Spring 5-11-2018

The Role of Homework in a Mathematics Classroom

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The Role of Homework in a Mathematics Classroom

A Project Presented to

The Graduate Faculty of

Minnesota State University Moorhead

By

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In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in

Curriculum and Instruction

May 2018

Moorhead, Minnesota

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Study Abstract

Title: The Role of Homework in Mathematics Classroom

Purposed Study:

The purpose of this research was to study what type of homework shows the most student improvement. The research focused on growth from a pre-test to a post-test that will compare the different types of homework assignments given in class. Each group was given the exact same lesson and topics to cover, but with different assignments for the day. After one week of the exact same assignments, the groups had a different type of homework for a week and then growth was measured using that homework. This allowed for further comparisons to conclude which type of assignment helps students grow the most.

Chapter One

General Problem/Issue

Homework has been a staple of American high schools for many years. In our world today, students have more responsibilities than ever before. Between sports, activities, jobs, family time, and school, the amount of time dedicated to homework is becoming less and less. Homework, especially in math, is still necessary to improve test scores, as it provides opportunities to practice for students. The issue is what homework best helps students increase their math scores and shows the most student growth.

The increase in homework resulted from the 1950s, when the Soviet Union launched Sputnik (Vatterott, 2009). Before this, especially in elementary grades, homework was falling out of favor among many schools with some abolishing homework completely. In 1957, when Sputnik was launched, Americans became fearful that the Soviet Union was going to pass America as the leading superpower, especially with the Soviet Union's improved technology. With this in mind, homework became a way to increase students' knowledge at a faster rate. The Soviet Union continued to expand their power, and with it, increased tensions with United States. Adults of the United States wanted their children to be at a higher level, when compared to Soviet Union students and the solution was to increase homework. In the next decades, the pendulum swung the other way towards limiting homework, as parents wanted their children to be able to play when they got home (Vatterott). With the release of *A Nation at Risk,* schools came under more pressure to improve student's abilities and in turn, homework was increased again. *A Nation at Risk* was a watershed moment in educational methods. According to *A Nation at Risk,* "American schools were getting worse: test scores were falling, millions of Americans were illiterate, and our teachers weren't educated enough or paid enough" (Boyd, n.d.). In recent

times, homework has come under scrutiny again as students' lives outside of school have become busier and busier. Throughout the institution of public schools, homework and the amount of homework that is assigned has been on a pendulum. With each decade, a change in the role of homework has changed. Throughout all this, schools and teachers have had to content with the rise of standardized tests and more pressure to improve student's abilities. Homework should not be a punishment but an opportunity for students to grow. Homework should an opportunity for students to practice their skills.

The issue is determining the best way to use homework for students to improve. With issues such as the amount of problems, the type of homework, and assigning grades to homework, it's difficult to know the best way of using it. Too often, homework is assigned and forgotten about by both students and teachers. It is assigned by the teacher, completed by the students, graded by the teacher, and then thrown away by the student. It is not analyzed by teacher or student beyond what grade the student received. It is too often seen as a punishment by students and not as a learning opportunity. If students are completing homework, there should be a way for homework to become more effective for students and teachers for improving student scores and abilities. By analyzing homework and what method of grading homework shows the most improvement in students test scores and math ability, homework can be better used to show improvement.

This topic has always been of interest to me. Since I have started teaching, homework has always been an issue of how to grade it and analyze it. At times, I have graded every problem, but the issue is the amount of time it takes and many students didn't use it to improve. The longer I have taught, I have trended towards checking for completion and then reviewing the answers. The students seem to comprehend and achieve at a higher level compared when using

this method as compared to other methods. Another idea thrown out is the idea of checking for completion on what they did in class. At the end of the hour, the students could show how far they were with that day's assignment and that would be their score for the idea. With the increase in technology, some classrooms in my current school district have moved to online only assignments. I have used this some, with sites like IXL.com, with mixed results. Some classes enjoy it, and feel it is beneficial, while others dislike it, due to the program itself. The reasons given for the feelings toward IXL is the amount of time it takes and the program needs answers in specific formats. Students have complained that, even if their answer is exactly the same as what IXL has but with a decimal instead of a fraction, the program marks it incorrect and the students go backwards with their score. With the increase of technology in schools and classrooms, it will be interesting to see what online homework does to increase student achievement. Another method I am curious of is the idea of no homework. Some schools have adapted this policy and I know students would approve of this method, but this method is the technique I feel most uncomfortable with. In Finland, schools typically assign limited homework and their test scores are among the top three in reading and mathematics combined (Sahlberg, 2014). It will be difficult to check for understanding using this method, as a teacher may not see student work until a quiz or test. By researching this issue, I hope to find which method of analyzing the homework and grading it best shows student improvement.

Subjects and Settings

Description of subjects. The research will focus on fifteen eighth through eleventh grade students ranging from thirteen to eighteen years old. The school is 91% white and 5% American Indian. The classes are mixed in terms of gender. There are a total of six females and nine males. There are four students with an Individualized Education Plan (IEP) and there is a

paraprofessional in the classroom to help students with an IEP. The classes also have a free and reduced lunch population of 54%. Students in the middle school exceeded on the Minnesota Comprehensive Assessment (MCA's) at a rate of 17.8% on math, while high school students exceeded 4.8% of the time. In the middle school, 23.8% met the standards, while 33.3% met the standards at the high school level.

Selection Criteria. For this research, I decided to use students that are in the Algebra 1 class in my current school district. The class ages range from fourteen to sixteen and currently has fifteen students. Four of the currently have an IEP and there is a paraprofessional in the class to assist students with the IEP.

Description of Setting. This study will take place in a small town in Minnesota with a population of approximately five hundred people. Many students in the school participate in an extra-curricular activity, with sports being the leading one. The average class size is twenty students and the school has students in pre-kindergarten to twelfth grade. From our graduating classes, the school averages 74% of students going to an Institute of Higher Education. The school typically graduates 85% of students in each graduating class. The median income for a household in the area is $22,308.

Informed Consent. Permission was obtained from the Institutional Review Board at Minnesota State University and from the school district to conduct this study. The school district's IRB procedure was followed to obtain permission to conduct research. This involved receiving permission from the Superintendent at the school where the research was conducted.

Protection of human subjects participating in research was assured. Participants were informed of the purpose of the research and any procedures required by the

participant, including disclosure of risks or benefits. Confidentiality was protected through the use of pseudonyms without identifying information. The choice to participate or withdraw at any time was outlined verbally.

Review of Literature

Homework has always been an issue for many students. Between apathy, not enough time, lack of understanding, or many other reasons, homework has always been a struggle. This study will examine what type of grading on homework most improves student performance. Teachers continue to assign homework because it depends on two common components: practice and perseverance (Larson, 2016). But there is still a discussion on the importance of homework and whether homework is needed. The number one reason, according to Pat Hinchey, was that students don't have enough time to complete homework (as cited in Kralovec & Buell, 2000, p.56). Even in the late nineteenth century and early twentieth century, there was a debate over homework. The idea is that homework is hurtful to students' mental and physical development (Eren & Henderson, 2011). But most teaching professionals agree that homework is necessary for improvement. This is supported by Harris Cooper when he showed there was a positive correlation between homework and student achievement (as cited in Reilly, 2006). An extra half hour of math per night in seventh grade through eleventh grade can advance a student an estimated two grade equivalent (Eren & Henderson, 2011). Many teachers understand the need for homework, but what value should we place on homework and how can teachers best use their students' homework to improve understanding.

Student growth is the main goal of all teachers. They want to see students improve from the beginning of the year until the end. Homework and assignments are the best way for students to practice the skills they learned. Students understand this as well. A study completed by Dr.

Julie Saam and Dr. Taekhil Jeong in 2013, which interviewed and studied three hundred students from a school located in a Midwestern state, states that "most students of the school perceived the homework to be very to somewhat important" (p.4). This quote shows that students understand the importance of homework and how valuable it can be. For mathematics, the correlation between average time spent on homework and math achievement was statistically higher than for reading (Saam & Jeong, 2013). This shows the value of homework, especially in mathematics, and how important it is. The debate exists between what type of homework that should be assigned and how much time should be spent on it.

Statement of the Problem. The purpose of this study is to investigate what grading policy and type of homework helps middle school and high school students achieve at high levels on classroom tests that will hopefully lead to improved scores on standardized tests.

With various types of homework, such as "drill-and-kill" and computer based programs, there are different types of mathematics homework being assigned. For middle and high school students, this study will examine the different types of assignments and attempt to find what best works for students.

Online homework. A common trend of many high school math teachers is moving towards web-based grading. Many teachers use programs like IXL to assign and grade homework. With the increased amount of technology in the classroom, the ability for students to get instant feedback, and the fact that our Minnesota Comprehensive Assessments (MCAs) are web-based are the ideas driving the fact for many teachers. As compared to paper-pencil based classrooms, the results have been mixed. High intrinsically motivated students do well with either paper and pencil based assignments or online-based assignments, while lower intrinsically motivated students performed better than normal on online homework (Dillard-Eggers &

Wooten, 2013). In a review of seven different studies on the effect of online based homework, it was found that four of the studies were inconclusive; Another studies two viewed online homework as favorable as compared to more traditional methods; another viewed online homework as unfavorable (Krueze, Krueze, Langsam, & Penner, 2016). In a different study, researchers found that students who used online-based assignments had a higher average growth as compared to those who used paper and pencil (Heffernan, Mendicino, & Razzaq, 2009). There are still several issues of moving to only online-based assessments, though there are students that don't have online capabilities at home and this limits their ability to complete their homework. Another factor is technology in the classroom. Some schools are not yet one-to-one in terms of device use, so some students may not be capable of completing their assignment in school as they don't have access to technology. Age is also an interesting comparison when viewing online assignments. Older students found lower levels of understanding and reported lower level of satisfactions with the online-based assignments as compared to younger students (Krueze et al., 2016). The debate over homework itself predates the online debate.

Time. An issue many students and parents have with homework is the amount of time spent on it. According to a survey based on one-hundred students from the National Association for Educational Progress (NAEP), thirty-six of the students who were seventeen years old had more than an hour of homework daily (Loveless, 2014). According to research conducted by the University of Oviedo in Spain, the optimal time spent for homework is one hour (Stahle, 2015). Dr. Harris Cooper, Duke University, recommends "that for each grade level, an additional ten minutes of homework is added" (as cited in Reilly, 2016). This means for a second grader, they should be doing twenty minutes of homework, while a fifth grader should be doing fifty minutes of homework. But the amount of time spent doesn't correlate to better math achievement. Time

needed is higher in students with low cognitive abilities and/or low achievement (Trautwein, 2007). Many students will report that they spent hours on homework, but we need to measure active time spent on work minus any distractions. According to Trautwein (2007), "At a class level, a higher number of homework tasks and higher homework achievement have proved to be associated with higher achievement gains, but more time on homework has not" (p.2-3).

Formative assessments. The goal of all homework, regardless of amount or type, is to help increase student achievement in the classroom and on standardized tests. One method of using homework more wisely is by using formative assessment. According to the Glossary of Education Reform, "Formative assessment refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, or course." Formative assessment helps students learn while they are doing the homework. Using formative assessment, teachers are able to identify where students make mistakes and help to correct them before getting to a summative assessment. With formative assessment, teachers must be aware of the type of assessment they are giving, to ensure it is easy to use, and to track the data to see how students are doing with it (Accordo & Kuder, 2017). It also allows students to adjust their plan of what they need to learn and instantly allows teachers to adjust to what their students know. With formative assessments, not as much homework is assigned, but practice is more done completely in class. This allows for instantaneous and descriptive feedback for students (Haley-Speca, 2016). This form of feedback has shown to have a large impact on students. According to John Hattie's research, formative assessment has an effect size of .9, while feedback has an effect size of .73. An effect size of .5 is a grade level increase, while an effect size of 1.0 is a two grade level increase.

Role Of Homework

Usage of Homework. The usage and the type of homework assigned in class is important as well. According to Rob Wieman and Fran Arbaugh, "An important characteristic of homework is that it provides each individual student with the opportunity to develop skills and to think about important mathematical ideas" (as cited in Cirillo, Herbel-Eisenmann, & Otten, 2015). When going over homework in class, it allows students to collectively work on the homework and have discussions about the homework (Cirillo et al). The students can also see how different students solved a problem that make more sense to them.

The type of homework has an impact on student achievement. There are four demand levels placed as it relates to homework: memorization, procedures without connections, procedures with connections, and doing mathematics (Smith & Stein, 1998). The memorization and procedures without connections are typically lower demand questions that typically require students to "drill and kill" by answering several lower cognitive level questions. Procedures without connections is doing problems that practice a skill, but not typically word problems. Procedures with connections comes from doing that practice skills in an applied situation. Doing mathematics is giving a real world situation and the students have to come up with the best way of solving. Having homework that contains procedures with connections and doing mathematics helps raise the students' achievement level. While many teachers may want to move to level four for their homework assignments, it is recommended to stay at the procedures with connections level, as moving to the doing mathematics level may prove too challenging for students to complete at home, and may create frustration (Lassak & Walk, 2017). While moving away from the memorization and procedures without connections level, this allows students to have fewer problems of homework, as the level is raised and the need for so much homework is reduced (Smith & Stein, 1998). The doing mathematics level is typically tasks that are completely done

in class and should be assigned as homework on an irregular basis. Finding the level of development for students doesn't fix everything, however some students will still skip the occasional problem, claim they ran out of time or don't understand the assignment (Lassak & Walk, 2017). Finding developmentally appropriate homework doesn't necessarily mean every student will always complete their homework.

Hypothesis Statement

With the idea that time, type, and feedback while related to homework being key characteristics of successful homework assignments, checking for completion while allowing students to ask questions should result in higher achievement. Therefore, grading assignments for completion, while also reviewing homework in class, results in showing more student growth in math than other methods of grading.

Chapter Two

Research Question

As a middle and high school math teacher, homework has always been a primary concern. As a teacher, we want to make homework as relevant as possible for the students to improve their skills. Assigning homework for the sake of homework wastes everyone's time and effort. With the added pressure of MCA test scores and our growth goals established by the state, we can't waste any time or effort to improve our student's abilities. Add in the fact that students have far more extra-curricular activities drawing their attention, time has become a more valuable commodity. From the research and my own personal goals, I have become even more interested in the role of homework in classrooms and have formulated the following research questions: What types of assigned homework shows the most student improvement on tests?

Answering the question allowed me to become more comfortable with what type of homework and how much homework best helps students improve their math ability and their test scores.

Research Plan

Methods and Rationale. For the collection of data, I used one class while every two lessons, changing the type of homework assignments. This will allow the comparison of students from the same group with four different types of homework to compare. Before the sections, the students took a pre-test on the material to get a baseline score. The students then received homework based on those two sections after going through a lecture based on the section. After completing the two lessons, the students took a post-test that was very similar to the pre-test. This allowed for a comparison of the homework methods. The students then followed the same procedure but with a different method of homework for the next two sections. The class followed

an ABCDABCD method. The first two sections were checking for completion, the next two were all online, the next two were no homework, and then finally grading each problem.

The pre-test and final tests were very similar to each other, with different numbers inserted into the problems. The pre-test was handed out at the very beginning of the hour, while the final test was distributed in a similar method. The tests both had twenty questions on them and are due at the end of the hour.

The students and group's growth scores from the pretest to the posttest was the primary tool to compare the different methods of homework. With these scores, we were able to look at average growth that allowed me to compare the different homework policies that can show which method of homework worked best in this research.

Schedule. Before the start of the lessons, at the beginning of the hour, we took a pretest to get our baseline score. After the pretest, we started a lesson covering the topics. At the end of the lesson, the students each received their homework assignment, as discussed in the previous section. All homework was due the next day. After two sections, the students took a post-test to compare growth. For the next two sections, the homework policies will change for the class, but the same routine will be followed.

Ethical Issues. The biggest ethical issue I had when conducting this research project was hurting the students as we move closer to MCA tests or hurting them when compared to one of the math standards at their grade level. I didn't want to choose a topic at a grade level where, if a student had a certain homework policy, it would damage their ability on the MCA test with a certain standard.

After completing the study, there were no ethical issues. The students were interested in this idea and went about as a normal day. The idea of missing concepts due to the type of homework was no issue, as the students learned the required material and scores were comparable to previous classes.

Chapter Three

Data Analysis and Interpretation

Description of Data

The purpose of this study was to attempt to determine which type of assigned work best helped students learn by finding a score pre-test about a topic and then taking a post-test after being taught the lesson. The topic being studied was comparing which types of assignments best helps students improve from pre-test to post-test. The pre-test consisted of fifteen questions each, except for the last one which only had eight. The pre-test was based around what would be taught in the upcoming lessons. The post-test was very similar, with only different terms. These students were typically high achieving students, with many of them receiving good scores on the Minnesota Comprehensive Assessment (MCA's). With this being their ninth grade year, they don't have a MCA test this year. With that in mind, participating in this study may help them the next few years until they take the MCA as juniors. The MCA's are an important measuring tool in Minnesota. Each grade level from 3rd to 8th grade have their own scale, which is indicated by the first number in their score. An 839 and lower is classified as does not meet; 840 to 849 is considered partially meets; 850 to 864 is considered meeting; and an 865 and above is considered exceeding. The scores for each student is included in Table 1.

Each class is different and by finding the way each class learns best, teachers can make their subject matter mean more. The best way to determine which method of grading best helped students was by comparing four different methods of assessments. These fifteen students were all in ninth grade that were all in Algebra 1 math class, which typically teaches linear equations, exponential equations, and quadratic equations. For this study, using quadratic equations felt the

most convenient in terms of time and was the next standard that was in our textbook. The tests were scored only if they were correct or incorrect answers given. Typically in my class, students are given partial credit for doing work. This allows students to show they know the skills but may make an arithmetic error or make a small mistake. For the sake of this study, I decided to only look for correct and incorrect answers. For the first round of completion homework, the students were tested on their knowledge of geometric sequences and recursive formulas. For the first round of online homework, the students were tested on adding, subtracting, and multiplying polynomials. For the first round of no homework, the students were tested on special types of polynomials and solving polynomial equations in factored form. For the first cycle of graded homework, the students were tested on factoring polynomials. For the second round of completion, the students were tested on graphing equations in the form: $y = ax^2$. For the second round of online, the students were tested on graphing equations in the form: $y = ax^2 + c$. For the second cycle of no homework, the students were tested on graphing equations in the form: $y = ax^2 + bx + c$. For the second round of graded homework, the students were tested on graphing equations of the form: $y = (x - a)(x - b)$, where a and b are some numbers. The students were also given a three question survey, asking "which method of homework grading did you prefer," "what type of homework did you learn the most from," and "what method of homework grading did you prefer the least" with the four types of homework from the study as options for answers.

Methods of Analysis

Participant Data

For this study, I used the Algebra 1 class at a school district which consisted of fifteen students. Further information on each student is provided on Appendix D.

All the students completed the pre-test and post-test and their scores were compiled into a spreadsheet. For the study, I used growth scores and averages of all pre-tests and post-tests from each of the fifteen students as my main source of comparison. An issue that I ran into during this survey was the number of days students were absent for vacations or sickness during the school day. The overall study took twenty days to complete. On average, students were gone for 2.13 days, but most of days absent were from students on vacation. These students missed the main teaching time and were unable to learn the content with their classmates.

Student Survey

The goal of the survey was to explore what the students actually preferred and to allow the students to answer what type of assignments helped them the most. It was a very simple survey to get more input from students on assignments.

Research Question

Research Question: What types of assigned homework shows the most student improvement on tests?

The completion homework meant students did the homework and to receive credit for the assignment, I checked that they completed the homework. After checking for completion, we went through each of the problems. The online homework was completed on IXL.com, a site our school uses for online problems. No homework was assigning no homework for the night, everything was done in class with absolutely nothing required outside of class. The graded homework was collected, graded by the teacher, and then handed back to the students.

From the table, which lists the pre-test scores average, post-test scores average, and growth score averages, the online homework for the fifteen question scores showed the highest

growth, while completion showed the lowest post-test score and lowest growth average. For the second cycle of homework comparison, completion showed the highest growth, while no homework showed the lowest growth. In total, when adding the growth scores to each other, completion homework showed a total growth of 12.36, online homework showed a total growth of 12.94, no homework showed a total growth of 11.81, and grading homework showed a total growth of 12.46. According to the data, there is not a lot of differentiation in the scores of the four different types of homework that were assigned. With only looking at the sums of the post-tests for each type of homework, completion had a total post-test of 12.36, online had 14.39, no homework had 13.26, while grading homework had 12.79. Even when using these numbers, there was not much variance in the scores of the different versions of homework. The average growth scores can be found in Appendix F.

While finding no real difference in the growth score and post-test scores, I then moved on to examining individual students to see if by analyzing individual students, if some improved using different assessments. These scores can be seen in Appendix G.

For student one, the different homework didn't make an impact. He was able to score highly on all four different methods that were given during the study. This makes sense based on his MCA scores and math ability that he typically demonstrates.

For student two, the homework methods again didn't make an impact. This can be seen in her MCA scores as well, and she is typically one of the highest scoring on tests.

For student three, the scores were more difficult to analyze based on the number of days missed due to his vacation. He typically scored highest on the online assessments. This makes sense as the IXL program self-corrects when a mistake is made. If a student gets a problem

wrong, they are given more questions. This works well for students that are absent, as they are corrected immediately on their answers and can see their mistakes.

For student four, the online and no homework worked a bit better, but by only two points for the first round. For the second time of online and no homework, there was no difference to the other two.

For student five, who also has an IEP, scored highest with the online homework and lowest on the graded. The online homework may be the best method of assessments for students on an IEP based on the past two results.

For student six, who is a low-achieving student on his MCA, the graded homework was the lowest. This student is someone who dislikes doing homework and has a low homework accomplishment rate. This makes sense that his lowest scores come from graded homework that was not completed.

For student seven, the completion homework was his lowest score. This student has high math ability, as seen from his MCA score, but lacks initiative at times. He doesn't always complete his homework on time or at all, but is naturally good at math. With completion, this student may just write down an answer to say it is complete and then forget about it.

For student eight, the completion was by far lowest. This student works hard for her grade, but is not naturally gifted at mathematics. The completion may not challenge her enough to answer questions to the best of her ability.

For student nine, the results were difficult to analyze. For the first completion assessment, she scored lowest but for the second time through, this was her highest score. This may come from the fact she was absent during the first completion assessment.

For student ten, the results are typical of what happens in class. She is great at some topics but really struggles at either. The completion worked really well the first time through, but didn't make a difference for the second time. She is in a group home and has bounced around quite a bit from home to home. She has had irregular times of education, but seems to have settled in at this current school district.

For student eleven, the lowest score again came from completion during the first round. He is similar to student seven, as he is naturally good at math, but lacks motivation.

For student twelve, the completion was the lowest for the first round, but the highest for the second. Since several students are similar with low completion scores the first round, the recursive topics discussed in that chapter may be difficult and requires a different instructional method to help students. This can also be seen by having the lowest post-test scores.

For student thirteen, the results were all over the place. This student is on an IEP for behavior. He is disorganized and typically loses homework and notes from the previous day. He has shown the ability in the past to have a high math ability, but lacks the organization to succeed. His no homework score was tied for his highest the first time, but the second time resulted in getting zero correct. This is a student that requires more attention to find out what is best for him.

For student fourteen, the different homework methods didn't make much of a difference. The completion and online homework resulted in the highest scores the first time, but all the scores were exactly the same for the second round.

For student fifteen, the completion was the lowest the first time, but received perfects the rest of the time. The first completion may again be a result of the difficulty level of the topic.

Overall, each student was good at some areas and struggled at others. This is why it is important to truly get to know each student. This can help them to achieve and for the teacher to find what is best for each student. It is also important to use differentiated instruction and differentiated assignments. Some students may really succeed at projects or group works, while others are great at individual problems. The key is to get to know the students and find what is best for them.

The survey showed more interesting answers, based on what the students thought. The students answered for their preference a tie between completion and no homework. This makes sense as most students don't typically want homework. The completion makes sense as well, because there is less pressure to get the answers correct; Students are grading their own homework and it is treated as practice only. One student stated that not having homework could be great if there was more practice. This could lead to the students to only doing in-class assignments, instead of assigned homework. This may be a great option for some topics, but could prove to be difficult when working on others that take more time for students. The type that students felt they learned the most from was completion. They stated they felt less pressure on the homework as it was just practice. The type of homework the students they felt they learned the least from was online and grading. For the online portion, some didn't have internet access at home, which proved to be difficult, while others just aren't comfortable with the online homework. The full results can be seen in Appendix H.

Conclusion

The four different assignments given to the students did not show much of a difference in the post-test scores. The scores all showed a very comparable score range. When comparing the

individual students, the same results are seen with little evidence of improvement when comparing the students. In answering the research question, it is difficult to answer what type of homework shows the most student growth. From the survey, there are more conclusions of what students prefer, but it is difficult to make evidence-based conclusions based on the data from the research. For my own teaching practice, I will continue to use a combination of completion and online assignments. The no homework concept was interesting, but more information is needed for me to feel more comfortable with the idea.

Chapter Four

Action Plan

For the rest of this school year and the upcoming years, I will be continuing to differentiate the different types of assignments that each class will be doing, including trying to

use the idea of no homework in class. Every student learns in different ways and I want to allow students to show their knowledge of topics in different ways. The assignments that were checked for completion seem to be the most successful for this class, but for some students, these assignments weren't as successful. Students that were more driven to succeed really did well with completion, where some that are less driven struggled. This is why differentiating is successful.

The no homework idea has proven successful in other countries, like Finland and South Korea, but not as much of it occurs in the United States. The students want to try this more often, with more problems in class but then no formal homework. When doing problems in class, some students enjoy putting a problem on the board and then working through it. Some that work slower struggled with this, as it forces them to work faster, which increases pressure on them. This would be interesting to try and grading may prove difficult as it will only be on quizzes and tests. It would really allow for some more formative assessments, which is constant desire in schools, but it would be hard for parents and administration to show progress until the quizzes or tests are completed and graded.

The online movement is something that many schools use. This is difficult in a student like ours that has a lack of internet at home, due to the poverty level. These students have to do all their homework in class and if they don't finish, they will have to do it in another class. This creates the problem with online homework in our school. This is something I will continue to use, but try to give the students multiple days to complete the homework instead of expecting it the next day. Hopefully, by giving the students multiple days, they will be able to complete more of the online assignments in class.

The grading every problem method will be the one I use the least. This method creates more time on grading for teachers and most students don't look at their scores to see where they could improve. Having the student's grade their own work allows them to have the instantaneous results where they can see exactly how they did, while allowing for some formative assessments when we can review problems.

The main goal of homework is for students to practice the skills that are required to meet the Minnesota Math Standards. Teachers should want to help every student accomplish this goal and it is important to use different methods of assessments to check for student understanding.

Chapter Five

Plan for Sharing

For this study, many teachers were interested in what type of assignments would best help our students. At a professional learning community (PLC) meeting, I shared the results of the research. We discussed how other teachers could use this idea to improve their assignments to increase student ability. The science teacher in our building does 95% of his assignments online for his class and has had some success with this. An issue he has encountered is student engagement, which he felt was a downfall of using online curriculum. Through this research and other research we will conduct, our PLC group hopes to improve student abilities and student engagement in the classes.

This action research was a positive experience for me as it has helped this school into looking into these types of ideas. Our staff has started the conversation about different assignments and how to help students the best way we can. I look forward to continuing to find new ways of helping out students so they can become the best students they can be.

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APPENDIX A

District Approval Form

Independent School District No. 2

Serving Hill City, Jacobson and Swatara

500 Ione Avenue
Hill City, MN 55748
Phone: (218) 697-2394
Fax: (218) 697-2594

Patrick Rendle, Superintendent/Principal
Andrew Dokken, Assistant Principal

1-09-18

To whom it may concern,

This letter is to grant Adam Johnson permission to conduct an action research study at Hill City School during the 2017-18 school year. I understand this study poses no risk to those involved or to the Hill City School District. I also understand that all information received will be kept confidential and will only be used for purposes of this study.

Sincerely,

Pat Rendle

Superintendent, Hill City Schools

APPENDIX B

Parental Consent Form

Independent School District No. 2

Serving Hill City, Jacobson and Swatara

500 lone Avenue
Hill City, MN 55748
Phone: (218) 697-2394
Fax: (218) 697-2594

Pat Rendle, Superintendent/Principal
Andrew Dokken, Assistant Principal

Consent Form

Participation in Research

Title: The Role of Homework in a Mathematics Classroom

Purpose: The purpose of this research is to determine what different types of assignments will help students have the highest achievement levels.

Study information: This study will compare five different methods of completing homework to try to find out which method promotes the most growth. Each student will have a different type of assignments/homework for two weeks to see which one works best.

Time: The participants will complete this study during the regular class period. This study will take place during the spring of 2018. The study will last for two weeks.

Risks: Participation in this study does require participants to be involved in any risks.

Benefits: This study will help examine which type of assignments/homework best helps student's achievement grow.

Confidentiality: Participant's identity will not be shared with anyone beyond the principal investigator, Ximena Suarez-Sousa, and the co-investigator, Adam Johnson. All individual information will be recorded and tracked under an identification number and not the participant's name.

Participation and withdrawal: Participation in this study is optional. Students can choose not to participate or choose to withdraw at any time without any negative effects on grades, relationship with the instructor, or relationship with Hill City Schools.

Contact: If you have any questions about the study, you may contact any of these people:

Adam Johnson Co-Investigator ph. 218-697-2394 (ext. 123) Email: ajohnson@isd002.org	Ximena P. Suarez-Sousa, Ph. D. Principal Investigator Assistant Professor, School of Teaching and Learning, Lommen 211C College of Education and Human Services Minnesota State University Moorhead ph. 218.477.2007 Email: suarez@mnstate.edu

Any questions about your rights may be directed to Lisa Karch, Ph. D., Chair of the MSUM Institutional Review Board, at 218-477-2699 or by lisa.karch@mnstate.edu. You will be given a copy of this form to keep.

"I have been informed of the study details and understand what participating in the study means. I understand that my child's identity will be protected and that he/she can choose to stop participating in the study at any time. By signing this form, I am agreeing to allow my child to participate in the study. I am at least 18 years of age or older."

Name of Child (Print)

Signature of Parent/Guardian — Date

Signature of Investigator — Date 1-11-18

Pat Rendle, Superintendent/Principal

A community partnership proud to be unique and personal; dedicated to life-long learning and educational excellence.

APPENDIX C

Method of Assent

I will explain to the students that "your parents have given consent for you to participate in a research project that I am conducting. The goal of this study is to find what type of assignments/homework best shows improvement on math subjects. The whole goal is to help you guys do what is best and to show what homework best helps. For the first week, you will have one type of assignment, with a pretest on Monday, and a post test on Friday. This will show your growth. For the second week, we will do the same thing but you will have a different type of assignment. So basically, do what we normally do and it should help show what is the best type of assignment. Any questions?"

APPENDIX D

Student information

	Gender	Number of Absences during study	Additional information	8th grade MCA Test Score
Student #1	Male	2	None	861
Student #2	Female	3	Type 1 diabetes	862
Student #3	Male	12	Went on vacation during study	852
Student #4	Male	3	IEP	846
Student #5	Male	1	IEP	836
Student #6	Male	1	None	840
Student #7	Male	0	None	861
Student #8	Female	4	Went on vacation during study	850
Student #9	Female	1	None	841
Student #10	Female	0	Foster home student	Not available
Student #11	Male	3	None	847
Student #12	Female	1	Foster home student/IEP	839
Student #13	Male	2	Six late to classes, IEP	844
Student #14	Female	0	Five late to classes	852
Student #15	Male	0	None	857

APPENDIX E

Student Survey

1.) What method of homework grading did you prefer?

Completion Online No Homework Grading

2.) What method of homework grading did you learn the most from?

Completion Online No Homework Grading

3.) What method of homework grading did you prefer the least?

Completion Online No Homework Grading

APPENDIX F

Average Growth Scores

Homework Pre-Test Scores Average, Post-Test Scores Average, and Growth Scores Average

	Pre-Test Score Average	Post-Test Score Average	Growth Score Average
Completion 1	3.6	9.3	5.7
Online 1	1.45	11.66	10.21
No Homework 1	1.45	11.06	9.61
Graded Homework 1	.33	10.13	9.8
Completion 2	0	3.06	3.06
Online 2	0	2.73	2.73
No Homework 2	0	2.2	2.2
Graded Homework 2	0	2.66	2.66

APPENDIX G

Individual student's scores on post-tests

Student Number	Completion 1	Online 1	No Homework 1	Graded 1	Completion 2	Online 2	No Homework 2	Graded 2
1	13	13	13	12	4	4	3	3
2	14	14	14	15	4	4	3	4
3	10	12	8	10	3	3	2	2
4	8	10	10	8	2	2	2	2
5	6	13	11	7	2	2	2	3
6	7	10	10	5	1	1	0	1
7	8	12	12	12	3	4	3	4
8	6	13	13	13	4	4	3	3
9	9	12	11	11	3	2	2	2
10	9	1	1	3	1	1	0	0
11	11	14	14	13	4	3	4	4
12	11	12	12	11	2	2	2	3
13	7	13	13	8	2	2	0	2
14	11	11	9	9	3	3	3	3
15	10	15	15	15	4	4	4	4

APPENDIX H

Survey Results

	Completion	Online	No Homework	Grading
What method of homework grading did you prefer?	6 students	1 student	6 students	0 students
What type of homework did you learn the most from?	9 students	2 students	1 student	1 student
What method of homework grading did you prefer the least?	0 students	5 students	3 students	5 students

APPENDIX I

Sample of post-tests from students

Student 13

Name: _____ Class: _____ Date: _____ ID: A

Post-test 3

Section 6.6 and 6.7 [redacted]

Write a recursive rule for the sequence.

1.

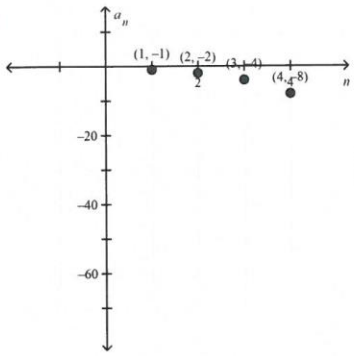
n	1	2	3	4
a_n	7	10	13	16

linear

2. 5, 20, 80, 320, 1280, …

non linear

3.



nonlinear ?

Determine whether the sequence is *geometric*, *arithmetic*, or *neither*. Explain your reasoning.

4. −4, −13, −22, −31, … Geometric

5. 4, −6, 24, −144, … neither

6. −3, −9, −27, −81, … arithmetic

Write the next three terms of the geometric sequence.

7. 3, 24, 192, 1536, … 12288, 98304, 786,432

Write the next three terms of the geometric sequence.

8. 64, 16, 4, 1, … .25, .0625, .01575

Write an equation for the nth term of the geometric sequence. Then find a_7.

9. 1, −2, 4, −8, … 16, −32, 64, −128

Name: _____ ID: A

10. 9, 27, 81, 243,... 729, 2187, 6561

Write the first six terms of the sequence.

11. $a_1 = 2, a_n = a_{n-1} - 3$

Write an explicit rule for the recursive rule.

12. $a_1 = -35, a_n = a_{n-1} - 29$

Write a recursive rule for the sequence. Then write the next two terms of the sequence.

13. 6, 8, 14, 22, 36, 58,...

14. 4, 3, 1, 2, – 1, 3, – 4,...

15. You open a holiday savings club with $2709. The balance increases each month and is shown in the sequence below.

    $2709, $2729, $2769, $2829, $2909, $3009,...

    a. Write a recursive rule for the sequence.

    b. Write the next two terms of the sequence.

    c. How much money will be in the holiday savings club after one year?

Student 5

Name: _____ Class: _____ Date: _____ ID: A

7.1 & 7.2 Post-test +13/15

Find the sum.

1. $(-2y-4)+(-y-6)$ $-3y-10$
2. $(8p^2+8p-4)+(3p^2-4p-6)$ $11p^2+4p-10$
3. $(-3a^2-8ab+b^2)+(2a^2-6ab+2b^2)$ $-1a^2-14ab+3b^2$
4. $(-3y-9)+(2y-7)$ $-1y-16$

Find the difference.

5. $(-3d^2+3d+3)-(4d+8)$ $-3d^2-1d-5$
6. $(-7x-x^2-12)-(-6-3x+5x^2)$ $-4x-6x^2-6$
7. $(-5k^2-7)-(3k^2-5k-11)$ $-8k^2+5k+4$
8. $(4d^2+3d+7)-(4d+4)$ $4d^2-1d-3$

Find the product.

9. $(m-2)(m+6)$ $m^2+6m-2m-12$ $m^2+4m-12$
10. $(6m-8)(8m+5)$ $48m^2+30m-64m-40$ $48m^2-34m-40$
11. $(4+5s)(6+s)$
12. $(3j-5)(-7+6j)$ $-21j+18j^2+35-30j$ $18j^2-51j+35$
13. $(q-9)(q-5)$ $q^2-5q-9q+45$ $q^2-14q+45$
14. $(4d^2+2d+1)(4d-3)$ $16d^3+8d^2+4d-12d^2-6d-3$ $16d^3-4d^2-2d-3$

Write the polynomial in standard form. Identify the degree and classify the polynomial by the number of terms.

15. $-7d^4+8+3d^6$ $3d^6-7d^4+8$ Trinomial Degree: 6

Student 1

Name: _____ Class: _____ Date: _____ ID: A

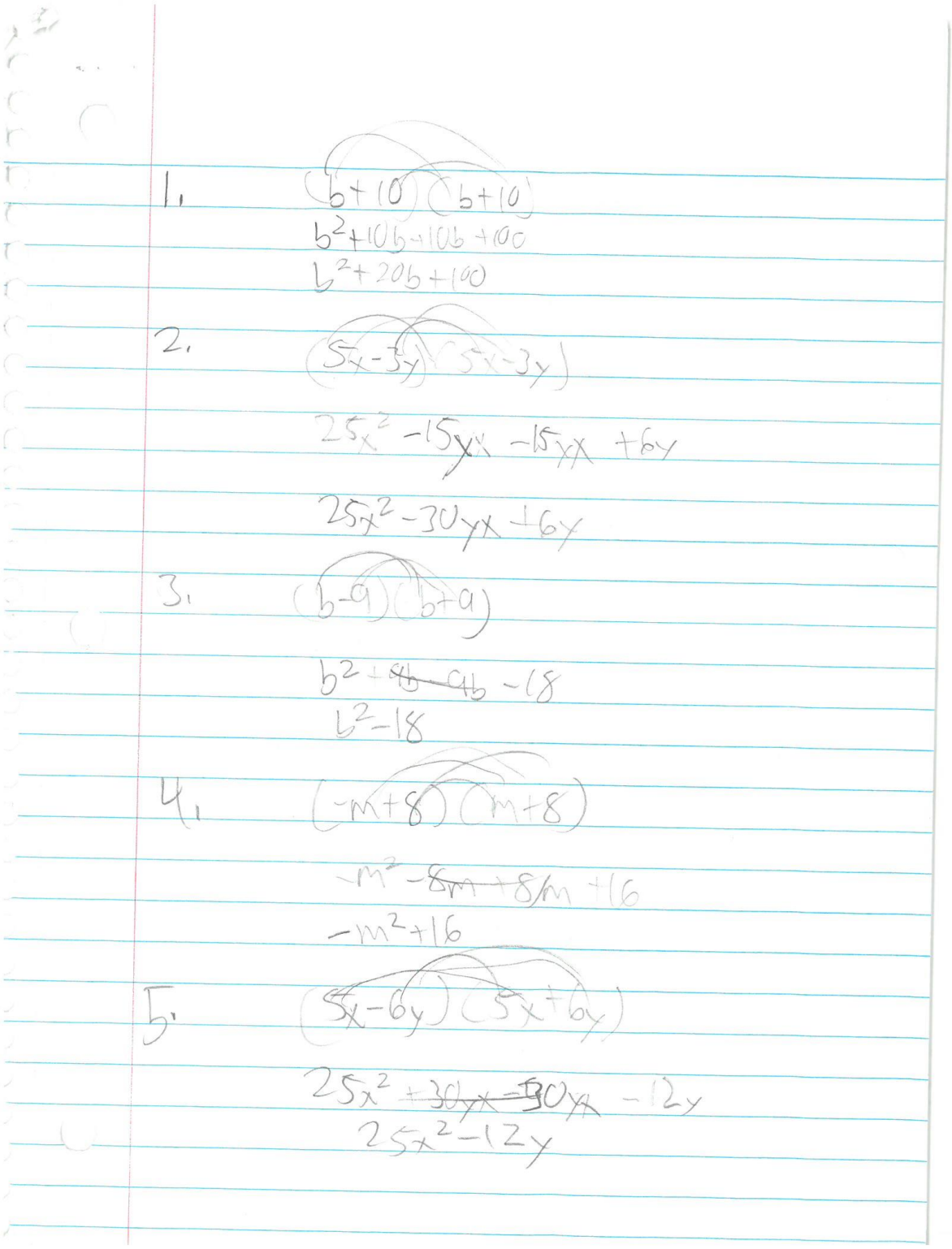
7.3 and 7.4 Posttest

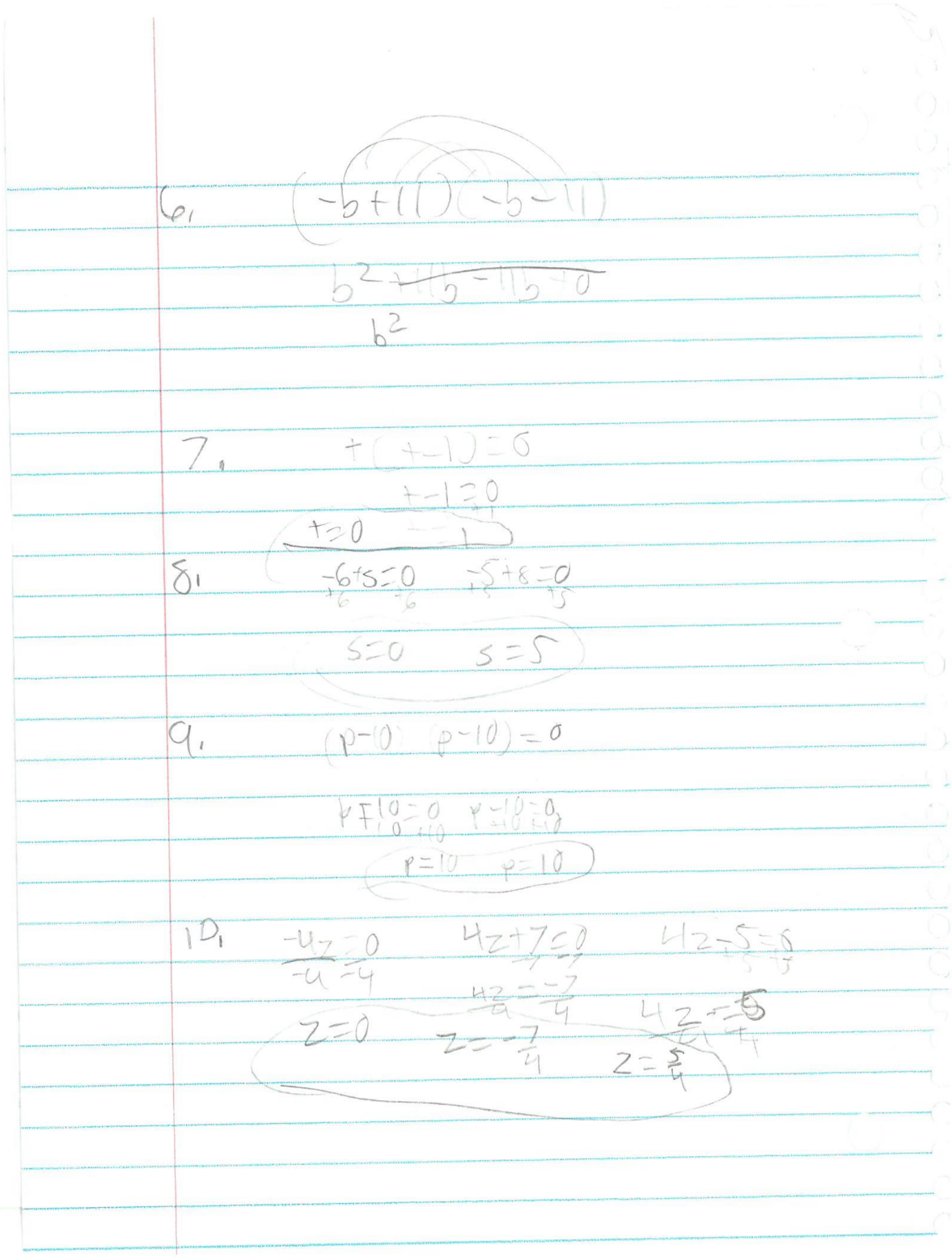
Find the product.

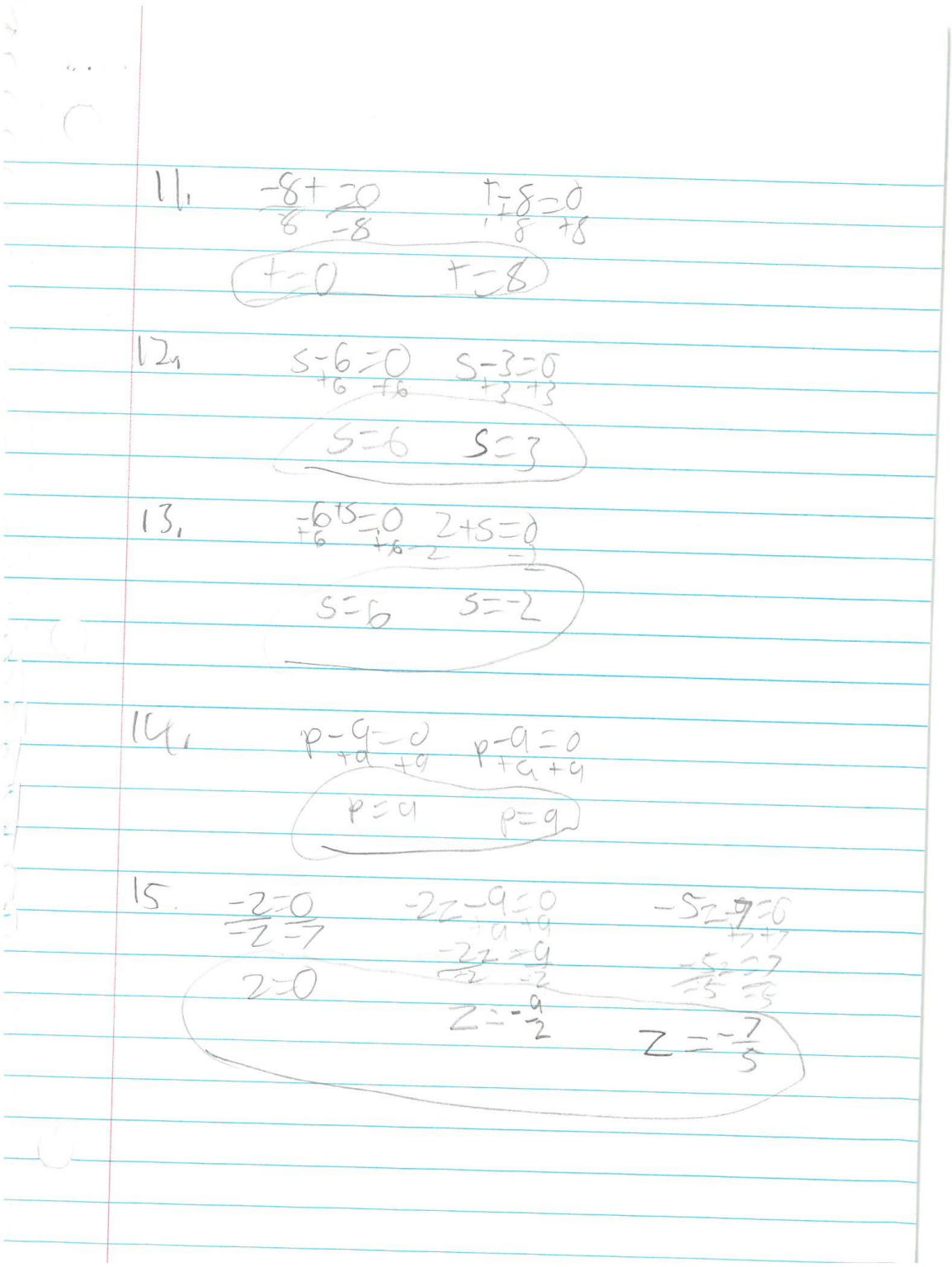
1. $(b+10)^2$
2. $(5x-3y)^2$
3. $(b-9)(b+9)$
4. $(-m+8)(m+8)$
5. $(5x-6y)(5x+6y)$
6. $(-b+11)(-b-11)$

Solve the equation.

7. $t(t-1)=0$
8. $(-6+s)(-5+s)=0$
9. $(p-10)^2=0$
10. $-4z(4z+7)(4z-5)=0$
11. $-8t(t-8)=0$
12. $(s-6)(s-3)=0$
13. $(-6+s)(2+s)=0$
14. $(p-9)^2=0$
15. $-z(-2z-9)(-5z-7)=0$


1. (b+10)(b+10)
b²+10b+10b+100
b²+20b+100
2. (5x-3y)(5x-3y)
25x²-15yx-15yx+6y
25x²-30yx+6y
3. (b-9)(b+9)
b²+9b-9b-18
b²-18
4. (-m+8)(m+8)
-m²-8m+8m+16
-m²+16
5. (5x-6y)(5x+6y)
25x²+30x-30yx-12y
25x²-12y


6. (-b+11)(-b-11)
b²+11b-11b-0
b²
7. t(t-1)=0
t-1=0
t=0 t=1
8. -6+s=0 -5+s=0
+6 +6 +5 +5
s=0 s=5
9. (p-0) (p-10)=0
p-10=0 p-10=0
+10 +10 +10 +10
p=10 p=10
10. -4z=0 4z+7=0 4z-5=5
-4 -4 4 4 4 4
z=0 4z=-7 4z=5
4 4 4 4
z=-7/4 z=5/4


11. -8 +8 = 0 -8 +8 t - 8 = 0 +8
t = 0 t = 8
12. s - 6 = 0 +6 +6 s - 3 = 0 +3 +3
s = 6 s = 3
13. -6 +6 s = 0 +6 -2 2 + s = 0 -2
s = 6 s = -2
14. p - q = 0 +q +q p - q = 0 +q +q
p = q p = q
15. -2 = 0 -2 -2 -2z - 9 = 0 +9 +9 -5z - 7 = 0 +7 +7
-2z = 9 -5z = 7
-2 -2 -5 -5
z = 0 z = -9/2 z = -7/5

Student 15

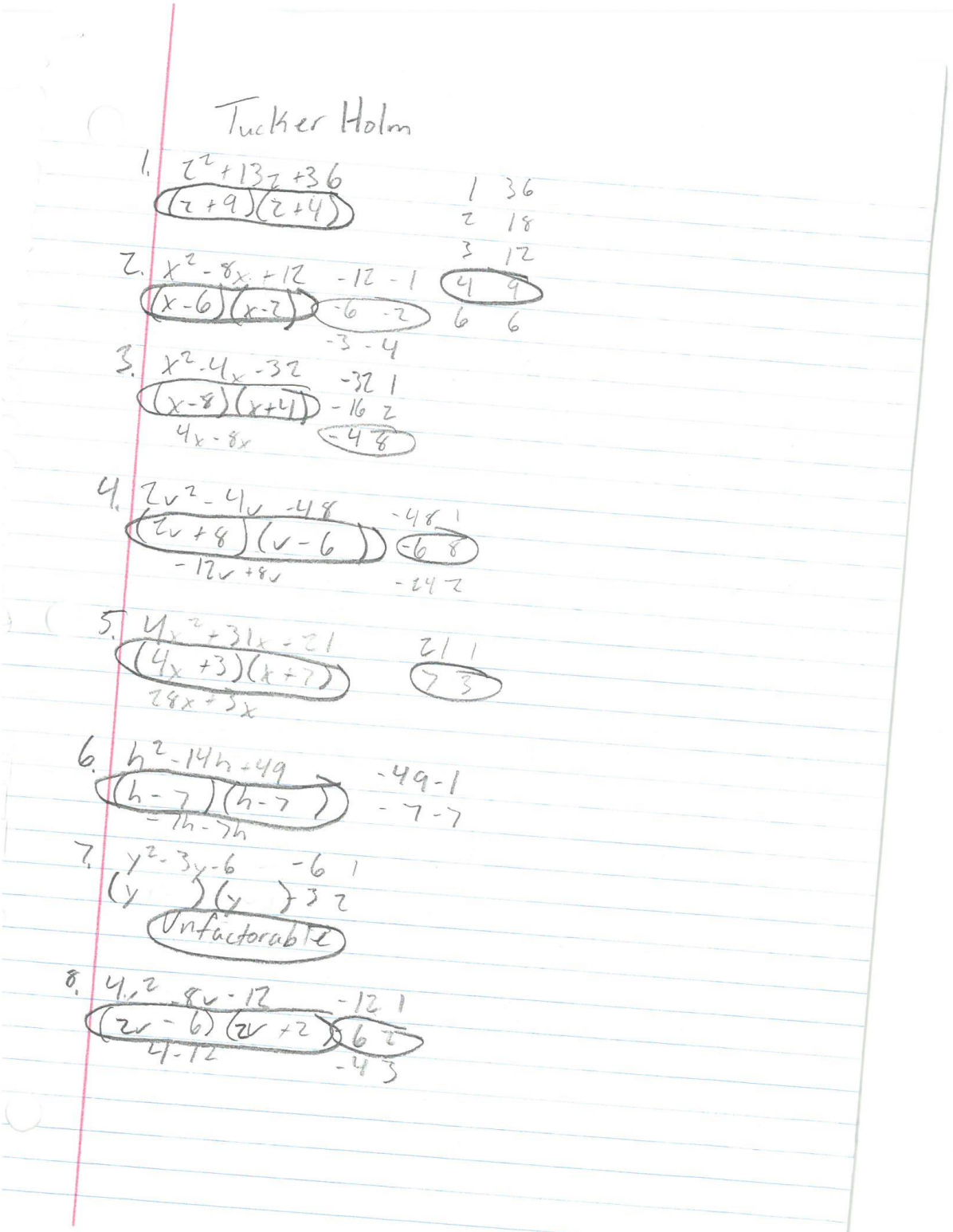
Name: _____ Class: Dom Date: _____ ID: A

+15/15

7.5 & 7.6 Pretest

Factor the polynomial completely.

1. $z^2 + 13z + 36$
2. $x^2 - 8x + 12$
3. $x^2 - 4x - 32$
4. $2v^2 - 4v - 48$
5. $4x^2 + 31x + 21$
6. $h^2 - 14h + 49$
7. $y^2 - 3y - 6$
8. $4v^2 - 8v - 12$
9. $4x^2 - 21x + 5$
10. $6x^2 + 19x + 10$
11. $10x^2 + 19x + 6$
12. $x^2 - 3x - 28$
13. $z^2 + 12z + 32$
14. $10x^2 - 23x + 12$
15. $x^2 - 12x + 32$



Tucker Holm

1. $z^2+13z+36$
$(z+9)(z+4)$
1 36
2 18
3 12
4 9
6 6

2. $x^2-8x+12$ -12 -1
$(x-6)(x-2)$ -6 -2
-3 -4

3. $x^2-4x-32$ -32 1
$(x-8)(x+4)$ -16 2
$4x-8x$ -4 8

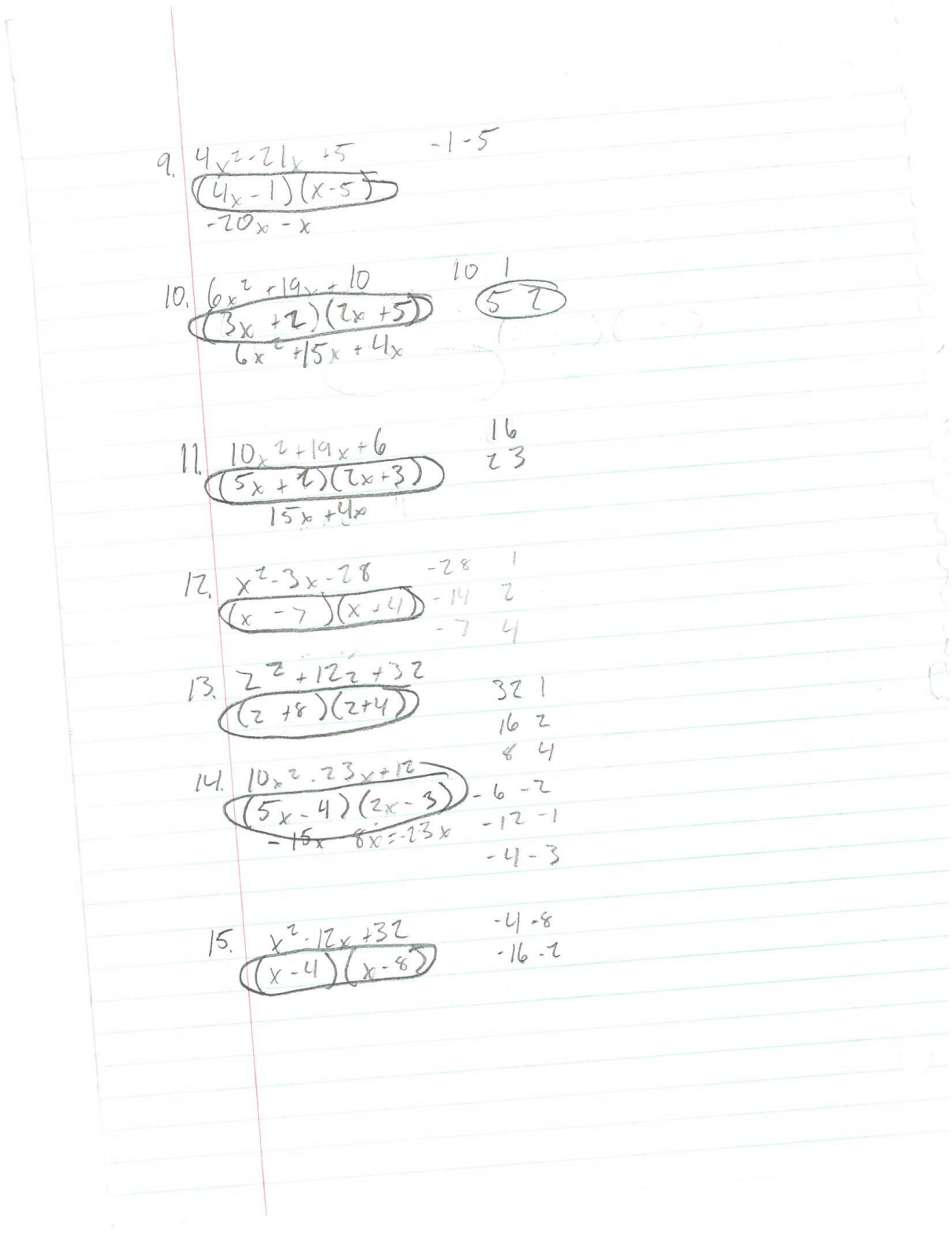
4. $2v^2-4v-48$ -48 1
$(2v+8)(v-6)$ -6 8
$-12v+8v$ -24 2

5. $4x^2+31x-21$ 21 1
$(4x+3)(x+7)$ 7 3
$28x+3x$

6. $h^2-14h+49$ -49 -1
$(h-7)(h-7)$ -7 -7
$-7h-7h$

7. y^2-3y-6 -6 1
$(y\ \ )(y\ \ )$ 2 3
Unfactorable

8. $4v^2-8v-12$ -12 1
$(2v-6)(2v+2)$ 6 2
$4v-12$ -4 3


9. $4x^2-21x+5$ -1 -5
$(4x-1)(x-5)$
$-20x-x$
10. $6x^2+19x+10$ 10 1
5 2
$(3x+2)(2x+5)$
$6x^2+15x+4x$
11. $10x^2+19x+6$ 16
2 3
$(5x+2)(2x+3)$
$15x+4x$
12. $x^2-3x-28$ -28 1
-14 2
$(x-7)(x+4)$
-7 4
13. $z^2+12z+32$
32 1
16 2
8 4
$(z+8)(z+4)$
14. $10x^2-23x+12$
-6 -2
-12 -1
-4 -3
$(5x-4)(2x-3)$
$-15x-8x=-23x$
15. $x^2-12x+32$
-4 -8
-16 -2
$(x-4)(x-8)$

Student 14

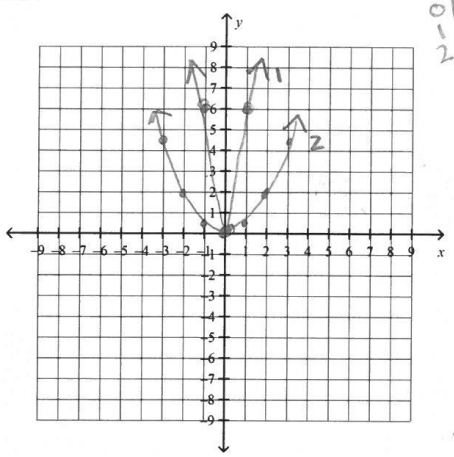
Name: _____ Class: _____ Date: _____ ID: A

8.1-8.4 Posttest

Short Answer

Graph the function.

1. $g(x) = 6x^2$

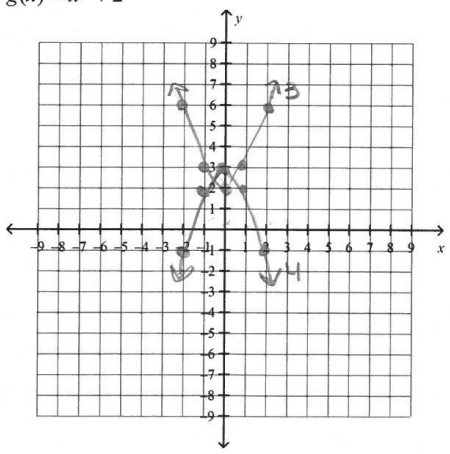


X	Y
-2	24
-1	6
0	0
1	6
2	24

2. $g(x) = \frac{1}{2}x^2$

X	Y
-1	.5
0	0
1	.5
2	2
3	4.5

3. $g(x) = x^2 + 2$



X	Y
0	2
1	3
2	6
3	11
4	18
-1	3
-2	6

$-(x^2)+3$

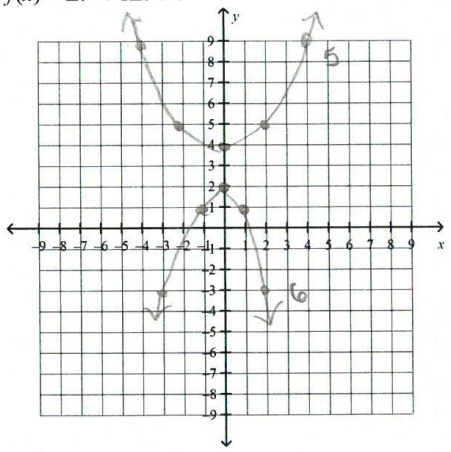
X	Y
-2	-1
-1	2
0	3
1	2
2	-1
3	
4	
5	

Name: _____ ID: A

4. $g(x) = -x^2 + 3$

Graph the function.

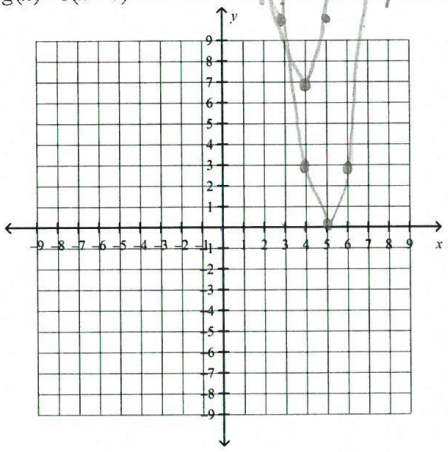
5. $f(x) = 2x^2 + 12x + 4$



6. $f(x) = -3x^2 - 12x + 2$

Graph the function.

7. $g(x) = 3(x-5)^2$



8. $g(x) = 3(x-4)^2 + 7$