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Homework: Is There More To It Than Answers?

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Math in the Middle Institute Partnership
Action Research Project Report

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Department of Mathematics
University of Nebraska-Lincoln
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Homework: Is There More To It Than Answers?

Abstract

In this action research study of my two high school geometry classrooms, I investigated the use of homework. By changing the focus on homework away from the answers to the process involved in getting the answers, I found that students felt more confident, utilized their class time better, and placed more effort on complex problems. Their questions also became more specific and more effective for finding gaps in their understanding. As a result of this research, I plan to change my strategy in the practice of homework. I will give students the answers on multi-step problems to allow them the opportunity to utilize problem solving and critical thinking skills to gain practice in autonomous learning.

Introduction

In my action research project, I changed the focus of homework away from the answers to the process involved in doing the homework. Each day I gave answers to the problems before students began their work. I focused their practice on the process and understanding that goes into arriving at the answer. Eliminating the sharing of answers I believed would make the conversations in my classroom and the hallways mathematically richer. I also had the students self-assess their learning on a daily basis through the use of a rubric. My intentions were to make their learning real and personal.

The lack of completed homework had been a constant problem in my high school classroom. I became frustrated with the lack of effort and enthusiasm I saw from my students. Many students shared answers and felt that they had learned the concepts. I wished that my students would have had the desire to accomplish assigned practice problems and view practice as their opportunity to practice their skills, making their learning personal, and a valuable tool in evaluating their understanding. As a teacher, I viewed homework as a formative activity in which I hoped to allow students the opportunity to explore and practice skills. Many days I did not feel that I was accomplishing this goal. I have found that if students are not completing the homework, they are usually not performing well on summative work. Changing this cycle was my goal.

During my teaching years in secondary and post-secondary classrooms, my view of homework has evolved. With that being said, I found that my theoretical view of homework was not always what I have enacted or accomplished in my classroom. Enacting new techniques in homework practices that enabled my students to explore more rigorous mathematics by utilizing more communication, reasoning and representations was in order. I wanted to redirect the focus

of homework to that of learning rather than just getting the answers. The National Council of the Teachers of Mathematics' standards (NCTM, 2000) call for learning to happen with understanding so students can become autonomous learners. My current practices with assignments did not facilitate the level of understanding that I wished it would. To this end, I wanted to create better math problem solvers of my students by focusing on the process rather than the end product.

Problem Statement

Change in practice was in order to reach the goals of NCTM (2000). I wanted to know what my students were thinking. Through researching and enacting new strategies, I hoped to better gauge my students' abilities in reasoning, representation and problem solving. My students' future careers depended upon their ability to connect their knowledge to future situations while communicating their ideas in a concise and logical format. Exploring practices in my classroom that fostered these skills was necessary.

By changing my approach, I hoped to help more students accomplish a new level of understanding mathematical concepts. Changing the students' view on the purpose of homework from an expected component to that of purposeful engagement and practice was one of my goals. I once read that homework was named incorrectly from the beginning of schooling. It should have been called home practice or home play, not homework. So many negative connotations have been attached to math homework over time just by the name.

I obviously valued learning, but I continually struggled with how to make the most learning happen for my students. Multiple students can be engaged in the same information and activities in the classroom, but they do not gain the same understanding. In handling the homework, I have always questioned if the students should be allowed to ask questions before or

after they have turned in their homework. Once again this drew me back to the fact that I wondered if my students had done their own thinking or just copied the thoughts of the class. By focusing on creating autonomous learners through changing my homework, I believed I would make inroads on teaching more independent learning. Helping my students becoming more engaged in practice activities on a daily basis was a goal of mine. Ideally, I desired to have a classroom where all students yearned to learn more as active, participating learners that were prepared for class with inquiring questions. I had hoped that students attended regularly and enjoyed the rigor and beauty of the mathematics.

My problem addressed the learning standard (NCTM, 2000) by helping students become autonomous learners. The value of this skill was not only seen in their classrooms, but also in their attempts to enjoy a lifetime of learning. NCTM says that students learn more and better when they take control of their own learning (2000). I attempted to help my students become confident in their ability tackling difficult problems and in growing eager to figure things out on their own.

The *Principles and Standards for School Mathematics* (NCTM, 2000) calls for deeply rooted changes in how we teach mathematics. Serious changes in homework strategies are essential for improving learning. The curriculum principle (NCTM, 2000) called for us to focus on important mathematics. The process is invaluable in mathematics. By working on the process rather than the end result, I hoped to deepen students' conceptual understanding. The assessment principle (NCTM, 2000) states that students show what they know and can do in different ways; thus, assessments should also be done in multiple ways, and teachers should look for a convergence of evidence from different sources.

Literature Review

In the U.S. education system, mathematics classes are well-known for assigning daily homework. Along with this homework, students notably do not complete or end up sharing homework answers. I researched the process of mathematics homework to aid in my attempt to stop this cycle in my classroom. While conducting my literature review related to homework, I found that most studies have been done on the completion rate and the amount of homework assigned. Studies regularly scrutinized and explored the correlation between the amount of homework and higher achievement and test scores. Over time, the pendulum has swung back and forth on the theories of thought on the amount of homework that should be given. During the course of my review, I found what appeared to be a gap in the research on homework. The purpose of homework may be getting overlooked. Many researchers have looked into students' homework motivation, parent's influence on student homework along with the process, reasoning and confidence levels of the students when performing homework. I discovered that the process and emotional side for students when performing math is an area in need of study.

It goes without saying that homework is a complicated thing. Corno, a professor at Columbia University, specializes in classroom learning and motivation. She has authored numerous articles dealing with homework. She points out that homework may be as much a part of the problems as the solution in improving education (Corno, 1996). The strategy of using homework in the framework of a mathematics classroom is not a cut and dry process. Many may believe that it is expected in math, but we have to remember that in using this learning strategy, there must be purpose and a benefit. Many if not most teachers' goals for assigning homework can only be accomplished under certain circumstances and care must be taken lest best intentions backfire (Corno, 1996). It seems that her research concluded that it is not the amount of homework rather that it is the time spent engaged in academic work that breeds success. An

overarching theme that research shows is that the lack of motivation, the quality of home influences and the students' emotions connected to homework are factors that bring a variety of variables to the table when we have homework. These are the ideas explored in my review.

Homework Motivation and Parental Involvement

As I researched the topic of homework, the lack of motivation to do homework came up many times. As all teachers know, student motivation is a constant that we are trying to foster. So much of students' motivation must come from internal sources. In my research, I explored the internalization of a need for understanding and explored personalizing the benefit of learning. Corno found that for homework to be effective it must be increasingly inspired by students' own interests and motivations (Corno, 2000). To achieve this, the students must be responsible for their own learning.

Research speaks of how parents are also a large factor in the equation of homework. Reading the research brought to light a naive view of homework that many hold by focusing mostly on the student. The lack of parental support extends onto the field of daily homework. Cancio, West and Young (2004) conducted an in-depth, hands-on study of homework and the connection that parents play in its completion, understanding and achievement. They investigated the feasibility of teaching parents of six boys aged 11-15 with EBD (emotional-behavioral disability) to establish and maintain a homework completion program based on teaching the students to manage their own behavior. Their research helped in understanding the enormous influence well-informed and strategy-trained parents can have toward the success of their child's learning. In this particular study through the purchase of incentives for their children, parents were able to enhance the motivation for homework

As teachers, one must question if children are at an unfair disadvantage by requiring and asking for work to be accomplished outside of the classroom if the student does not have home support. But in the same token, the student needs to learn how to change their environment to make it conducive to learning for them. In Corno's article titled *Looking at Homework Differently* (2001), she compiled many years of looking at homework. She calls for changes in how we assign and utilize schoolwork. In this article, she discusses how as students' experiences build, adult assistance fades into the background making it clear that the responsibility for both completion and quality of homework lies with the child. Children need to see homework as their own responsibility. Once again, achieving this will aid in the growth of them becoming autonomous learners.

In the book, *Adding It Up, Helping Children Learn Mathematics* (Kilpatrick, Swafford, & Findell, 2001), the changes needed to help students in our times are addressed. As stated before, perhaps the purpose for homework has been lost in the momentum of the creature. This book suggests many key points that need to be followed when creating purposeful homework. Homework should: provide practice, increase procedural fluency, maintain skills, prepare for the next class, foster responsibility and independence, communicate with home, and be realistic in length and difficulty. It is a continual challenge for the classroom teacher to address these goals in a balanced fashion.

Homework involves a large amount of motivation and parental involvement. I did not focus on the parental involvement since at this point I had little influence over the parental support my students received. My focus was on the students within my classroom and not their home influence. External rewards as a motivating factor were not part of my research. Cancio, West and Young's (2004) work prompted me to question if the homework I assigned really

assessed or achieved the results I wanted or if it evaluated the home environment more.

Obviously, if the family valued and supported the homework process, the student was more successful. When children viewed their parents as learners, the children valued their own education more (Corno, 2000).

Homework Process and Reasoning

There is a difference between doing math and learning math. In the primary grades, students equate doing math with the idea of learning it. As students mature in their schooling, educators must aid the children in understanding that the action of doing is not always enough to gain understanding.

Active learning does not only rely on being active. Anthony (1996) followed two students in case studies that focused on the knowledge-gaining strategy behaviors involved in the learning rather than the activity that the students were performing. Anthony's primary research interests involved students and teachers' learning within the mathematics classroom. In particular, she explored students' learning strategies within the classroom and the relationship of classroom instruction in fostering strategic learning practices. Related issues of teacher support of sociomathematical norms including explanations and justification within classroom discourse and the role of memorization and understanding have also been the focus of recent studies. I believe she found some interesting results related to helping students in becoming autonomous learners.

Examples of their strategic learning behaviors illustrate that having students involved in activities such as discussions, question answering and seatwork problems does not automatically guarantee successful knowledge construction. The nature of students' metacognitive knowledge and the quality of their learning strategies are seen to be critical factors in successful learning outcomes (Anthony, 1996, p. 349).

Heitzmann from Villanova University continually inquired into discovering what factors contributed to how homework enriches learning. Through the past 30 years in education, Heitzmann utilized his discussions with educators, observations of teaching and reviews of research to develop his ideas. Heitzmann (2007) found that educators must allow sufficient time for the student to complete the assignment. Holding each student accountable for his homework with the knowledge that his homework matters is imperative (Heitzmann, 2007). It sometimes seems like the routine of math homework is just that, a routine. The point that Heitzmann brings out is that students must know that their homework matters in their learning

How teachers observe and assess students' homework and processing is important. Senk, Beckmann and Thompson (1997) researched the assessment and grading practices of educators in 19 math classes in 5 high schools in 3 states. This trio of researchers found that in assessing and grading at the high school level that geometry was the most notable subject that they felt true process could be easily observed.

In a unique study, three educators collaborated with a business to conduct research on how learning takes place using worked-out examples. Atkinson, Derry, Renkl and Wortham (2000) joined forces to see how learning happens. They explored how a concept was used by individuals to interpret experiences and to solve problems. They found that the expert students typically focused on deeper structural aspects of the problem whereas novice students were often misled by surface features (Atkinson et al, 2000).

At Rice University, Austin (1980) investigated just this idea. He took two of his classes and explored if students should be allowed to ask questions before or after they turned in their work to gain the most understanding. His results suggested that allowing students questions on how to do problems before homework is collected is superior to allowing students questions on

homework once it is collected, graded and returned (Austin, 1980). This suggests that the idea of discussion about homework enhances and gives the students more immediate feedback. A caution that he found with this practice was that if students felt that answers and help on difficult problems was too easily obtained, students would tend to copy and learn less than when feedback was more difficult to obtain.

It is important when educators are directing student learning that ownership for that learning is fostered. One way to achieve this is through self-assessment. Felchikov and Goldfinch (2000) from Napier University looked at quantitative peer assessments versus teacher assessment. Felchikov and Goldfinch compared forty-eight assessment studies. Their research showed that the peer assessment most resembled that of teacher assessment when global marks were given (Felchikov & Goldfinch, 2000).

My research did not resemble the size or scope of Felchikov and Goldfinch (2000) or that of Senk, Beckmann and Thompson (1997) since I only looked at 2 classes under my management rather than spanning several states or groups. I did not analyze the large picture of student's processing like Anthony (1996) did, but rather just within the context of my geometry classroom and their homework involved in their spring semester. The ideas that I have gained in reading literature on homework I used as pieces of the pie that I formed through the discoveries in my action research. As Anthony (1996) found, students' knowledge gained is based upon the quality of their learning strategies. As I set up my research, I wanted to focus more upon the strategies than the activity. I had hoped to construct more tools for students to use in gaining knowledge for their future and self.

In preparing my short research project, I was aware that I would not be able to observe metacognitive knowledge changes in my students as Anthony (1996) did. Instead, I planned to

focus on equipping students with a learning strategy that aided them in being successful in building future knowledge. It is difficult to observe students' thinking skills, but through personal interviews like Anthony (1996) conducted, I hoped to gather observable behaviors in which my students showed changes their thinking process. As I changed the focus of homework to the process, I planned to eliminate the surface features such as the correct answer. My research planned to foster the uncovering of the deeper structural aspects of the problem.

Homework Confidence and Emotions

A traditional view of mathematics is that it is an unemotional subject. However, as Bibby (2002) from King's College in London demonstrated in her in-depth study of teachers, for many people mathematics is experienced in highly emotional ways – people come to know mathematics through emotions. The work that Bibby (2002) did on the emotional part of mathematics was intriguing. Bibby studied the emotional response that primary teachers experienced when working with mathematics. Primary school teachers as a group had recently been identified in the UK as lacking mathematical baseline knowledge. Bibby (2002) then studied the relation to these educators' emotional response in doing mathematics. Many people accept as truth that mathematics is just a study of numbers, processes and answers. Bibby (2002) found that the doing of mathematics is based primarily on emotion. She found that humans become discontent and disconnected from math since they are ashamed of their lack of ability. Every time that these teachers attempted math, that feeling of shame engulfed them and they ran the other way.

One of the main tenets of the discipline of mathematics is that the answer must be right. Parents and teachers can sabotage their own best efforts with children by plying them with expectations that every completed assignment must be perfect (Corno, 2000). These expectations

can push toward dishonesty and cheating. In my classroom, I know that the expectation to have homework done with correct answers has fostered cheating and copying of answers. By removing the need for perfection on assignments, some of the dishonesty can be removed. Having to be right at every turn is gut-wrenching for many students; thus the emotion of shame enters the picture. When students are continually wrong, self-doubt is created. When students doubt themselves, they lose confidence. I explored this area of self-doubt that leads to lack of confidence by removing the need to be right. By making the process the main objective rather than the answer, perhaps some good feelings were fostered allowing mathematics to be personalized for deeper understanding. Bibby (2002) also found that gaining self-confidence was marked by a strong degree of self-determination.

Conclusion of Literature Review

Homework is a common factor that everyone seems to know something about. But how much do educators really know? Research seems to focus on the length and completion of homework, while ignoring exactly what composes the homework. I found it difficult to find research on the action of the process of homework, but rather was able to find much on the answers and accuracy of homework. In my action research, I addressed the idea of learning through the strategy of homework. My research will add to the field of study on homework while exploring the strategy from the students' perspective on process and emotion.

Parents do play a large role in the process of homework. I did not involve parents like Cancio, West and Young (2004) did in their research. I instead focused on the students' personal change in the process rather than monitoring how their parent's influenced their work. In such a short action research project, it would have been difficult to involve parents.

I conducted my research similar to Senk, Beckmann and Thompson (1997) in that I used students from a high school geometry course. Austin (1980) compared two of his courses by changing one factor in each. My action research was not be set up in that fashion. I observed changes in the students' process and confidence rather than comparing and contrasting two focused groups.

With the idea of math homework, many emotions can be stirred. As teachers in the discipline of mathematics know, the subject is very emotional. As I observed and interviewed students, I looked for the emotions involved in their learning of math as Bibby (2002) did. Understanding these emotions and addressing them could lead to opening doors for understanding that may be closed to struggling students. Learning with understanding is essential to enable students to solve the new kinds of problems they will inevitably face in the future (NCTM, 2000). Through my action research, I hoped to allow my students to experience strategies and opportunities to help them on their path to personal learning.

Purpose Statement

Personal learning for a lifetime is a gift that everyone needs to give themselves. In my project, I hoped to see if it was possible to make changes in the way my students' perceived learning and attended to their homework. Perhaps in education teachers have conditioned students to "do" homework rather than to "learn" from the homework. In my research, I explored whether I could affect the thinking of the students by bridging the gap to learning, not just doing. By rethinking a major part of homework, the need for the correct answer, is it possible to focus on the process? By altering the focus, I hoped to help my students see the connections between mathematical concepts and personalize the learning of those concepts. Was it possible for my students to complete homework for the "learning" instead of just to get it done? In varying my

strategy of practice on homework, I explored if my teaching changed, if the time students spent on homework changed and if I could raise the confidence levels of students through this strategy alteration.

In my project, I investigated the following questions:

1. What will happen to the students' level of effort and homework completion by having students self-assess their daily work?
2. What will happen to students' confidence levels and their view on the purpose of homework when answers are not the desired output on homework?
3. How will the time spent on homework out of the classroom and in the classroom be affected by changing the focus on daily work?
4. What happens to my teaching when I provide students with answers to the homework ahead of time?

Method

I began my action research project on January 11, 2008, and concluded on April 16, 2008 using two of my geometry classes at McCook High School. Mr. Monte Else approached my class with consent forms for the research before I started my project. By utilizing the next three chapters in my textbook, I planned to carry out my new homework strategy research. These three chapters, encompassing trigonometry, polygons and area, would work well with the new homework approach.

Before I began the changes in my classroom, I conducted my initial small group interviews and had the students complete two written surveys (Appendices A, B, and C). Gathering the students' opinions without any preconceived ideas of what my project was about was my goal. Once I had these interviews and surveys completed, I then began the changes in my classes of geometry.

On the first day that I approached the students, I began by explaining to the classes how I would have them record their daily effort and scores on homework using the new rubric and weekly record sheet (Appendices D and E). Felchikov and Goldfinch (2000) influenced how I chose to go about the self-assessment for my project. The idea that the expected homework criteria must be explicit and well understood helped me in developing my homework self-assessment rubric. While I wanted to be clear, I still wanted the scores to mirror that of the instructor so I chose the three step grading system. Once again, my goal was to help students take ownership for their learning. I also explained that I would be changing how we would handle the answers for homework. During the first days using the new strategy, I took time to go over the procedure for filling out the weekly assessment sheet and exactly what I needed them to record. At the end of the first week, I checked with each student to be sure that they understood how to complete the weekly record sheet.

In changing my homework strategy each day, I printed and handed out the answers, placed the answers on the board or gave the answers verbally and had the students write down the solutions on their page before beginning the work. When they returned the next day with questions, I required them to tell me their set up for the problem before I would help with any questions. The students quickly got the idea that they had to have attempted the problems before asking me for help. This procedure was continued throughout the project. During the trigonometry test I was curious to see if students could do a test question that mirrored the changes in their homework focus. One question was adjusted by giving the answer; the exam asked them to give me the procedure. Interestingly, the students did not like having the answer to the test question. It seemed to throw them off so I did not try this again on the assessments. In a longer term study, I believe the change in summative assessment would be of benefit to study.

Weekly student record sheets and assignments were collected and kept during the research project. The data was organized in a file sorted by each student's name and later utilized to track trends in effort scores and comments written by the students. Students' self-assessed grades were recorded in my electronic grade book each week. This allowed me to have assessed averages as well as individual scores for later analysis.

Three surveys were conducted throughout the project. The first survey was conducted before I started the homework changes, a mid-survey conducted March 13 and then the concluding survey conducted April 16. Results were entered into a spreadsheet for easy analysis. From this spreadsheet I was able to analyze the changes in my students as a whole unit. I sorted the data by student name or student number. Differences in their answers were noted either by an increased score, decreased score or no change in their scoring. I grouped these changes to draw inferences on the class as a whole. Since some of the scoring was quantitative, I was able to figure statistical differences in the results. Those results appear in the findings section of this report.

Small group interviews were also conducted three times throughout the project. The first small group was gathered on February 4 during lunch. The mid-project interviews were conducted on March 13 during lunch and the final interviews were conducted on April 16 during class time. I recorded and transcribed each of these interview meetings. Cross sections of students were selected in each of the sessions. I utilized students from all achievement levels in the interviews as to get a good representation of views. Quotations and general feelings discovered during these interviews appear throughout my report.

I made daily personal journal notes throughout the project and created weekly journal entries on the observations that I made each week that pertained to my research questions. The

format of the weekly journals and prompts allowed me to focus on the changes in my students and my teaching over the 12 weekly entries (see Appendix F for teacher journal prompts).

My survey data was organized in spreadsheet format for easy reference and to aid in data analysis. As I gathered student samples of work, I highlighted or made a note about comments from the students that I found noteworthy. I later added a sampling of comments to my findings.

In collecting my data, I found that some lessons or particular concepts lent themselves better to implementing my new homework strategy better than others. This caused me to have no observations about my project some days and to have many observations on other days. I also found that if a student did not turn in their homework for a week or two, my numbers became quite altered in the analysis. I had to work on students to get their record sheets in or eliminate them from the analysis. I had one student leave my class during this time and I had one enter my class.

Findings

Research Question #1: What will happen to the students' level of effort and homework completion by having students self-assess their daily work?

The students' level of effort improved with the new homework strategy, but not due to the self-assessing grading change. Students who desired to perform well in the class put forth more effort to complete their homework accurately. During student interviews, I consistently heard from the students that they put forth more effort when they knew that their process was incorrect on the practice problems.

Elly¹: "Tried it more, used the answers and instead of waiting for the next day, tried to figure it out at home."

AJ: "Learned more"

Lori: "Did it more times to get it. I tried to work more to get the correct answer."
(Student Interview, April 16, 2008)

¹ All names are pseudonyms.

The improved effort was also shown on the student surveys conducted at the conclusion of the research. I received these direct quotes from students on the written surveys.

Nathaniel: "Spending a little more time"

Shanna: "I have been trying harder, I do more."

Rach: "If I get something wrong, I go back and correct it."

Teag: "I try everything, I complete more."

Syd: "I try to get the answers that are there for me."

Alli: "I just write my work out more now, always try to complete the work."

Jake: "I tried harder to get it right."

Jon: "Actually try to listen in class better and not give up as easy if I don't get it."

Ranae: "I really try to work through all the problems."

(Student Survey, April 16, 2008)

These are examples of the students who desired to do well in class. On the other hand, students who lacked the desire to perform well in class saw no change in effort and some even expressed that they had put forth less effort by self-assessing. I did note in the grading process that the less serious students consistently gave themselves high marks on daily work. These marks conflicted with their actual performance and their level of understanding.

I also noted in my teaching journal that the students were struggling with the self-assessing aspect of the project. The self-assessing aspect of the project did not prove to be a motivating factor to improve effort. The students felt uncomfortable being the one rating their learning. They really desired to have the input of the teacher and to have the responsibility of the grade placed on someone other than themselves. I believe this was true since they did not yet feel responsible for their learning. The idea that learning makes a difference to my students personally was still an abstract thought for them. In our education system, we have taught our students to perform for another person. Someone else is going to be grading you. You must perform by their standards. So it makes sense in my research that I found that students want someone to take the responsibility of their learning.

During 1st period class, it came out that they really do not like the self-assessing aspect of my project. Lori outburst, "I hate grading myself." As I was going over the need for them to fill out the weekly record sheet, Elly burst out, "If I don't understand it, it is not my fault. Like say I try, do all my homework but still don't get it, that is not my fault." These comments show me the frustration that they are having with self-assessing. I don't believe any student has said that they like it. All comments have been in the negative. Those that dislike the self-assessing are pretty vocal and have influenced the entire class (Teaching Journal, March 13, 2008).

In both the small group interviews conducted mid project and the weekly student record sheets, the following quotes summarized the results I was gathering about self-assessing.

Small group interview question #3:

What is your opinion of self-assessing your homework? Do you like it or not?

Ally: "I want someone other than me to look at it."

Chanse: "I want another to judge me on my work. It gives me a sense of accomplishment when someone else looks at it."

Nathe: "I personally don't like it that much because I don't want to give myself a good grade every time. It makes me feel bad if I score myself high each day. Even if I know it, I feel funny. When the teacher checks it, I feel more accomplished on what I've done."
(Student Interview, March 13, 2008)

These quotations were taken from student weekly record sheets. These comments focused on how they do not like self-assessing.

J.C.: "I like the answers before but I don't like how we grade them. I hate grading myself."

Elly: "I like having the answers so you can double check and work backwards but don't like the grading."

(Student Record Sheet, Feb. 18, 2008)

In comparing homework completion rates prior to the research project to those rates during the project, I found that the homework grades actually went down while the difference in incomplete papers was really unaffected. I looked at the homework grades in quarter 2 compared to the homework grades during the project (Tables 1 and 2).

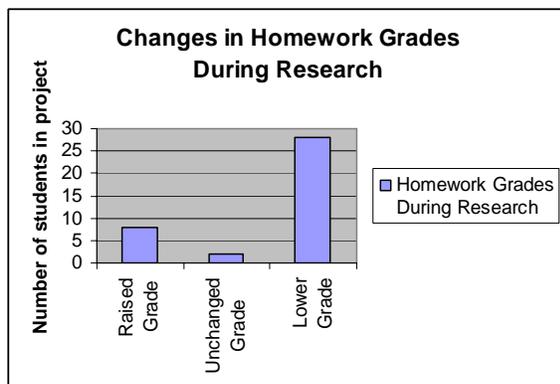


Table 1

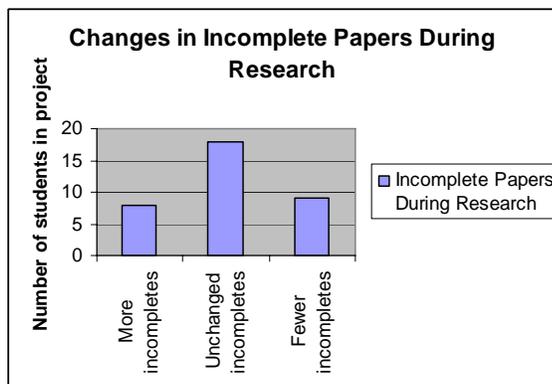


Table 2

The homework scores went down for 28 of the 35 students, remained unchanged for 2 of 35 students and were higher for 5 of 35 students. This tells me that the students' self-assessed scores were lower than the teacher-graded method. The actual incomplete papers from 2nd quarter in comparison to the research project time saw an increase in the number of incompletes for 8 of 35 students; 18 of 35 had the same number of incomplete papers and 9 of 35 saw a decrease in incomplete work. These numbers tell me that the number of incomplete papers remained fairly constant while actual homework grades dropped. Self-assessed scores were lower than teacher assessed scores even though the same numbers of papers were completed. This mirrors what prior research said about students evaluating work, scores are generally lower than those given by an instructor (Felchikov & Goldfinch, 2000).

Research Questions #2: What will happen to students' confidence levels and their view on the purpose of homework when answers are not the desired output on homework?

In tabulating the results of the pre-surveys, I found a common thread that students score themselves low in confidence when they get the answer wrong. As a teacher, I would have expected that completing the work incorrectly would inhibit confidence growth in students. In the pre-surveys, 18 out of 35 students mentioned that their confidence was low when they did not understand. Two students particularly mentioned that they have low confidence when "I get it

wrong.” By implementing my research strategy on homework, I found that students’ confidence levels rose when answers were presented before they began their practice set.

I documented hearing these comments from students during work time: “I told you that was the way to do it” and “I thought that was right” (Teaching Journal, February 8, 2008). I enjoyed hearing such positive math talk in my class. This positive talk turned into confidence building feelings within my classroom. As I conducted my research, I continually found results that confidence was building in my students. Six students indicated on their mid-research survey that their confidence level was higher than their initial survey while in the same time period three students indicated a decrease. During this same time, all the other students remained level in their self-evaluation of confidence (Student Survey, March 14, 2008). On the same survey at the conclusion of the project, eight students indicated that their confidence was higher than from the beginning of the project. At the same time, only two of the 32 students indicated lower confidence while 22 of the 32 remained unchanged. This comparison is evaluated only on the students who took all three surveys.

By utilizing another survey tool, I tracked the answers of the students on any changes that they felt about confidence through the project. Students were asked to rate their confidence level without answers provided and then again with the answers provided. Tables 3 and 4 represent the classes with their individual ratings and then the combination of all the students in the research project.

Survey Question #3: When I do not have the homework answers, my level of confidence is: scale score of 0 –10. 0=have no confidence, 5=somewhat confident, 10=very confident

Question #3	Period One	Period Two	Classes Combined	Question #3	Period One	Period Two	Classes Combined
Average	6	7	6.6	Average	5.9	6.5	6.3
Student #	13	20	33	Student #	14	22	36
Min	2	2	2	Min	3	1	1
Max	10	10	10	Max	9	10	10
Stand. Dev.	2.3	1.9	2.1	Stand. Dev.	1.6	2.3	2.1

Results of the mid-research survey, 3/13/08

Results of the end of research survey, 4/16/08

Table 3

Survey Question #4: When I am given the homework answers, my confidence level is: scale score of 0-10. 0=have no confidence, 5=somewhat confident, 10=very confident

Question #4	Period One	Period Two	Classes Combined	Question #4	Period One	Period Two	Classes Combined
Average	7.8	8	7.9	Average	8	7	7.4
Student #	13	20	33	Student #	14	22	36
Min	4	5	4	Min	5	3	3
Max	10	10	10	Max	10	10	10
Stand. Dev.	1.9	1.6	1.7	Stand. Dev.	1.6	2.3	2.1

Results of the mid-research survey, 3/13/08

Results of the end of research survey, 4/16/08

Table 4

These results show that my students rated feeling more confident on average when the answers were provided. Period one had more of a consensus on their feelings of confidence growth while period two had a less dramatic difference (Tables 3 and 4). One possible reason for the greater variance in period two was that on the concluding survey, I was able to get results from my chronically absent students who had struggled in my class.

By conducting small group interviews in the middle and at the conclusion of research, I received comments that confirmed that their confidence was growing.

Interview Question #7: Has knowing the answers to the homework problems before you begin affected your confidence level in math?

Nathe: "I like it more since it helps me to figure it out more. It gives me more confidence when I do it right. When the answers are there, I know I'm right. When I did not have the answers, I could get a whole assignment wrong and then have to do it again. Since I know right away if I'm correct or not, now I can change it right away."

Chaney: "It depends, sometimes I like it on the harder stuff so I know if I'm doing it right so I can double check, but most of the time I like having the answer later so that I have to work for it."

Elly: "I was more confident on the homework and less confident on the test."

Joell: "Made the homework easier for me."

Jared B: "Easier to get homework done when I had the answers, I paid attention in class better."

Shanna: "My confidence was up; it made me want to do the problems to reassure that I know how to do it."

Kaylla: "I was more reassured."

(Student Interviews, March 13, 2008 and April 16, 2008)

I found that this new homework method gave confidence to my struggling students. Several of my lower ability students were more willing to try. The fear of having the wrong answer was gone. “Jarod and Jakob both mentioned that they like the new homework method. It was helping them to get started and try problems that before had seemed insurmountable” (Teaching Journal, Feb. 15, 2008). I also mentioned in my journal how some of the prior struggling students have begun to answer questions for other students since they have been assured that they got the right answer. “Jarod told me that this was fun and easy” (Teaching Journal, March 14, 2008). Jarod has been a struggling student that really did not attempt much. I saw this as a breakthrough for him. It seems that he was more confident to try now.

Students’ confidence levels rise as their view of homework becomes a personal learning tool. Zake’s comment summarized the comments received from many students. He wrote, “I like how you give the answers. It makes it easier for me to find the answer and find the way to get it. It makes it easier to figure out if you’re right when you get done” (Student Record Sheet, March 14, 2008). It seems that the students were more self-assured about their work when they knew that they got the answer correct in a timely manner. The immediate feedback was helpful to most students that used the answers as a learning tool.

Research Question #3: How will the time spent on homework out of the classroom and in the classroom be affected by changing the focus on daily work?

I found that students spent more time in class and less out of the classroom by changing the homework strategy. They were able to complete the work in class more efficiently since the doubt of knowing if they were correct or not was removed. In evaluating weekly student record sheets, students indicated that they completed more work in class and used less out of class time to complete assignments. Multiple students indicated no score for out of class time since they got

homework entirely done in class. The self-assurance that they were correct made it easier to continue and complete homework assignments, which in turn helped to build confidence.

My survey results about how the students' time changed also confirmed that students spent more time in class while using the new homework strategy. The results I received from both the mid-research survey and the concluding survey indicate more time was spent in class than the students had previously spent.

Survey Question #5: The time I am spending on homework in the classroom has: 1-5 scale. 1=I do not use time in class, 3=no change in class time, 5=using all my in class time

Question #5	Period One	Period Two	Classes Combined		Question #5	Period One	Period Two	Classes Combined
Average	4	3.9	3.9		Average	3.7	3.9	3.8
Student #	13	20	33		Student #	14	22	36
Min	2	2	2		Min	3	2	2
Max	5	5	5		Max	5	5	5
Stand. Dev.	1	1.6	.9		Stand. Dev.	.7	1	.9

Results of the mid-research survey, 3/13/08

Results of the end of research survey, 4/16/08

Table 5

Survey Question #6: The time I am spending out of the classroom has: 1-5 scale. 1=I do not use any time out of class, 3=no change in time out of class, 5=spending a lot of time outside of class

Question #6	Period One	Period Two	Classes Combined		Question #6	Period One	Period Two	Classes Combined
Average	3.3	3.3	3.3		Average	3.1	3.1	3.1
Student #	13	20	33		Student #	14	22	36
Min	3	1	1		Min	2	2	2
Max	5	5	5		Max	4	5	5
Stand. Dev.	.7	1	.9		Stand. Dev.	.7	.8	.8

Results of the mid-research survey, 3/13/08

Results of the end of research survey, 4/16/08

Table 6

Period one had ratings of 4 and 3.7 and period two rated a score of 3.9 for both mid-research and at the end of the research indicating that they were spending more time in the classroom on homework (Table 5). The question about spending more time out of class on homework was not as significant a change with both classes having an average rating of 3.33 or less on a scale that a 3 indicates no change (Table 6). These numbers show that students were spending more time in the classroom completing the work. The rating of 3.9 and 3.8 for in class

time and the ratings of 3.3 and 3.11 for time out of class show me that they were using their class time better. On these surveys, a common consensus can be summarized by Codie and Gare's comments, "I do a little more in class," and "I use my class time better" (Student Record Sheet, April 1, 2008).

Students were making choices in the classroom on what to work on. I saw students leaving the basic knowledge and comprehension questions for later at home. "I can get that one, but what about this one?" (Teacher Journal, Feb 15, 2008) is what I heard them saying. Students seemed more willing to begin the practice problems to see if they had the concept while still sitting in the classroom. In my journal observations, I noted that students seemed to want to get started while they could ask me questions in the classroom. I observed,

It seems that students are using their class time to get work done. Perhaps they are able to work more quickly with the answers given. They know they are correct right away and can continue working on. The weekly record sheets are telling me that more students are getting work done in class" (Teaching Journal, March 28, 2008).

On April 2, I made a special note in noticing that all students were immediately on task when homework time began.

The room was silent for a bit as everyone was trying and checking answers as they went. I must say that this is a noticeable change for this class. In-class, on-task behavior has been a challenge for this group. The change I've seen is in student effort during class time (Teaching Journal, April 3, 2008).

During the final group interview, I once again heard from students that they were using their time in class better. Shanna and Amandie both felt that they spent less time out of class in completing assignments. "I knew I got the problem right immediately and I did not have to

second guess if I was right or not. I could move on since I got it right” (Student Interview, April 16, 2008). All of these examples showed that students were using their time better for learning.

Research Questions #4: What happens to my teaching when I provide students with answers to the homework ahead of time?

My teaching time became more efficient, productive and valuable to the students by giving the students answers when problems were assigned. I noted that less time was being spent on the homework checking routine. When questions were asked of me, I could more productively pinpoint problem areas in student thinking since the process was all that we were discussing. I required students to tell me their set-up for the problem. That in itself forced students to go further than just saying “I don’t get it” and waiting for the answer. An example is what I wrote about the student Gare, “I received more feedback on what he did not understand rather than a blanket comment that I don’t get it. This was definitely a breakthrough for Gare” (Teaching Journal, Feb. 15, 2008). I also noted in my teaching journal that the students seemed to want to have more of my time to answer their direct questions. They realized that I could guide them through the process better than anyone outside of the class. They used my time better in the classroom.

I became more productive, efficient and able to understand the students’ reasoning when answers were provided ahead of time on homework. I enjoyed getting a better window into the students’ thinking. I felt that I knew the students’ thoughts better and that I was better able to help them find the gaps in their concepts. My previous homework strategy lacked rich classroom discussion. The main tool I used to gather information on their level of understanding was what they showed me on paper. Many of my students were not showing me much. By forcing the process and requiring them to have a set-up to the problems, at least I could better evaluate where they were as far as conceptual understanding with my new homework strategy. An

example of this was when Dusty was required to show the process on a test. In those steps of the process, I could see that only one of the five steps involved were incorrect rather than the entire concept (Summative Assessment, March 5, 2008).

Class discussions became more centered on multi-step problem solving by using critical thinking skills when answers were provided prior to homework. During the concluding small group interview, JC said, “It changed the questions that I asked in class. I knew better what to ask you, my questions probably changed from what I asked before” (Student Interview, April 16, 2008). I found many journal entries that addressed the fact that students’ questions now focused on the multi-step problems and that they knew better what to ask.

I have definitely seen a difference in the questions that I am being asked and in the more efficient use of class time. The questions students are asking are so much more specific. I feel that I am able to really help a student pinpoint their gap in understanding and I can fill it in for them much better. Since the student usually has about 80% of the procedure correct, I spend time answering only the 20% that they did not understand. I feel that I am making better inroads to their understanding (Teaching Journal, April 4, 2008).

Gare started asking questions. He started doing homework. He even said, “I actually did these problems.” Gare has not usually completed his homework outside of class. On the worksheet for simplifying radicals, Gare asked during class, “I keep getting the 3 on the outside instead of on the inside like the answer says.” He was very specific in his question and by him sharing and identifying where the difference was, I could easily help him and remedy his misunderstanding (Teaching Journal, Feb. 15, 2008).

Conclusions

When the answer is no longer the goal on homework, I was able to spend more time on conceptual learning. Like Atkinson, Deroy, Renkl and Wortham (2000) found, once the surface features are removed, teachers and students are able to focus on deeper structural aspects of the problems. As an instructor, I was able to spend valuable time on only what students did not understand. By being more productive with my time in the classroom, I could help the students to be more engaged in work that matters to them. Corno (1996) found that it is not the amount of homework, rather, the time spent engaged in academic work, that breeds success. Any strategy

that instructors are able to enact that engages students more is worth the time. With my homework process, the questions I received were more specific and efficient which also led to better use of classroom time. Students were able to use me for guidance in their learning rather than as an answer checker.

It may sound strange, but perhaps the game of getting the answer correct was gone, so now the “game” became deeper conceptual understanding. Conceptual understanding was much harder to achieve and required more on the part of the student. I liked this because it aided in deeper, richer understanding of the mathematics. It seemed that during my research project, my students were not as afraid of “getting the answer wrong” since they already knew the answer. Perhaps a bit of the fear of being incorrect was eliminated since they had the answers. Bibby (2002) discussed the emotional side that student’s have with mathematics. My students felt more confident and were willing to put forth more effort so I concur with Bibby’s results. As student confidence grew through the sharing and helping of others, communication in the classroom became more vocabulary rich and positive.

Students know that homework is for their benefit. Even though they know this, they still are frustrated by having to complete it. By far, students’ confidence levels rose when the focus changed from answers to process. Many students felt that the answers helped them in their learning. For some it quickened their work and made their homework time more productive. The immediate feedback benefited their learning.

Heitzmann (2007) had found that students must know that their homework matters in the learning process. Perhaps students began to view homework as a learning tool rather than an evil part of the math curriculum. The difference between “doing” math and “learning” math was an important idea for students to grasp on their path to autonomous learning. Through my project, I

believed by changing the focus on homework, my students saw that school is about learning. Perhaps I was able to have a slight influence in their personal views on the purpose of homework. Anthony (1996) found that if students gain a learning strategy that is productive for them, they can be successful. My research shows that this change in homework strategy was advantageous for some of my students.

I believe my 14-16 year old students are still in a transition time in developing their autonomous learning. They still believe that they must perform for the teacher to get a grade. Some of the students are beginning to see the idea that they need to know concepts for themselves, but it is still a distant or non-existent thought for many. Corno (2000) wrote that to make homework more successful, students must view it as their responsibility. During these adolescent years for my students, they have many lessons about responsibility to learn. One important lesson to discover is that learning is personal and achieved when one do it for oneself.

Implications

As a teacher, I enjoyed having the answers provided. I plan to use this homework strategy in the future, but not on every assignment. There is a time and a place when having the answers provided is of great benefit to the students' learning. At the beginning steps of knowledge acquisition and conceptual development, having answers provided does not seem beneficial. On one-step problems, it is hard to evaluate understanding when students are given the answer. I foresee changes that might force my homework assignments to become more involved with multi-step problems and critical thinking. On problems that encompass many concepts and mathematical processes, my new homework strategy proved advantageous. Gaining critical thinking skills through more multi-step problems will be a future goal of my homework strategy.

As one of the ideas I have learned through Math in the Middle, students need the opportunity to struggle with problems. As an instructor, I plan to guide more as a coach in directing that learning. During my project, I remembered to use these ideas of Austin (1980) allowing my students the opportunity to struggle and learn.

I will continue to work on the personal emotions associated with the working of mathematics. Personal feelings that get in the way of students being successful in the math classroom intrigue me. At this time, not much research has been done on the emotions involved in the math classroom. I plan to continue my search into this aspect of the math classroom. Teachers must instill a love of math along with the confidence to do the thought processes. Gaining an appreciation of math in our everyday life would enable my students to enjoy a life full of learning. I had hoped to equip my students with the ability to learn in the future. Becoming an autonomous learner should be an over-reaching goal of our education system.

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5. Since you are scoring your own homework, has there been a change in your understanding of your homework problems?

Describe that change to me.

6. What is your opinion about having the answers to your homework before you begin?

Has it changed your homework in any way?

Describe the changes you have made.

7. Has knowing the answers to the homework problems before you begin affected your confidence level in math?

What type of change has occurred?

What do you think of this change?

8. Has knowing the answers to the homework problems before you begin affected the time you spend on homework?

In the Classroom?

Out of the class room?

What type of change has occurred?

Why did you make this change?

Is there anything you want to know from me?

(Last interview) As you think about how I will do homework next year for my math class, what advice would you give me?

(Last interview) If you could talk to your next year's math teacher, what advice would you give him or her about how to do homework for your class next year?

Appendix B

1	My effort on homework is:										
	0	1	2	3	4	5	6	7	8	9	10
	no effort		I do a little			I do some		I attempt most			100% effort daily
2	My level of reasoning on homework is:										
	0	1	2	3	4	5	6	7	8	9	10
	no thoughts		I reason through simple problems			I attempt some		I think through most			I understand the concepts
3	When I do not have the homework answers, my level of confidence is:										
	0	1	2	3	4	5	6	7	8	9	10
	have no confidence		unsure		somewhat			mostly confident			very confident
4	When I am given the homework answers, my confidence level is:										
	0	1	2	3	4	5	6	7	8	9	10
	have no confidence		unsure		somewhat			mostly confident			very confident
5	The time I am spending on homework in the classroom has:										
	1	2	3	4	5						
	I do not use any time in class on homework		I am spending less time in class		No change in class		I am using more class time		I'm using all my class time		
6	The time I am spending out of the classroom has:										
	1	2	3	4	5						
	no time outside of class		spending less time outside of class		no change		spending more time outside of class		spending a lot of time outside of class		
7	By self-assessing your homework, have you changed your homework effort?										
	Yes or No If it has changed, how?										
8	By self-assessing your homework, have you changed how much homework you complete?										
	Yes or No If it has changed, how?										

Appendix C

Student Survey

Name: _____

Date: _____

or Student ID #: _____

I usually try to complete this percent of my homework: _____ (0%-100%)

When I complete my homework, it is because:

If I do not complete my homework, it is because:

I believe math homework is assigned for this purpose:

I usually spend _____ minutes on math assignments outside of the classroom.

I would use this word or phrase to describe homework:

**H
O
M
E
W
O
R
K**

My confidence level in math

is:	5	4	3	2	1
	Very Confident		OK Confidence		I have no confidence
	in math		in math		in math

I would use this word or phrase to describe math:

I would use this word/phrase to describe my confidence in mathematics:

I feel I could improve my confidence in math by:

I feel confident in math class when:

I feel do not feel confident in math class when:

**C
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T
H**

Add any additional comments that you have about homework or your level of confidence in math:

Appendix D

Daily Practice Self-Assessment Scoring:

Students are expected to complete work assigned daily to achieve the highest level of understanding in geometry.

<p>Proficient Satisfactory, Possible Minor Flaws</p> <p style="font-size: 2em;">3</p>	<p>Shows understanding of the concepts and processes. Uses appropriate strategies to evaluate and model expressions. Computations are mostly correct. Written explanations are effective. Diagrams are mostly accurate and appropriate. Satisfies most all requirements of the problems.</p> <p><i>I am confident with my level of understanding on this assignment. I am proud of my work.</i></p>
<p>Progressing Nearly Satisfactory, with Serious Flaws</p> <p style="font-size: 2em;">2</p>	<p>Shows understanding of some of the concepts and processes. May not use appropriate strategies to evaluate and model expressions. Computations are somewhat correct. Written explanations are satisfactory. Diagrams are somewhat accurate and appropriate. Satisfies some requirements of the problems.</p> <p><i>I could have done better, but I lacked knowledge and/or effort. I was unsure on some ideas in this homework.</i></p>
<p>Beginning Unsatisfactory</p> <p style="font-size: 2em;">1</p>	<p>Shows little or no understanding of the concepts. May not use appropriate strategies to evaluate and model expressions. Computations are incorrect. Written explanations are not satisfactory or do not exist. Diagrams are not accurate or appropriate. Does not satisfy requirements of problems.</p> <p><i>This work is not completed to the best of my ability. I do not know these concepts. I am not proud of this work.</i></p>

Appendix E

Homework Record Sheet

Name: _____

Week of: _____ Period: _____

*Comments for teacher:***F** What I worked on:

My in class effort: 3 _ 2 _ 1

My out of class effort: 3 _ 2 _ 1

Time spent out of class: _____ minutes

One word to describe my work today:

My self-assessed rubric grade: 3 _ 2 _ 1**M** What I worked on:

My in class effort: 3 _ 2 _ 1

My out of class effort: 3 _ 2 _ 1

Time spent out of class: _____ minutes

One word to describe my work today:

My self-assessed rubric grade: 3 _ 2 _ 1**T** What I worked on:

My in class effort: 3 _ 2 _ 1

My out of class effort: 3 _ 2 _ 1

Time spent out of class: _____ minutes

One word to describe my work today:

My self-assessed rubric grade: 3 _ 2 _ 1**W** What I worked on:

My in class effort: 3 _ 2 _ 1

My out of class effort: 3 _ 2 _ 1

Time spent out of class: _____ minutes

One word to describe my work today:

My self-assessed rubric grade: 3 _ 2 _ 1**TH** What I worked on:

My in class effort: 3 _ 2 _ 1

My out of class effort: 3 _ 2 _ 1

Time spent out of class: _____ minutes

One word to describe my work today:

My self-assessed rubric grade: 3 _ 2 _ 1*This week I felt:*

Appendix F

Teacher Journal Prompt Guidelines for my Research Project:

Research Questions to focus on:

1. What will happen to the students’ level of effort and homework completion by having students self-assess their daily work?

2. What will happen to students’ confidence levels and their view on the purpose of homework when answers are not the desired output on homework?

3. How will the time spent on homework out of the classroom and in the classroom be affected by changing the focus on daily work?

4. What happens to my teaching when I provide students with answers to the homework ahead of time?

Reflection Questions:

1. What did I observe about students’ levels of effort this week?
 2. What changes have I seen in my students this week as they work for understanding, not answers?
 - a. (time, confidence, effort, completion)
 3. What did I learn this week about students’ views on homework?
 4. What went really well this week, related to my problem of practice (homework processes)?
 5. What did I learn this week about transferring new homework practices into reasoning in mathematics?
- ~~~~~

My journaling goals:

- Each day I will jot down notes of possible things I could write about. (i.e., one student, one math problem, one conversation).

- I will set aside a specific journaling day. My writing will be partly a description of the event and partly a reflection on why I chose this event, how it relates to my research question(s), and what it means to me. I will aim to write for approximately 30 minutes per week; 15 minutes on describing the 1-2 events, and then 15 minutes writing the reflection.

Teacher Journal Template

Week of _____

Possible Journal Topics:

Monday

Tuesday

Wednesday

Thursday

Friday

Details of Two Events:

Part description of the event and part reflection on why I chose this event, how it relates to my research questions, and what it means to me.