problems at the beginning of class. I also wanted the students to increase their mathematical vocabulary while explaining how a problem is being solved. By having the students present these problems on a daily basis, I looked for increased mathematical vocabulary, increased conceptual learning of solving problems and an increased interest in speaking about mathematics.

Since I was the researcher for this project, I spent some time speaking to the students about this project. I told them of my expectations, my anticipations, and my excitement to have them in this role of explaining mathematics to the other students. I told them that I had chosen them out

of all my classes, and they were also to be excited and not apprehensive about being in this project. They seemed to be excited to start the project as soon as possible.

Problem Statement

There are probably many areas in which my teaching can be improved. After some reflection I came up with three areas that I would like to improve. First, my students need to be more active in the classroom. This would mean physically getting up in front of the class and presenting a problem or a solution to a problem. Second, I feel sometimes my students are bored and need to be included in the daily lecture. Third, it would be nice for the students to review a problem or two from the previous day. After thinking about these issues, I could combine them into one problem. I would like to see my students more active by improving their confidence by presenting solutions and explaining their strategies to the class.

From my own experience in Math in the Middle, when the class first started in the summer of 2005 and the instructors asked us to go up and present a problem, I was not confident at all. There were times when I just prayed that they would not call on me unless it was a problem in which I was confident my answer was right. I have never had to “present” a problem that I was not comfortable with during my teaching career or during my college or high school years. As a teacher of middle school, even now I am teaching concepts with which I am comfortable, but I am getting more at ease with stepping out of my comfort zone and doing more with my classes. I wanted that for my students also. I wanted my students to be comfortable with talking about math, and knowing more about “how” a problem is solved and being confident about talking with their peers about how to solve a problem. I also wanted them to feel comfortable with not always being right and looking to others for assistance to gain more knowledge.

In my present classroom, the students do more explaining of solutions than before. They do more explaining of solutions, problems on the board/overhead/slate boards and review with more hands-on activities. The current state is not enough. I want them more involved with presenting and explaining solutions to the other students.

I had many questions; I asked myself concerning this problem. How can I improve my lessons to incorporate students? I can improve the lessons by having the students go up to the board and solve a problem. They could also solve a problem on the little white boards they have in their desk. How much can the students benefit by being more involved? When a student is actively engaged in the classroom they are paying more attention and are observing a lesson. When they are paying attention, they have a better chance of understanding the concept that is being taught. At which point of my lesson can the students be involved? The students can be involved at different times of the lesson. The students can be involved at the beginning of the lesson by showing a review problem from the previous day's assignment, during the lesson by working through a problem or at the end by reviewing what they had just learned. I chose my students to be involved at the beginning of the lesson.

I also need to look at who will be selected to be involved in these lessons. How do I choose which student to be involved? I like to incorporate all my students, so choosing was random and included all students. Could this method improve math understanding if I involve students? When students are included in the discussion, they are paying attention during that time. Could the understanding of a concept be more thorough or complete if the students are involved in the lesson? The students that I worked with have shown that understanding of a concept is accomplished when they are involved in the lesson.

Time is always a question when planning these lessons. Can I make time during my lesson for this involvement? I made time at the beginning of my class to present problems. Would it improve their confidence of speaking or speaking about math or hinder it? The students improved significantly in their speaking and vocabulary about mathematics. Do I have single students present or should I do pairs? Should I start with pairs and then go to single students? I chose to do both pairs and individual presentations.

Finally, the students ultimately look for the grade. How do I grade these presentations, or do I grade? How do I set up a rubric for grading if I do grade these? Do I grade only the presenter or the presenter and the class for their responses? I chose to grade only the presentations and the written work the students turned in using a rubric that I set up (see Appendix E).

There are plenty of questions to ask myself concerning this problem. My biggest problem would be time. Is there time to involve the students? Also how much time do I give the students? I found there is time to involve the students. The presentations given by the students were of significant importance to my classroom.

There are possible interventions that made this goal of having a student present solutions and explaining their strategies possible. I had thought about selecting students the day before, give them a problem, and expect them to be ready at class the following day. We would start class with a problem presenter. The grading or not grading was another question. If I do not put a grade to this, I felt the students would not do the research or the problem to the best of their ability because nothing is being tied to the whole issue. I wanted the students to complete the problem to the best of their ability without being afraid of being right or wrong. I especially wanted the presenter to be asked questions or accept comments on their problem. I wanted them

to be able to take the questions or comments and confer back to the students. I did not want them to feel stranded since I was in the classroom. I wanted to be the last resort if they got into a pinch and could answer the question or comment. The goal of all this was to really make the students responsible for completing the problem, being ready to display the solution and also fielding questions or comments from the other students in the class. This presentation would show me the understanding of the concept behind the problem, if they were able to present, explain and answer questions. The answer of who benefited from this would be both the student and the teacher. The student benefited by understanding the concept given and the teacher knew, by the presentation, if the student comprehended the concept. If necessary, the teacher may need to explain the concept again for comprehension.

I realized that I needed to research this more and see the benefits or downfalls of this solution to my problem. I just knew from my own experience that I like to know ahead of time what to present and also what is expected of me. I also liked having more confidence even though I did not have that confidence at first, for example, last summer. I also realized that I will not conquer all the fears that the students have, but I felt that giving them a chance to participate more in the classroom, not being at their desks all the time, thus decreasing their boredom, and also listening to their peers is something that I liked to see more in my classroom. The students listened to me day in and day out and probably would like a change. After this change, though, were a review of a concept, an improvement in speaking skills, an increase in responsibility, and more student involvement in my classroom. This was something that I felt was one problem in my classroom that I felt could stand some improvement.

The purpose of this study was to see if having my students present solutions to problems is beneficial to my classroom. Considering my current state of my classroom, which

needs to be more student-involved, I enjoyed seeing the students more engaged in their work. I felt this study was important because it made me aware if my students understood a concept. It also helped the students to be responsible for learning and explaining a solution to a problem. What I did have to ask myself was: Did my students benefit from this study? Did I make the study a good experience for my students? Did I have the time to make this study complete? What happened if this study did not start off well, could I change/fix the problem/study? Would I see a better understanding of mathematical concepts after the end of the study? These are all important questions that needed to be researched before starting this study.

Literature Review

Scenario

"Just give me the formula, and I can work the problem." How many times has this statement been heard? Students, today, want shortcuts to get homework finished without actually knowing why or how they worked the problem. With an increasing number of students who are at different learning levels in our classrooms, it is important for us to use methods of teaching that will hopefully reach all or most levels. Do we teach for procedural learning or conceptual learning? Most students prefer procedural learning because they do not want to know the "why" behind the lesson. Eisenhart (1993) studied eight seniors at a K-8 education program at a university. The program concentrated mostly in mathematics. "Teaching mathematics for understanding is one of the hallmarks of current reform efforts in mathematics teacher education" (Eisenhart et al., 1993, p. 8). However, in order for students to understand the lesson, they need to know the "why." In order for a student to be able to recall how to work a problem, understanding is a key element.

Challenge

Many educators face this dilemma of teaching for understanding. “However, there is evidence that procedural knowledge, specifically rote knowledge of rules and algorithms, is emphasized in most schools and that teachers devote much less time and attention to conceptual knowledge” (Eisenhart et al., 1993, p. 10). Sure it would be easier to teach for procedural learning; to give out the algorithm and let the students calculate. Therefore, our challenge is to create a classroom that involves conceptual learning that promotes learning appropriate goals that can hopefully lead to understanding the concepts.

A Review of Related Literature

There is a significant focus on problem-solving in mathematics. There is a lot of research involving this subject. However, while students are problem-solving, they are also learning vocabulary, learning to talk about mathematics and participating with other students while working on problems. A review of the literature related to conceptual learning and student participation that has been published has revealed that most studies talk about manipulatives, working with understanding, teaching tools, and student participation in instruction and discussion. The issue of conceptual learning has driven teachers to in-service programs to get a better understanding of how to change their curriculum to better conceptual learning in their classroom. Simon and Schifter (1993) used both qualitative and quantitative studies of teachers that taught grades four and above. The study revealed activities that were done in the classroom and also student beliefs about learning mathematics.

> The Educational Leaders in Mathematics (ELM) Project ^2 involved experienced teachers of Mathematics (K-12) in reexamining their ideas about the teaching and learning of mathematics and provided them with the support to develop a constructivist view of mathematics learning and instructional practices consistent with such a view (Simon & Schifter, 1993, p. 331).

The authors stressed the importance of teachers being well educated and focused on student learning. There was support given to the teachers to incorporate different instructional practices. Simon and Schifter (1993) went on to say,

> The cognitive changes described by teachers included greater facility with mathematical ideas, greater ability to communicate about mathematics, and deeper understanding of mathematical concepts. They reported that students were becoming more competent problem solvers who understood that there is more than one way to solve most problems (p. 335).

Even though teachers are becoming more aware of conceptual learning, there are different methods and teaching tools that can enhance teaching. When these methods and tools are used the students become better problem solvers and also a deeper understanding of mathematics is achieved.

Manipulatives

When teachers talk about manipulatives, sometimes the word 'play' comes to mind. Moyer (2001) studied ten middle school teachers who were receiving instruction on hands-on materials and manipulatives for classroom use. Moyer (2001) commented on the importance of manipulatives,

> Many researchers and theoreticians challenged previously held beliefs about learning, based on their beliefs that children must understand what they are learning for it to be permanent. Zoltan Dienes's (1969) work convinced researchers that the uses of various representations of a concept, or 'multiple embodiments,' were needed to support students' understanding. Piaget (1952) suggested that children do not have the mental maturity to group abstract mathematical concepts presented in words or symbols alone and need many experiences with concrete materials and drawings for learning to occur (p. 175).

One lens through which to view manipulatives is through the lens of student performance. "The finding of much research has shown that students who use manipulatives during mathematics instruction outperform students who do not" (Moyer, 2001, p. 177). Using manipulatives in the classroom can be for any level of classroom. Performance can be measured in these classrooms

using these manipulatives to check for mathematical understanding. “Motivating by means of useful applications, working on modeling, solving problems…this is the way we consider ideal for our mathematics teaching at all levels” (Alsina, 2002, p. 242). Also, the use of manipulatives can create a concrete image that the students can use. Sometimes these concrete images benefit students and their mathematical understanding.

> In an evaluation of knowledge and skills, carried out in Catalonia for 10-year-old children, it was found, for example, that they (students) had major problems reading scales in thermometers, numerical values in vertical axes, or train time tables. The confusion was due not to the numbers, but to the presence of images of real objects! (Alsina, 2002, p. 242).

Manipulatives can be a positive addition to a classroom. When these manipulatives are used properly in the classroom these skills can be significantly increased.

Lessons with Understanding

When educators discuss understanding, there are two types: procedural understanding and conceptual understanding. The conceptual understanding goes along with working for understanding. Barron et al., (1998) studied sixth grade students to see if they actually learn from their experiences. He looked for understanding and enthusiasm that surrounded the following types of approaches. “The history of the idea of ‘learning by doing’ makes clear the need for informed discussions about problem- and project-based approaches” (Barron et al., 1998, p. 272). Barron et al., (1998) went on to say that these problem-based and project-based lessons were impressive,

> Not only did students understand what they were trying to learn, but this knowledge appeared to help them direct their learning. One classroom teacher, for example, was impressed by the students’ increased ability to generate their own questions to guide their scientific inquiry (p. 275).

Students’ ability to question themselves helps them to understand the “why” behind a lesson, especially if they take the time to question themselves.

Teaching for conceptual understanding takes time, and educators know time is precious. “If Ms. Daniels spent time addressing the conceptual underpinnings of these procedures, she ran the risk of being able to cover fewer topics” (Eisenhart et al., 1993, p. 19). Teaching not only takes time, but the students also need time to work the lesson. “It was not enough simply to introduce (or review) a topic; students must also have sufficient time to practice” (Eisenhart et al., 1993, p. 19). Once students have that time for working on the lesson, we could check for understanding. “Sometimes students wrote these problems and solutions on the board” (Moyer, 2001, p. 189). The message here is that students learn conceptual understanding by doing problem- or project-based lessons. These lessons not only take time for teachers to teach but also require time for students to complete.

Teaching tools

There are a multitude of different teaching tools. Teachers need to adapt different tools for procedural and conceptual learning. Fuchs and his associates (1997) studied forty elementary school classrooms. During this study they looked for an increase in conceptual learning as opposed to procedural learning. “As teachers begin to implement collaborative learning methods with demonstrated efficacy, such as cooperative learning…, reciprocal teaching…, and class wide peer tutoring…, they will likely introduce adaptations to meet the demands of their classrooms” (Fuchs, et al., 1997, p. 224). Cooperative learning can be viewed as students working together. If students can work together and teachers can “group” students for interaction, it can be highly effective.

> In addition, the present study strengthens the potential connection established in earlier work… between students’ use of conceptually oriented explanations and students achievement, and it emphasizes the importance of the quality of student interactions during peer-mediated learning activities. As teachers increasingly rely on peers to mediate learning experiences, they need to incorporate explicit methods for ensuring high-quality interactions and explanations (Fuchs et al., 1997, p. 243).

Group work is one teaching tool, but educators need to give the students some tools to enhance their group work. Stein, Grover and Henningsen (1996) investigated a financially struggling middle school with student populations from different ethnic groups. They examined instruction, thinking processes and mathematical tasks.

> The underlying premise is that students must first be provided with opportunities, encouragement, and assistance to engage in thinking, reasoning, and sense-making in the mathematics classroom. Consistent engagement in such thinking practices should, in turn, lead to a deeper understanding of mathematics as well as the ability to demonstrate complex problem solving, reasoning, and communication skills on assessments of learning outcomes (Stein, Grover & Henningsen, 1996, p. 457).

Sense-making is the process that students go through to take what they have heard, seen or felt and also taken examples of, for evidence to help them understand a concept. This is important as students learn with different learning styles. Students need the opportunities to think, reason, problem-solve, communicate and demonstrate to show their level of understanding of a concept. Teachers may use different approaches toward students to understand where they are with their sense-making. They may use verbal or non-verbal ways to see a student's reasoning and skills.

Student participation in instruction and discussion

As we look into student instruction and discussion in the classroom, there are different avenues to explore.

> According to the National Council of Teachers of Mathematics (NCTM, 1991), teachers should engage students in the exploration and discussion of mathematical ideas. The benefits students are to reap from mathematical communication sound promising: 'Writing and talking about their thinking clarifies students' ideas…. Emphasizing communication in a mathematics class helps shift the classroom from an environment in which students are totally dependent on the teacher to one in which students assume more responsibility for validating their own thinking' … . Wanting students to think for themselves and learn to communicate their thinking are powerful goals (Lubienski, 2000, p. 377-378).

There are different ways that teachers can have students participate in their classroom. Students can write their problem-solving through written communication. They can also communicate verbally by demonstrating how a problem can be solved. By communicating verbally, the students can show their understanding through the use of diagrams, vocabulary, and reasoning through both oral and written communication, by the presentation of problems and their solutions. There are factors that need to be addressed in having these types of student discussions or presentations.

> The NCTM (1991) urges teachers to create 'an environment in which everyone's thinking is respected and in which reasoning and arguing about mathematical meaning is the norm' … 'Key dimensions of a learning environment in which serious mathematical thinking can take place [are]: a genuine respect for others' ideas, a valuing of reasoning and sense making, pacing and timing that allows students to puzzle and to think and the forging of a social and intellectual community. Such a learning environment should help all students believe in themselves as successful mathematical thinkers' (Lubienski, 2000, p. 398 - 399).

Having classroom participation either through discussion or instruction can be very successful if the students respect other students' ways of reasoning and sense making.

In summary, we, as teachers, need to understand the difference between conceptual and procedural learning and understanding. We need a combination of student participation in instruction and discussion, manipulatives, different teaching tools and lessons with both procedural and conceptual learning. Any discussion about these types of learning styles could bring about a possible change in curriculum. As Simon and Schifter (1993) stress, while it is important for teachers to be educated, there is also a need to be focused on students' conceptual learning.

This literature review helped me to see that there has been successful research relating to conceptual learning, instruction and discussion. Students have benefited from different types of teaching methods. These different types of teaching methods that were incorporated into the

classroom, which included manipulatives, communication between students, oral presentations, and increased vocabulary, were extremely beneficial to the enhancement of students' learning and especially conceptual learning of mathematics.

This research project differs from the published literature in several ways. For instance, this research involved middle school students, while some of the students in the literature were elementary or high school students. Also, while this research investigates student oral presentations, most published research investigated different types of teaching methods. For instance, the published literature talked about hands-on application, manipulatives, written communication and group work. While Barron et al. (1998) studied both problem and project based approaches, this study focused on problem based approaches. This study focused on ninth graders and oral communication, the published literature from Simon and Schifter (1993) studied K-12 teachers. This research study was unique as it involved ninth graders, oral and written communication and preparedness for presentations.

Purpose Statement

The purpose of this study was to determine if having students present problems at the beginning of class will increase conceptual knowledge. What I would like to have seen was an increase in mathematical vocabulary, an increase in confidence when explaining how a problem is solved and an increase in mathematical conceptual knowledge of the observers who are watching the presentation of the problem. This project was an effective approach to determine if the students can apply their knowledge to explain how a problem is solved in front of the class. This was also another strategy to see if there was improvement in having their assignment completed before class. This project has offered students a more structured way to review the previous day's assignment and also maximized instructional time since we began each class with

a problem. This brought the students into the "mathematical" mindset for the teacher to continue with instruction.

My action research project included presenting problems by students at the beginning of class. The following questions were addressed:

1. How will beginning each math class with a presentation of a problem benefit the presenter of the problem?
2. How will beginning each math class with a presentation of a problem benefit the observers in the classroom?
3. How will beginning each math class with a presentation increase a conceptual learning environment for the students?

I had data collected in the form of a student survey, collection of students' work, students' journals and teacher's journals. This collection enabled me answer the questions above to see if the project had a purpose in my classroom.

Method

I started the project on February 19, 2007 with a survey to the students (see Appendix A). The survey helped to indicate the different opinions my students had toward: presentations in the classroom, cooperatively working with others in the classroom, listening to other students explaining a problem and the comfort level in the classroom. I ended the survey with open-ended questions about what the students liked best about math and liked least about math in the classroom and what they would like to see changed in the classroom. After completing the survey and the day's math instruction, I assigned problems randomly to different students. I told them that I would randomly select students the following day to present these problems on the board in front of class. I also asked that they have the problems written out as I would collect them the following day. I assured them that if they had any questions, I would answer them either that day or before the presentation. The following day the selected students presented their problem. Before the students were selected to present their problem, the journal notebooks were

handed out to the students. The students were previously instructed on certain questions I wanted them to answer while they wrote in their journal after the presentation (see Appendix B). These prompts were to help the students write down their comments about the presentation. These prompts were taped to the inside of the student journals to enable them to write their comments down in an orderly fashion.

During the presentation, I was journaling also. I had given myself teacher prompts (see appendix C); these prompts helped me to collectively answer questions about the presentation I ended my research on May 7, 2007, with the same survey given at the beginning of the project. This was the completion of my research, but we continued with the presentations in class after the research project was completed.

I analyzed this data by reading through the journals once a week. I wrote in my journal every time I had a student present, which was 3-5 times per week. I analyzed the problems that the students turned in after the problem was presented. At the beginning of the project, the handed-in problems were of good quality. They were completed well with work shown. Toward the end of the project, the problems that were handed in were not as good of quality. The work was not shown as well as earlier. The presentations continued to be communicated well. The students may not have written the problems down in entirety on paper but the explanation and presentation of the problems were just as good if not better than in the beginning of the project.

Findings

With regard to my students' attitude toward math, asking questions, attitude and interests, I gave my students a survey to begin my project. The survey, found in appendix A, asked questions such as, "I am comfortable doing presentations in front of the class." The students

were prompted to circle one of the following: strongly agree, agree, neutral, disagree, or strongly disagree. The survey results of this survey can be seen in Appendix D.

These findings led me to believe that having the students complete a presentation in class would not be a problem. The response to the first question of, “I am comfortable doing presentations in class,” was 9 out of 10 students being neutral or agreeing that they could do a presentation. The ninth question asked, “The only person who should explain math problems in class is the teacher,” was answered with 9 out of 10 students feeling neutral or disagreeing. These responses told me that the students were, for the most part, willing to do the presentations and also felt that the teacher was not the only person who could explain math problems. These surveys lead me to believe that we could start this project off on a good sign with good participation.

A total of 44 presentations were completed during this project. At the beginning of the project, some students did a very good job at presenting. They went slowly, used precise vocabulary and answered questions that the teacher or students asked. In the first half of the project from February 19 until March 21, we had 26 presentations. In the first half, I documented that fourteen students used good vocabulary. These fourteen students were fairly confident at the presentation, used correct vocabulary, related the material well to the other students, and answered questions well. Of those fourteen students, three had to respond to me for assistance and with a little direction, they continued with the problem and presentation.

The other twelve presentations were completed, but the students may have had difficulty with vocabulary, confidence (they did not face the students; they faced the board), were not able to answer questions about the problem they presented or were not ready to do the presentation, but they presented with assistance from the teacher. All students had to present whether they

were ready or not. I told them in the beginning that I would be there to assist but I did not want them to rely on me throughout the entire project. The second half of the project seemed to have gone better.

The second half of the project continued with 18 more presentations. These presentations changed a little because I did not tell the students the day before who was presenting. They also did not know the problem that they were presenting. Toward the end of the project, the last two weeks, I wrote problems on the board prior to class and asked for volunteers to solve the problems. I made sure that I included all of my students during this course of time. Some were volunteering excitedly, some not so much, but they were included in the presentations.

Of these 18 presentations, 16 students completed them with precise vocabulary and thorough explanations. Their confidence increased where I did not need to intervene as much or very little. They explained, showed their work, used good vocabulary, answered questions and showed an increase in confidence over the past month. The two other presentations, were still a little weak, with vocabulary not used as well or the problem not explained as well as it could have been.

During this time of presentations, my students also documented their observations. Some of the comments suggested that the presenter speak slower, write more clearly on the board, talk louder and ask if there are questions. I addressed these comments with the presenters early in our project so that they could make the presentations easier and clearer to understand. A comment that was made by a student was, “The problem was easy to understand for me. The lesson is more clear than before.” Another comment was made by a student who was absent the prior day. The question was, “Did the presentation help you understand the concept better? The student responded, “Yes, because I wasn’t here and wasn’t taught it.” Another comment was, “Yes, it

helps me to have more examples." For the most part the students used the student journal prompts well. They took the time to answer the questions which helped me to give advice to the presenters.

During this time, homework, quizzes and tests were given in the classroom. For the most part, I gave quizzes after presentations were given. On one occurrence, I gave a quiz before presentations. After the quiz was taken, we had presentation of problems. The original scores out of 32 points were 3, 4, 18, 20, 20, 24, 26, 28, 30, and 31. This gave me a mean average of 20.4 or a grade of 63.75%. I was quite dismayed at the results of the quiz, so I offered to all the students to gain half credit back on all missed problems. The scores increased to 4, 10.5, 18, 24, 26, 26, 28, 31, 31, 31, and 31. This resulted in a mean average of 26.05 or a grade of 81.40%. This was a significant increase, which I attributed to the presentations of problems by the students.

The written work by the students, as I indicated earlier, was good at the beginning of the project. The students submitted 39 written problems. I had 5 students who did not turn in their written problems. I graded these written problems using a rubric (see appendix E). The grades of the 39 problems resulted in a mean of 2.769, which according to my rubric is .231 from a perfect average.

I ended my project with the same survey that I gave in the beginning of my project. The results from the survey are found in appendix F. These results, though varied, showed me an increase in students being more comfortable doing presentations. There was also an increase in liking to talk about how to solve math problems and asking other students questions. This, I believe, is a direct result of the presentations given in class.

How will beginning each math class with a presentation of a problem benefit the presenter of the problem? This was my first research question. I documented an increase in confidence, an increase in vocabulary, an increase in volunteering and an increase in excitement about explaining math problems. The students needed to be ready to explain or volunteer to present, and I found an increase in that. One of the questions on the survey given was an open ended question, “The most interesting thing I’ve learned this year in math is….” One student commented, “More people’s grades are going up after presentations.” This leads me to believe that the presenters benefited through their oral communication and presentations to the class.

The next research question, “How will beginning each math class with a presentation of a problem benefit the observers in the classroom,” was shown through classroom work. The example of the quiz, given before presentations, was a direct result of students needing that extra explanation in order to have a better understanding of the concepts, before moving on to the next concept. Another observation was made through the survey given. The question on the survey was, “The thing I like best about math class is….” A student responded, “You can help each other and learn problems different ways. There are more ways to solve a problem than one.” This was made in reference to a problem that was presented by a student. This particular student showed a different way of solving a problem. This comment refers to different approaches that were observed by the students in the classroom. I also noted in my journal that the students observing were asking questions to the presenters. These questions were not always present, but for most of the presentations, questions were asked by the observers. I found that the observers were paying attention and were actually involved in the lesson being presented. This is beneficial when students are paying attention and asking questions.

The last question, “How will beginning each math class with a presentation increase a conceptual learning environment for the students,” could be documented by the quiz given that I commented on earlier. I also documented in my journaling whether proper vocabulary was used, the explanation was good, the order of operations was followed, the proper order of steps was followed, good terminology was used, questions were answered well, the concepts were explained well, definitions were well explained, and the student took direction well. When students use good vocabulary, define words, explain a problem and take direction well, they understand the concepts that were taught. I can also look at my students’ final grades in my class. I found that the grades the students received for fourth quarter were significantly increased.

I have taught these ten students for three years. Some of the students had never received an A in any of my math classes. One of my students in the third quarter received a grade of 88%. This quarter ran from January 3 to March 8. The fourth quarter ran from March 12 till May 24. This particular student received a grade of 98% in the fourth quarter. This student stated on May 7, when I said that the research project is over, “These presentations, I know, helped me to understand math better. Can we continue doing them?” I told the students we can continue; we just do not need to continue the documentation. I had another student say, “I like doing these presentations. They helped me to do better on my review and tests.”

When I look at the third and fourth quarter grades for these ten students, I see a remarkable difference. Two students received a grade of 93 or above during the third quarter. The mean of the class for the third quarter was an 86%. The fourth quarter grades were remarkable. I had five students receive a grade of 93 or above. The mean of the class the fourth quarter was 87.5%. The average was not as significant as the increase in individual grades. I had seven students increase their grade anywhere from one point to ten points during this time

period. I had two students who continued to do the presentations well, but they shut down when completing their homework or studying for tests. Their grades went down anywhere from seven to eleven points. I had one student remain with the same grade for both third and fourth quarter.

These comments and grades encouraged me to think that they not only increased their conceptual learning of mathematics, but also increased their excitement of mathematics and increased their confidence talking about mathematics. When one of my students states almost every day, “Are we doing presentations today?”, or “Can I present today?” this really increases my enthusiasm to continue to include this type of project in my classroom.

Conclusions

According to my findings and the data that I gathered throughout this project, I can say that presenting problems at the beginning of class does increase not only conceptual knowledge in my classroom but also increases confidence, excitement, written work, vocabulary and volunteerism. I saw increased confidence as the presenters learned to face the students during their presentation. I had students excitedly volunteer to present problems, even though they knew that I had to include all students in my classroom. I saw an increase in vocabulary when students were helping other students with problems during homework time. The written work that students turned in, for the most part, had most if not all the work shown for me to grade.

These findings and also the comments that were made by the students when the project was over, led me to think that these presentations were extremely beneficial to my students. When students appreciate the presentation because they were absent the prior day or because they know their next test grade may increase due to the presentation this makes me want to continue this procedure in my classroom next year. When a teacher sees improved classroom

work and improved students' grades and enthusiasm, it becomes evident that presentation of problems needs to be included into the classroom procedures.

This data supports the literature, especially when discussing conceptual understanding. The conceptual understanding goes along with working for understanding. "The history of the idea of 'learning by doing' makes clear the need for informed discussions about problem- and project-based approaches" (Barron et al., 1998, p. 272). Barron et al., (1998) went on to say that these problem-based and project-based lessons were impressive.

> Not only did students understand what they were trying to learn, but this knowledge appeared to help them direct their learning. One classroom teacher, for example, was impressed by the students' increased ability to generate their own questions to guide their scientific inquiry (p. 275).

Students' ability to question themselves helps them to understand the "why" behind a lesson, especially if they take the time to question themselves. When students are asked to present a problem, they also had to answer questions about the problem. This helps them to understand "why" they approached the problem the way that they did.

As we look into student instruction and discussion in the classroom, there are different avenues to explore.

> According to the National Council of Teachers of Mathematics (NCTM, 1991), teachers should engage students in the exploration and discussion of mathematical ideas. The benefits students are to reap from mathematical communication sound promising: 'Writing and talking about their thinking clarifies students' ideas…. Emphasizing communication in a mathematics class helps shift the classroom from an environment in which students are totally dependent on the teacher to one in which students assume more responsibility for validating their own thinking' … . Wanting students to think for themselves and learn to communicate their thinking are powerful goals (Lubienski, 2000, p. 377-378).

When students present a problem, they are communicating what they are thinking. While this communication may not always be correct, they are learning so much in the process. Not only is the conceptual learning increasing but so are confidence, problem solving,

responsibility, writing and communication. These are characteristics that are important in our students' learning process.

Implications

As a result of this study, I will find myself including this process of presenting problems in my daily procedures in my classroom. As I do not know if this process will work well in my 40 minute classes, I do know that I can incorporate it into my block (90 minute) classes since I have enough time. My students benefited greatly from this project. Since the students do not need to document during or after the presentation, we may even have extra time for an additional presentation. Since the students wanted to continue the process of presentations, I will try to incorporate this into my lesson plans and classroom procedures next year.

I found my results from this study to be encouraging. I felt it deserves further attention, and I believe, when looking through my data and student grades, that it is beneficial that students communicate both in writing and verbally in a classroom. The outcomes from this communication and experimentation may need to be modified to fit different types of classrooms with different types of students. The students whom I evaluated were generally the same ability level. Some of my other classes may not be as reliable or capable of this type of procedure but if modified it could work for all students. I remain very interested and intrigued in this project. The growth opportunities of my students using presentation of problems can have a significant effect on them. This assures me that I still have much to learn and much to incorporate into my classroom if I want to increase the conceptual learning of my students.

I would like to advise any educator that including student oral presentations in class is extremely beneficial. The benefits outweigh the time that may be used on other teaching methods or other concepts that could be introduced. Not only are students building responsibility, they are

building their vocabulary, their written work or assignments, their patience in dealing with questions, and they are building their confidence in speaking about mathematics. These are qualities that are of great importance. When a student completes an oral presentation of a math problem, they are actively using the skills that were taught them. This shows their conceptual knowledge and increases the knowledge of those observing the oral presentation.

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Appendix A

Survey given to students at the beginning and ending of the project

For the following questions (#1-8) please choose: strongly agree, agree, neutral, disagree, strongly disagree

1. I am comfortable doing presentations in front of the class.
   strongly agree, agree, neutral, disagree, strongly disagree

2. The most important thing in math class is to get the right answers.
   Strongly agree, agree, neutral, disagree, strongly disagree

3. The most important thing in math class is to be able to explain my thinking to other students.
   Strongly agree, agree, neutral, disagree, strongly disagree

4. I think that listening to other students explain math problems helps me learn.
   Strongly agree, agree, neutral, disagree, strongly disagree

5. I feel comfortable in math class asking the teacher questions.
   Strongly agree, agree, neutral, disagree, strongly disagree

6. I feel comfortable in math class asking other students questions.
   Strongly agree, agree, neutral, disagree, strongly disagree

7. I like to talk about how I solve math problems.
   Strongly agree, agree, neutral, disagree, strongly disagree

8. I like to cooperatively work with someone on math problems.
   Strongly agree, agree, neutral, disagree, strongly disagree

9. The only person who should be explaining math problems in math class is the teacher.
   Strongly agree, agree, neutral, disagree, strongly disagree

10. The thing I like best about math class is…….

11. The thing I like least about math class is……..

12. The most interesting thing I've learned this year in math class is…….

13. If I could change one thing about math class, it would be…..

Appendix B

Student Journal Prompts:

I want the students that are observing the presentation to:

1. write down the student or students names presenting the problem
2. write down the date the presentation was conducted
3. write down the lesson/concept that is being presented
4. answer briefly was the problem presented in a way you understand
5. list a couple of ideas that could have made the presentation more clear
6. did the presentation help you to understand the concept better
7. Questions you may have??

(I would like the students observing to write short answers to the questions above.)

Appendix C

Teacher Journal Prompts:

I want myself to include:
1. Date of the presentation
2. student/students presenting the problem
3. lesson/concept that was being presented
4. Was the problem presented in an orderly fashion?
5. Was the presenter confident in how they presented the problem?
6. Was the vocabulary used properly and appropriately?
7. Overall was the problem presented in a fashion that shows the student(s) presenting spent time working on the problem, and was it presented in a manner that helps the students observing to understand the lesson/concept

(I will be using my rubric that I have listed to give some feedback to my students on their presentations. Hopefully it helps for them to receive that feedback so they can increase their confidence with presentations.)

Appendix D

These are the results of the survey given to students at the beginning of the project:

	strongly agree	agree	Neutral	disagree	strongly disagree
Question 1	4	1	4		1
Question 2		3	6	1	
Question 3	1	4	3	2	
Question 4	1	5	3	1	
Question 5	6		3	1	
Question 6	4	4	1	1	
Question 7		2	5	3	
Question 8	3	1	6		
Question 9		1	2	5	2

Appendix E

Rubric for Grading:

Rubric for the student(s) presenting the problem:

3 - Problem written out completely (all work shown), problem explained using good vocabulary; most questions by the students were answered.

2 - Problem written out not in entirety (not all work shown), problem explained but not using good vocabulary, answered some questions of the students.

1 - Problem written out, but no work shown (only answer given), problem not explained well (unprepared for explanation), unable to answer the questions of the students

0 - Problem not written out, not explained, student unprepared, no questions answered.

Appendix F

These are the results of the survey given at the ending of the project:

	Strongly agree	agree	Neutral	disagree	strongly disagree
Question 1	5	2	1	2	
Question 2	2	3	5		
Question 3	2	1	4	2	1
Question 4	3	6	1		
Question 5	4	2	3	1	
Question 6	3	4	3		
Question 7			7	2	1
Question 8	2	1	7		
Question 9		1	3	3	3