Females in Mathematics: Creating an Environment That Aims to Lessen Anxiety and Promote Participation

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Females in mathematics: Creating an environment that aims to lessen anxiety and promote participation

by

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A thesis submitted to the
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Females in mathematics: Creating an environment that aims to lessen anxiety and promote participation

by

Susan Rose Smalter
I would like to dedicate this thesis to my supportive husband, Greg. Thank you for cheering me on for all these years and for your many hours proofreading. To my son, Collin, you were the goal at the end of all this schooling. And to my parents who always encouraged me when I was younger to continue my education beyond high school. I have always wanted to make you proud.
I would like to acknowledge and thank my advisor, Dr. Van Voorst for all of his guidance on this thesis. In addition, thank you and acknowledgement needs to be given to an amazing teacher, principal, and district for allowing me into your classroom, school and district to carry out my study. Many acknowledgment and thanks to my family for watching Collin, so I could complete my thesis.
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Chapter I: Introduction

Context

While sitting during my teaming time with teachers from the other core subjects, the topic of female participation within our classrooms surfaced. The science teacher and I both agreed the females in our classes are not as quick to raise their hand to participate in classroom discussions as the males in our classrooms. We proceeded to elaborate on this issue. I thought it might be possible that the females know the answers, but are afraid because they are not confident with their answer. From my colleague’s standpoint, he thought that maybe the girls in his class did not want to appear smart. With most girls in eighth grade being thirteen or fourteen, I suppose it could be possible for them not to raise their hand because they feel that being smart would be an unattractive quality to a member of the opposite sex.

Whatever the case may be, I am interested in looking at female participation in the classroom. It is of utmost importance to me to create a classroom where females do not feel inferior to their male counterparts and feel comfortable expressing their ideas without consequence and without damaging their self-confidence. In my classroom, I want to do everything possible to encourage females in the area of mathematics and to create a classroom environment which significantly reduces the stigmas that are associated with mathematics.

Significance of Problem

Females are still underrepresented in the STEM (Science, Technology, Engineering and Mathematics) fields even though recently there has been a reduction
in the academic achievement gap between male and female students. If females are performing similarly to their male counterparts, why do females choose not to pursue careers in math related fields? Is there something that can be done early in their schooling to encourage females to continue on in mathematics courses? Due to the underrepresentation of women in math related fields not only in higher academia, but also in the work force, it is important to research the reasons that support females continuing in such fields. Additionally, and unfortunately, stereotypes concerning females in the area of mathematics continue to exist. This is why it is important to examine various ways to encourage females. The factors that propel females to continue on will most likely help to improve the climate for females within predominately male courses and fields.

**Purpose**

The purpose of this research is to help inform other teachers of what can be done in the classroom to create a climate that may prove to be beneficial for the female students within their classrooms. I propose that if females are allowed to engage in their preferred method of learning, verbal and written, we can realize potential benefits in the classroom. The purpose of my action research is to see if collaboration through conversation within an all-female friendship group and using writing as an additional vehicle for communication would benefit females. Would females feel less apprehensive about sharing within the larger classroom setting? Would there be an increase in participation at the individual level? Would there be an increase in academic achievement? Would female students begin to feel more
confident? I believe it would be advantageous for females to discuss problems and then write about them, but am uncertain of how the discussion and journaling would affect the aforementioned. I believe that both sexes would benefit from this study. However, I am interested in seeing how this would affect females.

**Theoretical Framework**

To conduct the study I will use qualitative research techniques. The theoretical framework that will guide my research is Vygotsky’s social development theory which asserts that social interactions impact cognitive development. To capture the interactions, I will observe the females while they are in their all-female friendship groups and detail the communication that takes place while in this setting. My classroom observations will be recorded in a journal. Soon after recording my observation, I will also reflect on what was observed that day. Additionally, I will interview students both pre- and post-collaborative group sessions to find out more about their comfort level within the group, their willingness to share information within the group, and the quality of the discussion that takes place within the group. Furthermore, written communication in the form of dialectic journaling will also be collected and analyzed to see if this additional piece of communication will benefit females in the area of whole class participation, self-confidence, and academic achievement. Due to the limited amount of time the students were available to me, the last piece dealing with dialectic journals was not implemented.
Chapter II: Review of the Literature

Definition of Terms

Before discussing the literature, there are some important terms that need to be defined. Below is a list of terms that will be used in my thesis along with their definitions.

Female friendship group – this is a single-sex group composed of female students who are friends and who work together to understand and talk about mathematics.

Achievement in mathematics – the ability to successfully acquire and maintain any or all of the skills required to solve math problems.

Math anxiety – an intense feeling of fear toward mathematics affecting a person’s ability to comprehend and complete problems in mathematics.

Affective math anxiety – the emotional aspect of math anxiety which includes feelings of nervousness, stress, and other physiological responses.

Cognitive math anxiety – the mental aspect of math anxiety which includes worry and self-deprecatory thoughts concerning one’s performance.

Math Anxiety in Students

Considerable research was conducted in the 1970’s regarding math anxiety. This, however, did not happen until there were appropriate and fitting objective tools in place to measure math anxiety. Since then, there have been massive amounts of studies regarding the relationship involving math anxiety and various other topics.

One particular topic of great significance is math anxiety and how it relates to performance in mathematics.
People who suffer from math anxiety experience both affective and cognitive anxiety. For the purpose of this study, a discussion of the cognitive aspects of math anxiety is crucial. In several studies math anxiety has been shown to interfere with cognitive functioning. Eysenck and Calvo’s (1992) model of general anxiety effects, referred to as processing efficiency theory, supports this claim. This theory hypothesizes that the brain’s ability to process and recall information is hampered due to the nervous individual devoting time to the negative thoughts which enter their brain rather than focusing on what is in front of them at the time. Ultimately, when our working memory is compromised, mental processing is weakened. In regards to math anxiety, when a person is focused on their fear of math or dislike of math, instead of our brains focusing to solve problems, our brain is preoccupied with these thoughts and is unable to perform to its highest ability. Math anxiety lessens math performance due to focusing on the secondary task of paying attention to the thoughts (Wigfield & Meece, 1988). When math performance suffers due to math anxiety other consequences follow. Several studies have shown some serious consequences due to math anxiety including lack of ability when it comes to mathematics, a decrease in mathematics achievement, negative feelings and attitudes toward mathematics, avoidance of mathematics courses, and the forfeiting of career opportunities related to mathematics (Betz, 1978; Brush, 1978; Burton, 1979; Donady & Tobias, 1977; Hendel, 1980; Richardson & Suinn, 1972; Shapka & Keating, 2003; Tobias & Weissbrod, 1980).
In order to prevent and reduce the effects of math anxiety, various teaching strategies were proposed. One teaching approach suggested involved encouraging students to work in small, cooperative groups. In addition to reducing anxiety, this approach may have important affective consequences (Vacc, 1993). Furthermore, Greenwood (1984) conducted a study which suggests problem solving and talking about the techniques used to solve those problems is important in preventing math anxiety.

**Influences**

Even though parents are seen as the primary social influence in children’s lives, friends become ever more significant during the adolescent years (Furman & Buhrmester, 1992). There are several studies supporting the view that attitudes in mathematics are shaped by social influences. Ercikan, McCreith and Lapointe (2005) found that a student’s attitude toward mathematics was the most powerful predictor of math achievement and participation in advanced courses. Riegle-Crumb, Farkas and Muller (2006) propose that while it is likely that friends are important for the general academic success of students, the personal relationships that girls establish with other females who are skilled in math and science creates a special social and academic context. Females in these unique relationships draw on each other for support as they work toward attaining achievement in these historically male domains. Friendships, for males and females, may have different functions. Though male friendships tend to focus around certain activities, female friendships are centered on conversations around identity and the revealing of information about oneself. Additionally, male
friendships are more likely to place emphasis on competition. In contrast, female friendships tend to be more cooperative (Buettel & Marini, 1995). With this being said, there are teachers, including myself, who are reluctant in allowing students to work with their friends, regardless of gender, because of the off-task conversation and behavior that sometimes can occur in this type of learning environment. However, the results from Riegle-Crumb, Farkas, and Muller (2006) suggest that friendships among females play a significant role in influencing the courses their female friends decide to take. In this respect, friends act as a strong, positive influence; providing encouragement, support, and someone with whom they can share their learning and studying in order to help propel each other toward success.

Research conducted by Inzlicht and Ben-Zeev (2000) found that merely placing high-performing females in a male dominated setting can cause them to experience performance deficits. The study also found that as the amount of males introduced into the setting increased, performance deficits in females were likely to increase. When females are outnumbered, as was the case in the aforementioned study, this may cause them to experience stereotype threat. Stereotype threat occurs when a person who is the target of stereotyping feels intellectually inferior and is thereby subjected to the possibility of confirming the same stereotypes, even though the stereotype may not hold true for that individual. For females, this can occur without even being aware that the threat exists. Stereotype threat theory suggests that simply sitting down for a math test is enough to cause stereotype threat. There are other studies confirming the connection of poor performance with stereotype threat.
theory (Keller & Dauenheimer, 2003; O’Brien & Crandall, 2003). If this is in fact the case that females tend to perform poorly in male dominated settings, it seems possible that grouping females in a group that is not male heavy would lessen the likelihood that females would experience performance deficits. This is what I am hoping to do with placing only females in a group.

In addition to experiencing stereotype threat, females also attempt to preserve their self-worth. Self-worth theory of achievement motivation asserts that in a situation where poor performance is expected to show shortcomings in aptitude, some students will withdraw in order to avoid the possibility of damaging their self-worth. If the situation is likely to reveal low ability, students may view this as a great threat. As a result of this highly stressful environment, students may perform poorly. These students may also immediately withdraw from the situation allowing them to immediately protect themselves from the threat. Conversely, students who attribute performance to factors other than ability construct an environment of low threat and in turn these students are able to perform well. A study by Dinnel and Thompson (2007) concluded that their findings on the whole were reflective and consistent with the result that self-worth explanation is valid in regards to poor performance of females in mathematics.

**Single-sex Education**

This leads to a current and relevant research area: single-sex education for females. If simply having males in the room can lead to deficits in performance among high achieving females, then maybe there is a benefit to all female classes.
The small population of females continuing math courses at the higher levels leaves “a large portion of the female population at a disadvantage in a technologically challenging and advancing society and economy (Shapka and Keating, 2003, p.930).” Due to these concerns there has been recent attention on alternate education procedures to increase further involvement of females in math related studies and fields. One such method of recent interest is teaching girls in an all-female classroom setting. Because of the mixed evidence surrounding the benefits of an all-female learning environment, Shapka and Keating (2003) examined several studies before presenting their own. Even when the authors looked at most studies they found that they were undermined by the underlying truth that students in each environment have “distinct preexisting characteristics,” for example, socioeconomic status and/or academic differences. When the differences are controlled for, findings can be inconsistent due to the various decisions on how to best control for those differences. In addition, the analytic framework used to analyze the data can vary the findings. Further reliable research that has been done in this area also has had mixed results. LePore and Warren (1997) found that there was no evidence of academic or psychological advantage resulting from same-sex schools. On the other hand, Young and Fraser (1990) conducted a study using a large Australian database in which students who were in same-sex schools outperformed those in mixed schools on a statewide science test. The authors reason that the whole school segregation system may need to be modified due to the fact that students themselves prefer to attend coeducational school systems. Those who support the coeducational system argue
that the absence of the opposite sex in the classroom is not representative of the real world and thus creates a false environment. In contrast to this argument is the fact that the real world is apparent in the classroom and exposes the females to gender biases. The authors note that findings on the treatment of females and males with regard to attention and support in the classroom are mixed. One way to compromise on the issue of coeducational versus same-sex schooling is to offer same-sex classes within the coeducational system.

The results from the research by Shapka and Keating (2003) were mixed. The results in regards to achievement and course continuation in all-female classes were outstanding and showed that there were benefits to this type of instruction. The study showed that there was a significant positive effect in regards to girls’ performance and persistence. However, the program did not seem to influence girls’ attitudes toward math. There is one reason, in particular, which is worth talking about as to why the program did not affect their attitudes. Mainly, the duration of the program was not a sufficient amount of time to reverse attitudes which had been constructed throughout the course of their life. Even if the program lasted for five years, there are beliefs and attitudes from parents, media, school, friends and other venues that have been deeply rooted for many years. A program lasting for two years is hardly enough time to begin chipping away at the ideals which have been shaping the child over the course of their lifetime.

Additional research surrounding the topic of single-sex education conducted by Streitmatter’s (1997) confirms that females, when compared to their male-
counterparts, are more likely to be “disadvantaged systematically” in school. For instance, females tend to receive less attention from teachers, tend to receive different instruction, and tend to be less likely to participate in class. Moreover, most of the research relating to single-sex instruction that has been conducted within the last twenty years has been primarily quantitative (these studies statistically controlled for personal characteristics), and as a result have not explored variables such as female confidence within single-gender classrooms and females thoughts about this type of setting. Therefore, more studies need to be done from the perspective of girls for us to gain a deeper understanding and to capture a more complete picture of girls-only classrooms.

This study found that the girls in this program were comfortable taking academic risks. Students worked through questions out loud and collaborated with one another to reach an answer. The observational data and the reports of the girls showed that the females in this class were more apt to raise questions and respond to questions than they were in their coeducational classes. An additional significant finding from the study was the classroom seemed to improve the girls’ self-confidence and ability to learn math. Streitmatter (1997) believes that the girls’ participation through both observation and information from the females may show that they are becoming more aware of who they are and what they can be by taking risks.

Several limitations to the study exist. First, the study focused on one group of students and one teacher. Streitmatter did not observe the girls in any of their co-
educational classes. Second, the girls that were chosen to be in the classes performed well academically to begin with and the fact that a majority of females were chosen for this class may possibly have added to the girls’ perception of being a part of something unique, consequently producing a Hawthorne effect. This could affect the credibility and the transferability of the results.

Additional questions which future research may want to address are the duration of the study (Is a one to two year study enough time for students to see an increase in self-confidence as a person and as a mathematician?), the benefit boys may receive from single-gender classes, the impact of a gender-specific class on girls’ identity development, and the teacher’s influence on the classroom.

Thought Processes and Writing

For the final piece to inform my research, I examined several pieces of literature in regards to thought processes. Albert (2000) looked at the relationship between two modes of thought process: written and verbal. Within the written mode of thinking is a claim that states that it provides for a new zone, beyond the zone of proximal development, called the zone of proximal practice. While in this zone students autonomously arrange their thoughts about math and are able to make meaning of what they have learned.

Within the context of a larger study, the researcher examined seven seventh grade students to provide evidence for the benefits of writing as an aid in self-adjusting while in the zone of proximal practice. The study is significant in that students can use writing as a means of shifting from a zone of proximal development
to a zone where students are self-regulating their ideas and concepts in mathematics. In order to look at how this new zone affects students, the author found it relevant to examine research done about the act of writing and the cognitive process. This is important because it uncovers a new way for students to self-regulate their learning.

The author looked at several studies surrounding writing research, specifically looking at Bruner, Oliver, and Greenfield (1966) and Luria and Yudovich (1971). Their research work focused on writing as a learning strategy. In addition, Emig (1983), an educational theorist, argued that writing is a unique language process and "is more readily a form and source of learning than talking." Vygotsky (1986) stated that writing was a systematic process that required a more thoughtful and conscious act than verbal communication. The researcher did not include reviews of literature that were contrary or mixed regarding this subject.

This particular piece of research done by Albert (2000) examined the ways in which students were able to move from using their social interactions as scaffolding to using their own writing as scaffolding in order to reach higher levels of understanding. There were three themes which resulted from the data analysis and they are accompanied by dialogue from the interview with the students. The first theme is keeping track of my thinking. The interviews started with an explanation of how students organized their information. Through the course of the dialogue through the interviewer and a student, you discover that one of the female students made a chart because it was easy. Thinking about a problem through writing can help to clarify and bring a structure to the analysis of a problem. The second theme is
students' attitudes about writing. In a different interview, the male students were asked how writing helped them to explain their thought process. On the whole, the response was that the writing helped the students make sense of the problem. The last theme is the math is right, but the answer is wrong. Obtaining the train would have to travel eight hundred miles per hour, or the bus would have to hold three hundred students would not hold true for most trains or busses for that matter. Sometimes an answer can be computed correctly, but may not always make sense in the real world. "Flawed" answers like these, that are inconsistent with the real world, generate discussion that is, itself, beneficial to the learning process.

Even though Albert (2000) examined both male and female students for her study on mathematical thought processes, I believe that the information that came out of the study could have positive implications for females. Females can both think about a problem using their writing skills, but then can also use their verbal communication skills to discuss a problem more in depth in a group setting. In particular, verbal communication is a positive quality for females to have when working through problems. In a situation where performance depends heavily on social interaction or there is a group task which also depends heavily on verbal skills, females tend to outperform males (Hyde & Linn, 1988). Allowing females to work together in small friendship groups to communicate and struggle through problems creates an environment where they can share their ideas openly without fear of being wrong.

Additionally thought-provoking was a study done by Scales (2000) which
explored the importance of mathematic journals and their implications for altering teaching practices such as using journals as an alternative form of assessment. In this study journals collected from twenty-four students of various ability levels in a mixed third and fourth grade classroom were analyzed and color coded into five themes: understanding, descriptive, attitude, self-assessment, and un-coded (non-math related topics). The research found students needed more practice using mathematical language. Even students at high achievement levels were not using math terminology correctly. The journal entries aided the teacher/researcher in assessing the student’s understanding of the material; however, she acknowledged the limitations of using journals as a formal assessment tool. What I found most helpful from this article was the unexpected result from the study. Students who did not normally participate orally in class felt comfortable communicating through their journal entries. Even though this is a study conducted in an elementary school I believe there are aspects of this study that relate to my own. In my study I would like to have a written component, specifically using journals. Would girls who do not normally participate orally in class feel more comfortable writing in their journal?

Ideally, the action research of my thesis would include all of these components, but as previously stated, I have decided to look at female friendship groups without the added written communication component.

**Rationale**

While stereotype threat suggests female performance suffers with the presence of males, math anxiety can impact a female’s willingness to share ideas in the
presence of males. Math anxiety has been researched for over thirty years and has been found to have both affective and cognitive effects. This study would observe females within the classroom setting as a whole and within their female friendship group to see if students feel less anxious about sharing within their group as opposed to the larger setting of the classroom.

This study hopes to show that allowing females to work in friendship groups could lead to a supportive and encouraging environment in which females share more (due to lessened math anxiety) and perform better (due to lessened stereotype threat). In order to capture the discussions taking place within the groups, the group discussion will be audiotaped. In addition, pre- and post-interview questions will be audiotaped. The interviews will be administered by me and the interview questions were created by me.
Chapter III: Methods

Participants

My study was conducted in a suburban middle school in New York State and will examine the interactions and the outcomes of being in a female-friendship group. Currently I substitute teach within the district this action research was conducted. As a substitute teacher my research was unable to be carried out in its entirety and modifications have been made. For this study, eighth grade students worked together in same-sex pairs. This study focuses on the interactions which take place over the course of ten days between two pairs of female friends.

To ensure that the pairs of females working together were indeed friends I used the knowledge and experience the classroom teacher has with her students. The classroom teacher had each of the female students last year in her classroom and was able to correctly place students with a friend. The study I will conduct will focus on two female friendship groups. The participants of the study are four eighth grade females who have been placed in an all-female friendship group. Parental consent forms (Appendix A) and assent forms for minors (Appendix B) will be given to each student, collected, and will remain in my care for the duration of the study. If any student chooses to withdraw from the study, this will in no way impact their grade or standing in my classroom.

Data Collection, Procedures, & Instruments

To collect data for my action research, the classroom teacher asked for willing participants. She selected a pair of female students she knew to be friends to
participate. Audiotapes were used to collect data in regards to the conversations the
two pairs of female students had while working on assigned math word problems.

To ensure the integrity of the research I am conducting for my thesis, I am
making every effort to have multiple sources of data. At the outset, any time the all-
female groups are working together they will be audiotaped. Audiotaping will allow
me to review the conversations more carefully in order to capture anything that may
have been missed from observing. After the ten days of discussion within the groups,
the tapes for the female friendship groups will be transcribed for further review.
Furthermore, students in the female friendship group will be involved in pre- and
post-interviews (Appendix C and Appendix D). In addition to the audiotapes, the
female students will also be observed in while in the classroom. I will be looking to
see if these students participate and when they participate in class. Observations will
occur once every five days for a total of two scheduled occurrences. This will allow
me to be partially immersed in the data. Having multiple forms of gathered data will
allow for triangulation of the data collected.

Data Analysis

In order to analyze the data for this action research I was immersed in the data
of the conversations looking for connections to previous research and looking for
emerging themes.

In order to analyze the data for my thesis, I used domain analysis. I will be
immersed in the data looking for connections from what has been collected. After
immersion, I will develop overarching themes and categories that result from the
observations, interviews, and journals. Themes that have been developed may need further analysis or clarification. This will allow me to go back and modify or adjust my study based on what has come out of the data. When the analysis is complete and the themes are developed, I will then look for confirming and disconfirming evidence from the data to support those themes.
Chapter IV: Results

Introduction

It is difficult to conclude whether or not academic achievement and participation were enhanced while the two pairs of female students were working together. This is due in part to the amount of time spent audiotaping their interactions (only ten days) and undocumented student participation and achievement in relation to students working in their pairs. However, there are certain findings worth noting that surfaced while audiotaping the female pairings. The transcripts from the audiotapes are included (Appendix E). Appendix G contains the problems with correct solutions that the girls talk about in their audiotaped sessions. You will notice that interactions for group number one only progress until day seven. This is due to the tape running out on the first side. The females in this group forgot to turn over the tape and as a result, sessions eight through ten are missing. I still feel that there is enough data to proceed with the results. There is also enough evidence from their recordings to help support the themes and findings.

Pre-Interview Findings

According to the pre-interview session, three out of the four girls had extremely positive dispositions toward math. Only one of the girls expressed difficulty, but did say she liked it. Here is what the girls answered when asked how they feel about math:

Um, I like it a lot because I like to work on problems and figure out things. – Girl #1 from Group 1.
Um, math is actually one of my favorite subjects, so it’s, I think it’s, a way for me to learn. It actually does teach me a lot and I am glad that it’s one of the subjects we get to learn. –Girl #2 from Group 1.

Um, I’m not, like, good at math, but I like it. I’m not very strong at it. It’s hard for me to, like, do it. I have to use a calculator for most stuff. –Girl #1 from Group 2.

I like it because, it like...I don’t know. I like it. –Girl #2 from Group 2 (Appendix D).

Additionally, when asked about participating and sharing within the classroom setting, most girls expressed that they were comfortable sharing within the context of the whole classroom and did so because they wanted to learn. Two of the girls did say that they participate when they know they have the right answer. Going along with this, students we asked how they felt about working within a group setting and two of the females from the same group had this to say:

Um, I feel good. I feel more comfortable with a small group. –Girl #1 from Group 2.

Um, I feel more comfortable sharing in a group setting instead of with the whole class. –Girl #2 from Group 2 (Appendix D).

When asked about how they feel about working through problems, three of the four females expressed that if they were to come across a problem they did not understand or a problem they had difficulties solving, they would ask for help.

I get stuck sometimes, but I’ll just raise my hand and ask for help. Then, I usually will just figure it out and then I will have it and I’ll know it like the back of my hand. –Girl #1 from Group 1.

Um, I love working on math problems ‘cause then if, also, if you work on them, you’ll get to know the material better and you’ll know what you’re doing and I think that if you do that you’ll, it will help you a lot. I mean...um, if I’m not sure about it, like, like for homework for instance, if I run into a problem I’m not very sure, I’m not sure about, what I usually do is bring home the lesson that was taught in
class so I can look back on it. If I get stuck, I will usually, like, ask for help, but first I'll try to get through it, the second time myself, just try to see if I can get it right again. I mean I do get frustrated, but I don't, like, get mad or angry. —Girl #2 from Group 1.

I don't like word problems. If it's a basic question, I feel confident. It's easier working in a group rather than working by myself. I can talk through the problem when I am working with someone. —Girl #1 from Group 2 (Appendix D).

Themes from Audiotaping

First, the female pairings of students offered significant amounts of guidance in the form of taking the time to talk through problems. One of the girls from each of the pairings took the time to explain in great detail several of the problems, and although not always coming up with the correct answer, the process was explained correctly fairly often. However, there were times when information was conveyed incorrectly. Here are a few excerpts from the transcript demonstrating the lengths at which the female pairs went to explain information to one another.

G2: Ok. And, do you realize, do you know why that's positive six instead of negative six?
G1: Yep.
G2: Why?
G1: Because it goes up and to the right.
G2: Ok.
From group #1 (Appendix E).

G2: So, what's two times negative one to the second power plus two? So, it's PEMDAS, remember? You gotta follow PEMDAS, parentheses, exponents, multiply, divide, add, subtract.
G1: Uh-huh.
G2: So, then, which one, what step would you do first? Would you multiply these two? Do exponents?
G1: Parentheses.
G2: Right. So, it'd be two...
G1: ...two times negative one.
G2: Which is what?
G1: <sings to the tune of Row, Row, Row Your Boat> Same signs add and keep, different signs subtract.
G2: No, that’s for subtraction and addition, it’s that, it’s that song. But, then for multiplication and division, it’s remember? If your eyes were the same, you’d be happy.
G1: So, it’s two?
G2: No, it’s negative two because they don’t have the same sign. ‘Cause remember? It’s like sad face, happy face...remember that? If your eyes were the same, you’d be happy, too. Remember that?
G1: Yeah.
G2: OK. So, then it would be negative two. So, negative two...
G1: Negative two.
G2: ...to the second power plus one. So, now what are we going to do? Now, what would you do?
G1: Two times negative two? Negative two times negative two?
G2: Which would be what?
G1: Positive four.
G2: Yep.
G1: So, then, four...
G2: Four plus one equals five equals zero. So, it doesn’t work.
G1: Ugh, so many steps to take.
G2: I know. You do e. So, you do one equals...wait, no, just kidding.
G1: No, you gotta do...
G2: Two equals one...
G1: No, you do y equals and then you do...
G2: No.
G1: Ugh. Where are you getting the two from?
G2: ‘Cause you substitute. ‘Cause you substitute x and y for these two. X and y, so those two. The y is, um, two, so that’s where I’m getting the two from...equals...what’s x?
G1: One.
G2: So, it’s y equals x to the second power...minus what?
G1: Wait, wait, wait. One to the second power minus one?
G2: Two, because x is two, or, yeah, x...oh, no, yeah, you’re right. X is one. Sorry. So, what do you do first?
G1: You do...exponents.
G2: So, what would that be?
G1: Uh...uh, that would be...
G2: What’s one squared?
G1: Isn’t that just one times one?
G2: Uh-huh. So what is it?
G1: One.
G2: Yeah, so, one equals one minus one.
G1: One equals one minus one.
G2: So, what is that?
G1: Zero.
G2: So, it's obviously got to be d, so, but let's check it first. So, y, so, six equals two the second power plus two. So, what's two squared?
G1: Um, two times two... four.
G2: So, four plus two... what's four plus two?
G1: Six.
G2: So, six equals six. That's right! Yeah! So it's d.
G1: Yeah, d!
G2: Finally! We just finished the first problem. Isn't it ridiculous, we just finished the first problem? We've been working on it for, like, ten minutes. OK, whatever, but... OK, so, now, we've got to do the second one. Alright, so, uh, I'm going to get a separate sheet of paper, because I can't fit all my work. OK, alright, now we're gonna go do two. So, you substitute the y and the x and the y, right? So, it would be, so, it would be, um...

From group #1 (Appendix E).

G1: To figure out the right side of the table you have to do two hundred thirty-seven minus one five one, so, that's eighty six. So, this is, like, being added by eighty-six. I don't know if you get that. So, then you have to see if it works for two thirty-seven and three twenty-three.
G2: Wait, I don't get this.
G1: I'm explaining it. So, then three twenty-three... mmmm... three twenty-three minus...
G2: I don't get this.
G1: Minus two three seven. OK.
G2: OK. We have to do minus two three seven.
G1: OK, so it goes up by eighty-six.
G2: It goes up by eighty-six. OK, so, it goes up by eighty-six every time then this goes up by one. So, we have to do, we have to... OK, bye.

From group #2 (Appendix E).

It was as if there was a fundamental, built-in belief of not leaving anyone behind. Female students in each of the pairings were always trying to make sure that their friend understood what a problem was asking. Even though the pairs faced difficulties they genuinely wanted to work through the problem until they truly comprehended what a question was asking of them.
Another evident finding from the audiotapes was the amount of support the girls provided for each other. Anytime one of the girls provided an incorrect answer, the other girl would, in a caring way, say that they were incorrect and offer advice on how to go about working on a problem. Although this may not be evident from the transcript, the tone in the girls’ voices was never impolite. They also provided one another with encouragement. Although there were several instances of encouragement throughout the sessions, below is an excerpt of two of them.

G2: One, two, three. Three. OK.
G1: Isn’t it one half?
G2: Three over six. One half.
G1: Very good.

*From group #2 (Appendix E).*

G2: Then it’s twelve over three.
G1: Twelve over three.
G2: Yeah, that’s what I got. Can that be reduced? Yeah. No, ’cause it’s, oh yeah. OK.
G1: Good job, girl #2.
G2: Four. Thank you. Four minus zero and zero minus negative two. Zero minus negative two turns into boop, boop. So, it’s four over two. Did you get that?
G1: Um, not yet.

*From group #2 (Appendix E).*

Females in the pairings were not without their fair share of disagreements, but what stood out to me was their willingness and ability to seek out help when there was a problem that neither of them knew the answer to. Not only did they seek and ask help from each other, they also asked for help from a classmate and the teacher.

*Post-Interview Findings*

Overall, the consensus from the females was that working within their group was fun. Moreover, the girls felt comfortable working within their group because
they were close with the person they were paired with. Each female student knew the group they were working with was unique. When asked what differences they saw in the group they were working with and past groups the girls had this to say:

Well, say if we’re in groups with, like, guys, just guys, um, it’s awkward really sometimes and you don’t really get a lot done, ’cause most of the time the guys are just joking around, but with Girl #2 we got everything done and see the other group they had, got, had to get their seats moved, but me and Girl #2 got to stay next to each other, ’cause we worked well together, so me and Girl #2 got to stay next to each other ’cause of that. –Girl #1 from Group 1.

Um, differences that I see is that since we are actually friends, it’s, we feel more comfortable sharing our ideas or things that we need to, like, help each other with, unlike, when if you’re talking, if you’re in a group with somebody you’re not really friends with or you’ve never really talked to, so that’s the difference I see. –Girl #2 from Group 1.

Me and girl #1 had more fun and, like, when I’m with other people, like, we don’t have a lot of fun, because me and girl #1 are friends. –Girl #1 from Group 2.

Um, well, people that you sit with and you don’t know, you’re not really comfortable sharing with them, like, ’cause, you just, I don’t know why, but you’re just not, so, I felt, like, more comfortable with girl #1, because we’re, like, good friends and stuff, so, yeah. –Girl #2 from Group 2 (Appendix D).

In addition to feeling more comfortable sharing with their friend, the females expressed that they did feel as if they gained something from this experience. Girl number one in group one said that it helped her focus more and she found it easier to work. Her friend said that even though she preferred to work alone, she was able to work through problems with someone and she knew that someone was willing to help her and that even though they may not have gotten a problem on the first try, they managed to get the answer by the end. The second girl in group two said that she was able to ask for help from her friend and found that having someone to consult with made working easier. The first girl in the second group said that she felt that she
could share now and felt more comfortable. She even said that this was an opening experience for her. She felt as though she could be corrected (Appendix D). Each of the girls did convey that working with their friend helped and affected them in a positive way.

**Observation Findings**

Although the time spent observing was limited, the one main observation I made was females do participate in class. Due to the length of this study, this is more than likely not attributed to the girls being in their friendship group, but rather this is probably due to the teacher creating a warm, caring environment where her students feel safe to participate.

**Possible Negative Aspects**

One possible negative aspect of placing females with a friend to work with may be their inability to end their conversations during instructional time. For this study, female students were seated next to each other while the lesson was being taught. If the female friendship pairing does not have self-control during the lesson, this can be a disturbance to their fellow classmates. One of the groups did have difficulties with this and as a result were separated at the end of this study. Even though the pairing may have worked well together while in their group time, within the context of the whole class, there were times when they were a distraction during the lesson.

Another closely related negative aspect may be their distractibility while working within their group. There were side conversations that did take place, some
of which were not included on the tapes. Here is some of the side dialogue that took place:

G1 & G2: <sing> Girl put your record on tell me your favorite song. Just go ahead let your hair down. –Group #1 (Appendix E).

G1: I burned my tongue.
G2: I know what will cheer girl #1 up.
G1: I burned my tongue.
G2: Girl #1, I know what will cheer you up.
G1: No, it won’t cheer me up.
G2: No, wanna bet?
G1: No.
G2: <fake giggles>
G1: Can I take a break real quick?
G2: <fake giggles> OK, so, and then this…
G1: Did you see the burnage on my tongue?
G2: No. Yuck. Ewww!
G1: It hurts.
G2: OK, this is five a, b six, c four. Six n, five, six, seven, eight, nine, ten, eleven, twelve, m, eight, nine, ten. Twenty-one x six, seven, eight, nine. Nine, not a g, nine. Y six, z, five, six, seven, eight, nine, ten, eleven, twelve. I don’t know how to do these, girl #1. Do you? –Group #2 (Appendix E).

Realistically speaking, talking about math for the entire duration of a class period may be an unrealistic requirement and maybe taking a break for a bit to talk may not harm anything. However, the side conversation was noticeable while listening through the tapes.
Chapter V: Discussion and Conclusion

This chapter of the study leads into a discussion regarding female-friendly classrooms and the role of the educator with regards to the findings in this study. After analyzing the findings and observing the strong themes from the data, I describe the ways in which I will use this information to inform my own teaching and the teaching of others. In addition, the limitations of this study and recommendations and direction for future research in this area will be discussed.

Discussion

Ultimately, the reason to study gender and mathematics is to bring about equity in a field where females have traditionally been underrepresented. In order to encourage our female students to participate and continue their education in math, I believe that it is important to create a learning environment in which their needs are accounted for. Based on the literature, the most significant predictor of participation and achievement in math is a student’s attitude. In addition, students’ attitudes are shaped by social influences. Knowing the aforementioned information causes me to believe that it seems like a natural fit to create a learning environment that is female friendly. Allowing females to collaborate with friends within the classroom gives them the ability to communicate about mathematics in an environment that is supportive, warm, and non-threatening. I propose that within such an environment females will feel safe with sharing information with one another. This type of environment can be used to further strengthen female math achievement and participation.
As a teacher, I desire to create an environment where every child feels safe sharing in the classroom. As a female math teacher, who has been through upper level math courses where I was one of three females in a class of twenty-four students, I can say that I want females in particular to feel protected in my classroom. As a teacher/researcher I am in a position of power that I do not take lightly. The information that resulted from this study is significant in that it gives females a voice. Hopefully, the knowledge I have gained through my past experience with female students and through the course of this thesis study will help me to further encourage females to take an active role in their mathematics education.

Additionally, the results of this study will be shared with the district in which my study was conducted. The school I partnered with to complete my thesis recently implemented female only technology classes and are looking at ways to encourage females in the STEM fields. I strongly believe allowing females to work with friends while within the classroom is one such way to support females as they venture out to take predominately male classes.

Limitations

There are several limitations to this study. The first of which is the inability to generalize the results. This is largely due to the small number of students who participated in this study. Additionally, the students needed to be friends which made this a sample of necessity and placed further limits on the population. This in turn threatens the reliability and validity of the results of this study. Moreover, this study focused on only two pairs of female friends in the same classroom. The females were
not observed with any other pairing to see if in fact they did share more because they were with a friend. The females in the study were not placed with a female who was not a friend. There is not baseline from which to work. A final limitation is that the females were chosen by their teacher to be a part of this study which may have added to the girls’ perception of being a part of something unique, consequently producing a Hawthorne effect. The participants may have improved or modified their behavior due to being involved in with this study. This could affect the credibility and transferability of the results.

**Recommendation for Future Research**

Despite the aforementioned limitations, useful information was obtained, and there are several ways to modify or add to this study. One way to build upon this study would be to implement the writing component mentioned earlier in this study. Writing as described in the literature review is one way for students to create meaning of what is being learned within the classroom. This study is lacking in collected work and the written piece along with written work from students could be collected and could add a new dimension to the study. Another addition would be to compare a female friendship pairing with that of a non-female friendship pairing or an all-male friendship pairing. Would the various pairings of students spend a great deal of time explaining and talking through problems? Would they offer each other the same kind of encouragement? An additional area for future research consideration would be to increase the duration of the study. Ten days does not seem like a long enough time period to see if there is a definite increase in participation and decrease in anxiety.
Conclusion

The results of this study allowed for some knowledge to be gained in regards to how female students feel about working with a friend. And although there were several limitations to this study, it appears as though there are benefits and positive outcomes to having female students work with a friend. Being comfortable enough to share with a friend, to ask for help, and to provide encouragement to one another are among those benefits.
References


Appendix A

STATEMENT OF INFORMED CONSENT FOR PARENTS

This form describes a research study being conducted with female students regarding the impact of working in a friendship group with other female students. The purpose of the study is to examine changes in math anxiety and similar factors in students when working in a friendly environment versus working alone. The person conducting the research is a student at The College at Brockport SUNY and is conducting this study in conjunction with her master's thesis. If you agree to have your child participate in this study, she will be asked to complete an interview before the two week period of working within the friendship group and after working in the friendship group.

A possible benefit to this study is an increased understanding of how to teach and encourage female students to participate and excel in math.

Your child's participation in this study is completely voluntary. Being in it or refusing to be in it will not affect your child's grades or class standing. Your child is free to stop participating in the study at any time.

I understand that:

1. My child will work in a friendship group for 10 to 15 minutes per day for two weeks in the Fall semester of 2010.

2. My child's participation involves answering questions verbally in an interview setting both before and after working in the friendship group. The answers to the questions will be recorded on paper and with audiotape. No personally identifiable information will be written down and audiotapes will be destroyed when the study is complete. There will only be two interview sessions. One interview session will take place before working in the group and the second will take place after the two week study is complete. It is estimated that it will take 20 minutes to complete each interview. She will not miss instructional time for the interviews; instead this can be done during study hall or lunch.

3. My child's participation is voluntary and she has the right to refuse to answer any questions. She will have a chance to discuss any questions she has about the study with the researcher at any time.

4. My child's confidentiality is protected. Her name will not be written down. There will be no way to connect my child to her responses. If any publication results from this research, she would not be identified by name. Results will be given anonymously and in group form only, so that neither the participants nor their schools can be identified. Results will be shared with the district. Participation will have no effect on grades or status.

5. There will be no anticipated personal risks because of participation in this study.

6. Approximately 4 people will take part in this study. The results will be used for the completion of a research project by the primary researcher.

If you wish to give permission for your child to participate, and you agree with the statement below, please sign in the space provided. Remember, you may change your mind at any point and withdraw.
from the study. Your child can refuse to participate even if you have given permission for her to participate.

I understand the information provided in this form and agree to allow my child to participate as a participant in this project. I am 18 years of age or older. I have read and understand the above statements. All my questions about my child's participation in this study have been answered to my satisfaction.

If you have any questions you may contact:

<table>
<thead>
<tr>
<th>Principal</th>
<th>Primary researcher</th>
</tr>
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<tbody>
<tr>
<td>Principal's name</td>
<td>Susan Smalter</td>
</tr>
<tr>
<td>Principal's telephone number</td>
<td></td>
</tr>
<tr>
<td>Principal's e-mail address</td>
<td><a href="mailto:susan.smalter@gmail.com">susan.smalter@gmail.com</a></td>
</tr>
</tbody>
</table>

I agree to have my child participate and understand that she will be audiotaped.

Signature: ____________________ Date: ____________

Child's name ________________________________

I do not agree to have my child participate and do not agree to have her be audiotaped.

Signature: ____________________ Date: ____________

Child's name ________________________________
Appendix B

STATEMENT OF INFORMED ASSENT FOR MINORS

This form describes a research study being conducted with female students regarding the impact of working in a friendship group with other female students. The purpose of the study is to examine changes in math anxiety and similar factors in students when working in a friendly environment versus working alone. The person conducting the research is a student at The College at Brockport SUNY and is conducting this study in conjunction with her master’s thesis. If you agree to participate in this study, you will be asked to complete an interview before the two week period of working within the friendship group and after working in the friendship group.

A possible benefit to this study is an increased understanding of how to teach and encourage female students to participate and excel in math.

Your participation in this study is completely voluntary. Being in it or refusing to be in it will not affect your grades or class standing. You are free to change your mind or stop being in the study at any time.

I understand that:

1. I will work in a friendship group for 10 to 15 minutes per day for two weeks in the Fall semester of 2010.

2. My participation involves answering questions verbally in an interview setting both before and after working in the friendship group. The answers to the questions will be recorded on paper and with audiotape. No personally identifiable information will be written down and audiotapes will be destroyed when the study is complete. There will only be two interview sessions. One interview session will take place before working in the group and the second will take place after the two week study is complete. It is estimated that it will take 20 minutes to complete each interview. I will not miss instructional time for the interviews; instead this can be done during study hall or lunch.

3. My participation is voluntary and I have the right to refuse to answer any questions. I will have a chance to discuss any questions I have about the study with the researcher at any time.

4. My confidentiality is protected. My name will not be written down. There will be no way to connect me to my responses. If any publication results from this research, I would not be identified by name. Results will be given anonymously and in group form only, so that neither the participants nor their schools can be identified. Results will be shared with the district. Participation will have no effect on grades or status.

5. There will be no anticipated personal risks because of participation in this study.

6. Approximately 4 people will take part in this study. The results will be used for the completion of a research project by the primary researcher.

You are being asked whether or not you want to participate in this study. If you wish to participate, and you agree with the statement below, please sign in the space provided. Remember, you may
change your mind at any point and withdraw from the study. You can refuse to participate even if your parent/guardian gives permission for you to participate.

If you have any questions you may contact:

<table>
<thead>
<tr>
<th>Principal</th>
<th>Primary researcher</th>
</tr>
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<tbody>
<tr>
<td>Principal's name</td>
<td>Susan Smalter</td>
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<tr>
<td>Principal's telephone number</td>
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<tr>
<td>Principal's e-mail address</td>
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Appendix C

Interview Questions

Pre-Interview Questions:

1. How do you feel about math?
2. How do you feel about working with other people?
3. How do you feel about sharing in the whole class setting? Why do you feel that way?
4. When do you choose to participate in class? Why do you choose to participate or choose not to participate in class?
5. How do you feel about sharing within a group setting?
6. How do you feel about working through problems?

Post-Interview Questions:

1. How do you feel about your group?
2. How do you feel about working in your group opposed to working by yourself?
3. Do you feel comfortable sharing with your group? Why or Why not?
4. What are some of the differences you see with the group you are working with and groups that you have worked with in the past?
5. Are there any problems your group faced? If so, what kind?
6. How do you feel about what your group accomplished?
7. How do you feel you interact with one another?
8. Has being in this group helped you in any way? If so, in what ways do you feel it has helped you?
Appendix D

Answers to Interview Questions

For female #1 in group 1:

Pre-Interview Questions:

1. How do you feel about math?

   Um, I like it a lot because I like to work on problems and figure out things.

2. How do you feel about working with other people?

   I like interacting with other people and doing hands-on stuff and I am very talkative, so I, we'll talk and we'll get everything done and it's fun and fast.

3. How do you feel about sharing in the whole class setting? Why do you feel that way?

   Um, I like it and it's funny 'cause sometimes at random points people will crack a random joke and it's really fun.

4. When do you choose to participate in class? Why do you choose to participate or choose not to participate in class?

   I choose to participate in class because I like math a lot and it's one of my favorite subjects. I feel comfortable sharing in class.

5. How do you feel about sharing within a group setting?

   I like it. Um, I don't know about other people, but I like it a lot. It's fun.

6. How do you feel about working through problems?

   I get stuck sometimes, but I'll just raise my hand and ask for help. Then, I usually will just figure it out and then I will have it and I'll know it like the back of my hand.

Post-Interview Questions:

1. How do you feel about your group?
Um, well, Girl #2 and I had a lot of fun, so I liked it. Me and Girl #1 get along well with each other.

2. How do you feel about working in your group opposed to working by yourself?

Well, you're not as bored and, um... I don't like working by myself because sometimes I won't be able to figure out a problem and then, so, we'll figure it out together, me and Girl #2 and we get it right.

3. Do you feel comfortable sharing with your group? Why or Why not?

Yeah, I did. I liked it. I liked, um, talking...to the recorder. Are we talking about, like, the recorder sharing?

Well, how did you feel about sharing with the person you were working with?

Good. Me and girl #2 are close.

4. What are some of the differences you see with the group you are working with and groups that you have worked with in the past?

Well, say if we're in groups with, like, guys, just guys, um, it's awkward really sometimes and you don't really get a lot done, 'cause most of the time the guys are just joking around, but with Girl #2 we got everything done and see the other group they had, got, had to get their seats moved, but me and Girl #2 got to stay next to each other, 'cause we worked well together, so me and Girl #2 got to stay next to each other 'cause of that.

5. Are there any problems your group faced? If so, what kind?

None at all.

6. How do you feel about what your group accomplished?

I feel really good, 'cause I feel like I did good on the test.

7. How do you feel you interact with one another?

Well. We laughed a lot and it was fun. And we actually, me and Girl #2 both liked this unit, so it was easy.

8. Has being in this group helped you in any way? If so, in what ways do you feel it has helped you?
I feel liked it helped me focus more, really, and it was easier to work.

For female #2 in group 1:

Pre-Interview Questions:

1. How do you feel about math?

   *Um, math is actually one of my favorite subjects, so it's, I think it's, a way for me to learn. It actually does teach me a lot and I am glad that it's one of the subjects we get to learn.*

2. How do you feel about working with other people?

   *Um, well, I do like working in groups sometimes, but I, but it's not, it's not really one of my favorite things to do. I kind of do sometimes like to work by myself, but I mean I'll work with other people. I get along with them.*

3. How do you feel about sharing in the whole class setting? Why do you feel that way?

   *Oh, I do! I find, I find that it's better if you, if you're participating. Then, if you have a question, you should definitely ask it, because you want to make sure you're doing the right thing and know what you're doing.*

4. When do you choose to participate in class? Why do you choose to participate or choose not to participate in class?

   *Well, I think you should participate in class the whole period because, like, you should know what you are doing instead of like looking around and not really paying attention. I choose to participate because I want to learn and I want to maybe get my grades up a little bit. In some cases sometimes, I want to get them obviously back up and I do want to be an A student in math because it is one of my favorite subjects as I said and it is, it does help you a lot in life.*

5. How do you feel about sharing within a group setting?

   *Um, with the group setting I kind of, I mean, it's fine. It's not, like, a big problem for me. It doesn't really bother me, but sometimes, like, we may not all agree with each other, but in the end we all do come to a conclusion, if we are working on a problem or something.*
6. How do you feel about working through problems?

*Um, I love working on math problems 'cause then if, also, if you work on them, you'll get to know the material better and you'll know what you're doing and I think that if you do that you'll, it will help you a lot. I mean...um, if I'm not sure about it, like, like for homework for instance, if I run into a problem I'm not very sure, I'm not sure about, what I usually do is bring home the lesson that was taught in class so I can look back on it. If I get stuck, I will usually, like, ask for help, but first I'll try to get through it, the second time myself, just try to see if I can get it right again. I mean I do get frustrated, but I don't, like, get mad or angry.*

**Post-Interview Questions:**

1. How do you feel about your group?

*Um, I felt like we worked very well together. We were able to, if we had any struggles with any of the problems we were able to get through them easily.*

2. How do you feel about working in your group opposed to working by yourself?

*Um, well, I do like working independently, but it was nice working in a group because if I had any questions or if she had any questions we were able to help each other out.*

3. Do you feel comfortable sharing with your group? Why or Why not?

*Um, I did, because if she had any questions or she wasn’t sure about anything, she was able to ask me if she was doing anything right, or the opposite. If I had any questions, I could ask her if she was, if I was, if I was doing anything wrong.*

4. What are some of the differences you see with the group you are working with and groups that you have worked with in the past?

*Um, differences that I see is that since we are actually friends, it's, we feel more comfortable sharing our ideas or things that we need to, like, help each other with, unlike, when if you're talking, if you're in a group with somebody you're not really friends with or you've never really talked to, so that's the difference I see.*

5. Are there any problems your group faced? If so, what kind?
Um, well, I mean, we did run into some problems, 'cause maybe we, we weren't sure if we were doing something right and I would say one thing and maybe it wasn't correct, or she would say one thing and maybe she wasn't even doing it correct either and so we were trying to figure out if, if we, if we could get the right answer, but then we, but it wasn't a big issue, we were able to work through it.

6. How do you feel about what your group accomplished?

Um, I feel that we did, we were, the accomplishes we made I think really helped, um, because, um, maybe any, um, any unit that we were doing we were able to know what we were doing better, so that is definitely an accomplishment that we made and I felt that it was really helpful.

7. How do you feel you interact with one another?

Um, we interacted very well, because it was easier to, um, know if we were, um, doing anything wrong in a problem, so we interacted very well, I think.

8. Has being in this group helped you in any way? If so, in what ways do you feel it has helped you?

Um, it's definitely helped, because, um even though I, I do prefer to work, like, independently, this group made, let me know that it's OK, that if I'm in a group I'm able to work through if we have any struggles. And it's helped because it's like I know that people are willing to help, so maybe we won't get it on the first time, but we'll be able to get the answer by the end.

For female #1 in group 2:

Pre-Interview Questions:

1. How do you feel about math?

Um, I'm not, like, good at math, but I like it. I'm not very strong at it. It's hard for me to, like, do it. I have to use a calculator for most stuff.

2. How do you feel about working with other people?

Um, I like working with other people. It's better than working alone.

3. How do you feel about sharing in the whole class setting? Why do you feel that way?
Um, I like it. Um, because I feel comfortable with it.

4. When do you choose to participate in class? Why do you choose to participate or choose not to participate in class?

Um, I usually do when I know I have the right answer.

5. How do you feel about sharing within a group setting?

Um, I feel good. I feel more comfortable with a small group.

6. How do you feel about working through problems?

I don’t like word problems. If it’s a basic question, I feel confident. It’s easier working in a group rather than working by myself. I can talk through the problem when I am working with someone.

Post-Interview Questions:

1. How do you feel about your group?

Um, I liked my group. It was fun.

2. How do you feel about working in your group opposed to working by yourself?

Um, I like working in a group better than by myself, because, like, you can, like, talk about it and if you have, like, differences, you can explain it, and, like, yeah.

3. Do you feel comfortable sharing with your group? Why or Why not?

Yes, because when you share, like, if you’re wrong, they could help you get the right answer.

4. What are some of the differences you see with the group you are working with and groups that you have worked with in the past?

Me and girl #1 had more fun and, like, when I’m with other people, like, we don’t have a lot of fun, because me and girl #1 are friends.

5. Are there any problems your group faced? If so, what kind?
Uh, I don't think so, no.

6. How do you feel about what your group accomplished?

Uh, I feel good. We, we did our work, most of the time.

7. How do you feel you interact with one another?

Um, good, we talked a lot about math.

8. Has being in this group helped you in any way? If so, in what ways do you feel it has helped you?

Um, yeah, it helped me, because I can learn from, like, I can share now, like, I feel comfortable, 'cause, like, when I'm wrong. It was an opening experience for me, so, I don't know how to word it, but, like, you can, like, be corrected. I don't know.

For female #2 in group 2:

Pre-Interview Questions:

1. How do you feel about math?

I like it because, it like... I don't know. I like it.

2. How do you feel about working with other people?

I am comfortable with it because it gives you, like, opportunity to share your own answer even if you know you're not right. You can still tell other people why.

3. How do you feel about sharing in the whole class setting? Why do you feel that way?

Yeah, I am comfortable with it, because, well, I am kind of comfortable with it, but if I am not it's because I know I don't have the right answer and I want other people to say it, so I understand why I don't have the right answer.

4. When do you choose to participate in class? Why do you choose to participate or choose not to participate in class?
When I know I have the right answer.

5. How do you feel about sharing within a group setting?

*Um, I feel more comfortable sharing in a group setting instead of with the whole class.*

6. How do you feel about working through problems?

*I feel comfortable.*

Post-Interview Questions:

1. How do you feel about your group?

*Um, confident because me and girl #1 get along really well and we're friends and stuff, so, it was more fun.*

2. How do you feel about working in your group opposed to working by yourself?

*Uh, working in a group is more fun and more, like, you want to look forward, to doing, like working with your math buddy as the teacher said because I don't know. It's more fun than working by yourself.*

3. Do you feel comfortable sharing with your group? Why or Why not?

*Yes, because, I don't really know why, because me and girl #1 usually got the same answers and if we didn't, we would show our work and see, like, how we got them. So, yeah, I felt comfortable.*

4. What are some of the differences you see with the group you are working with and groups that you have worked with in the past?

*Um, well, people that you sit with and you don't know, you're not really comfortable sharing with them, like, 'cause, you just, I don't know why, but you're just not, so, I felt, like, more comfortable with girl #1, because we're, like, good friends and stuff, so, yeah.*

5. Are there any problems your group faced? If so, what kind?

*I don't think so. No problems, no.*

6. How do you feel about what your group accomplished?
Good. I felt good.

7. How do you feel you interact with one another?

Um, greatly!

8. Has being in this group helped you in any way? If so, in what ways do you feel it has helped you?

If you get a question wrong, they can, like, help. If you get a different answer, they can help you and show you what way, instead of asking the teacher, if you're working by yourself. You don't really have anyone to, like, consult with. So, it's easier, in, like, those ways, it's easier to have a partner.
Group 1: Day 1 (January 20)

G1: Hi, I'm girl #1.
G2: I'm girl #2.
G1: Alright, ready? Determine the slope of each name, wait. Determine the slope of each line named below.
G2: Alright so we have to do, like, a, b, c, d, e, f, g, and h.
G1: Alright, so.
G2: Uh, A is right here.
G1: Oh!
G2: So, pick a spot. Mine are different.
G1: Don't we have the same points?
G2: You could have done, like, whatever.
G1: I'm confused.
G2: Do this one and this one. So you are going to go up one, two.
G1: No! Up three!
G2: No!
G1: Oh, I'm on the wrong one.
G2: And then over one, two, three, four, five, six. Over six, so that is going to be up two over six, which can be reduced to...um...
G1: It can't reduce.
G2: Yes, it can.
G1: Oh, divide by two. Three over one.
G2: Ok. And, do you realize, do you know why that's positive six instead of negative six?
G1: Yep.
G2: Why?
G1: Because it goes up and to the right.
G2: Ok.
G1: Now let's see. You guys are so loud. Shhhhh!
G2: Ok, um.
G1: Wait. Are we doing e?
G2: Yes. Pick this point right here and then do this one.
G1: So, we go up one, two.
G2: No, you don’t go up, remember?
G1: Oh.
G2: This one, when it's this way, it's not...wait, what is it called when it's not...
G1: Unformidable?
T: Undefined is when it is vertical. You would not want to ski down that line, right? But THIS is like cross country, so, cross country skiing. What’s the slope of this line right here?
G1: Unformiable!
G2: No, it’s zero.
T: Zero. It has no steepness. So this one’s zero (referring to e) and this one’s (referring to f) undefined. OK?
G1: OK.
G2: OK.
T: Two different kinds.
G1: So, where’s the thingy?
G2: OK, so then you go over...No! It goes zero, one, two, three, four, five, six. So, it’s...
G1: One, two, three, four, five. One, two, three four...
G2: Five, six.
G1: No, you don’t count the dots. You count what’s in between.
G2: Yeah, I know.
G1: One, then one, two, three, four, five. No, five.
G2: No, six.
G1: One, two, three, four, five!
G2: Six. But, you don’t count that one, but you count this one.
G1: Nooo. Ughh!
G2: Fine.
G1: Six over zero. You have neat handwriting.
G2: This one...g is...OK, g is...
G1: G is...did we already do e?
G2: Yeah. E is five over zero. G is...
G1: Wait, wait, wait. Where is g on the graph? Point to it again.
G2: This one right here.
G1: OK. Up one, two. Then you would go...
G1: Down.
G2: Down. It’s down negative two and then over one, two, three...over four.
G1: So, negative two...
G2: Four.
G1: Four. We can reduce that.
G2: It would be one over two. Negative one over two.
G1: OK.
G2: OK, so, this one would be...
G1: Over...OK. How do you do that?

Group 1: Day 2 (January 21)

G1: Hey, I’m girl #1.
G2: And I'm girl #2.
G1: OK. Ready?
G2: We have to go through (-2, 0). So you go up, or, no down two because it's negative. Yeah.
G1: Then you get the origin.
G2: No, it's down two and then you just stay there because it's zero. The origin's zero, so the point is right here.
G1: Right here?
G2: Oh, no. The point is right, no, no, no. Zero, one, oh that's right.
G1: Mine's right. Aha.
G2: Yeah, that was right. OK, and then, it goes, the slope is, equals three. So, it's three over one because that's what it was up over here. Just put it over one. So you go up three, one, two, three and over one.
G1: To the right 'cause it's positive.
G2: Yup.
G1: You went up too far.
G2: One, two, three.
G1: No. From here one, two, three.
G2: Oh, it is. Oh yeah, you're right. One, two, three, one. One, two, three, one. And you just keep doing that.
G1: You're doing it wrong.
G2: No I'm not. I'm doing it right. OK, now you go through...you go up four.
G1: You only read this. You didn't finish this. You've got to use your buddy, the straight-edge.
G2: Where's my buddy?
G1: Oooh, I've got Abby. OK. And now, over.
G2: It's up four. One, two, three.
G1: Nope. It's negative one.
G2: No, it's four. Positive four. So, you go up four. One, two, three, four. And then you go to the left four. One, two, three, four, which is right here. And then the slope is negative one. So you start here, and then you go...you go, negative one, down one. Wait, that makes no sense.
G1: Yeah, it does.
G2: Well, you can't really make a line though.
G1: Yeah, you can.
G2: Negative one, down one.
G1: Right? Now you stop there and you make your slope.
G2: Oh! Wait! No! You go up, because it's positive one on the bottom, not negative.
G1: Does it go to the left?
G2: Yeah. You go to the left. Wait a second, I'm so confused.
G1: I made a triangle. I made a triangle.
G2: I don't understand what I am doing.
G1: Teacher.
G2: Negative one.
G1: Teacher.

**Group 1: Day 3 (January 24)**

G1: I said I need help.
G2: This is x one, y one, x two, y two.
G1: X one, y two.
G2: No, x one, y one. X two, y two. OK so the formula you have to do is x two minus y one and then x two minus x one. So, do...
G1: So, what's with the six and the five?
G2: Because. Just watch. OK, so do x two. So, do three minus two.
G1: One
G2: Write it out. Three minus two, and then it's five minus two. And then. And then. Should get one fourth. Five minus two. OK, well, OK. Well then, it's one third. I don't know why that is. Equals. X one, y one, x two, y two.
G1: X two, y two. OK.
G2: So, do it in order that...
G1: Um...put...
G2: Negative two.
G1: Four...no we're not talking right now. We are doing the problem.
G2: OK, now...
G1: X2, y2
G2: X2, y2. Wait, no, you don't have to put those there. Just do what I do.
G1: OK.
G2: So, then...
G1: You want to do four...
G2: Minus.
G1: Four minus...
G2: One.
G1: Oh, yeah, one.
G2: And, then, negative five minus negative three.
G1: Negative five minus...
G2: Negative three. So, it's negative two.
G1: Equals negative two.
G2: So, circle your answer.
G1: OK. Um, for a, we got one over three. For b, we got negative four over negative one which is positive then altogether, so that's positive four over one. And then we got three over negative two for c. Yeah, that. I didn't know how to do this, so I just guessed on the test. Um and we're done now, so this is girl number one.
G2: And girl number two.
G1: Goodbye.
G2: We are going to go now because we are solving the problem. Goodbye.
G1: Bye-bye.
Group 1: Day 4 (January 25)

G2: Ok, so, we have to find what the equation is. So, what is this going up by? One. And then this is going up by... plus two, plus two. So, the x goes up by one and the y goes up by two. So you have to put y equals, and then it would be, um,...
G1: Two plus negative three.
G2: No, because it would be... no, because, y, oh yeah, well because y is over x, because it's rise over run, so it would be 3x and then you would do and then you would just find out the equation.

Group 1: Day 5 (January 26)

G2: I'm girl #2.
G1: I'm girl #1.
G2: Alright, so, we are working on the problem. OK, so, make a table and then...
G1: Um, um, you do the steps. I don't know. OK, um.
G2: So we have to figure out, um, if it's case 1, case 2, or case 3. So, we have to find the pattern.
G1: Um, it goes up by, the first one goes up by one. Plus one, plus one. This one goes, two three, four, five, six, seven. Seven, eight, nine, ten, eleven, twelve. Up by five. Wouldn't you do then one times five?
G2: No, it would be y equals five times x, or, yeah, 5x, because they give you, this is the y, so then it's five x because you need to find out x in this part.
G1: So, what do you do then with the plus one?
G2: You don't do anything with it. It just stays like that.
G1: OK. Plus one, plus one, this is plus...
G2: That one doesn't have a pattern, so it might be case 2, because it goes up by one and then it goes up by three.
G1: What is case 2?
G2: Case 2 is um, the product of x and y is always the same number. Sometimes the slope just doesn't make sense. There is no steady pattern. These are nonlinear. So, what you have to do is that, um, so like in this example, it went up by four, but then it went up by six. And this one went down by two and then went down by a half. So, it's xy equals, not that one, but xy equals six, because...
G1: So, how would you do this?
G2: That one would be xy equals, um...
G1: Um...
G2: I think it's times four, because, or xy equals four, because, um, when you multiply that it equals four and if you were to keep going it would be the same.
G1: OK. Six, four, two.
G2: That one might have a pattern, because it goes down by two and then it goes down by one.
G1: Awww! No, we're not done. OK, bye-bye.
G2: Bye.
G1: Hi again.
G2: OK, so...
G1: No, you gotta say hi.
G2: Hi.
G1: Hey, there. How's it going?
G2: Good. Let's start the problem now.
G1: No.
G2: So, we have to find out the last cost. So, a hundred fifty one, wait, no, it would be two thirty seven minus...
G1: One fifty one.
G2: One fifty one equals eighty six. That's a lot. See if that's the same. So, it would be...
G1: Three one three.
G2: Three two three minus.
G1: Minus...
G2: Two thirty seven, which would be eighty-six.
G1: Check one more time.
G2: One more time. Four-o-nine.
T: OK.
G1: No! No, what are you doing?
T: Are you down there, yet?
G2: No, we're almost done.
G1: No, we're almost done.
G2: It's eighty six, OK. So, then we have...
G1: Ahhhhhhh!
G2: Four-o-nine plus eighty-six equals four ninety-five.
G1: The answer is four ninety-five. B-O-B.

G1: We're back.
G2: OK, um, so, we have to write a function rule...
G1: Write a function rule to show the relationship between the number of hearts and the figure, aww, Valentine's Day.
G2: So, now, we...
G1: It's coming soon. We're working.
G2: So, um, I don't... wait, there's no, like, number, I mean letters that we have to use in the equation because they didn't say.
G1: Yes it does, n and h. N for number and h for heart.
G2: Yeah, but we, yeah, that's what I was gonna say, but it doesn't say that we have to.
G1: Yeah, but the quotation.
G2: Yeah, but, OK. So, then the figure number, so it would be, um, the heart would be n equals h two. I think.
G1: N.
G2: N equals h two, because the number of hearts in the figure is going up by two. I think it’s right.
G1: I think it’s two h.
G2: OK, um. Is that right? I’m not sure if that’s right. Would it be...
T: OK, so you got h equals two n. Now you check it. If you take two times one, what do you get?
G2: Two.
T: Then, how do you get to three?
G2: You would add two, or one.
T: One, so plus one.
G2: OK.
T: Nice job.
G2: Um, using the rule in part b, determine the number of hearts in figure one hundred? What? Well, wait, they go all the way up to one hundred, so it would be, um, equals a hundred times two plus one.
G1: One hundred two?
G2: No, a hundred times two, not a hundred and two. It’s in the equation. So, then,...
G1: Do we have to solve it?
G2: Yeah, so then, it would be a hundred times two. What’s that?
G1: Two hundred.
G2: Plus one.
G1: Two-o-one.
G2: Yep. That’s it.
G1: Easy peasy lemon squeezy. OK, bye.

Group 1: Day 6 (January 27)

G2: So, x, y.
G1: X, y, alright. Which ordered pair is a solution of...
T: Hey, guys, can you go to number 2 on your homework?
G1: Why?

G2: Hello.
G1: Hi!
G2: Alright, OK, so, we do...
G1: Wait, you gotta say hi.
G2: I said hi.
G1: Hi.
G2: OK, so we have to figure out, um, the slope, so we just have to count over...
G1: No, you start from the middle. It’s up three over one.
G2: It doesn’t matter which one you go on.
G1: Up three over one, I’m just giving you a heads up.
G2: No, but it doesn’t matter which, you can do it on this one or this one.
G1: Eek!
G2: It doesn’t matter if it’s in the middle, down here, or over up there, it doesn’t matter, because it’s all the same. So, it’s negative one...
G1: Wait, where are you getting?
G2: Over negative three, because, you go over, ‘cause you, ‘cause you, well you’d, I think it would be rise, but you rise one, two, three and it’s over one.
G1: So, it would be positive three, negative one.
G2: No, it’s all positive because it’s up and then over.
T: Ok, pens and pencils down, recorders, off please.
G1: What!?
G2: Because it’s up and then over right, so the right goes both positive.
T: Girl #2.
G2: What?
G2: Now, OK.
G1: Hi. Hi.
G2: OK.
G1: Say hi.
G2: I already did the first time. OK, so the first one goes x, y.
G1: x, y. This part I know, but I don’t know...
G2: So, you can do it three minus three, but it doesn’t really matter, but if you are going to do it in that order, this one doesn’t really matter what order you go in because you have two of the same numbers. And then, um, and then, it would be, but then you would have to do negative two minus three.
G1: Boop, boop.
G2: So, what would that be?
G1: Same signs add and keep. Different signs subtract.
G2: So, same signs add and keep. So, you add which is five and you keep it.
G1: Five, negative.
G2: So, it’s negative five. Wait. Wait. No, isn’t it, I think it’s negative two minus four. Isn’t it? ‘Cause I put, I think...four, three, negative two. Wait.
T: Yes. Negative two minus four.
G2: Yeah, I don’t know how, I don’t know where.
T: No big deal. You just wrote down the wrong number up there. It’s still going to have a zero slope. Negative two minus four is negative six.
G1: Negative six.
G2: It’s just gonna be zero, so that doesn’t really matter.
G1: Seven over fourteen for the next one.
G2: No, but then you have to reduce it, which is...
T: Girls, recorders off for me, please.
G1: Seven over one.
G2: Two over one. We’ll be right back.
Group 1: Day 7 (January 28)

G1: Ok, so number one. Here we go. So, match the equations with the table below.
OK, so, we have to find the pattern.
G2: How do you go from negative one to zero?
G1: Plus one, plus one, plus one. This is plus none, plus two, plus four.
G2: There is no...
G1: No pattern.
G2: If there is no pattern, then it’s...
G1: We have to go to case two.
G2: It’s not case one. It’s not case one.
G1: It’s not case one, so we have to go to case two now.
G2: Case two is when you try to see if the two numbers x and y that are in, like, the chart thingy add, I mean multiply to the same thing. So, like, negative one times zero is what?
G1: Zero.
G2: What’s zero times zero?
G1: Zero.
G2: What’s two times one?
G1: Two.
G2: So, it’s not case two, right? So, now we have to go to case three.
G1: Three!
G2: The next one, so...
G1: Yeah.
G2: You try to see…it would be x.
G1: X.
G1: X equals…OK, um, what’s case three again?
G2: Yeah, I forgot.
T: Case three is if you are squaring x. Don’t worry about the cases though. All you guys are doing is just substituting in numbers to see which one works. So, just put in, like, zero, zero and which one works?
G2: Oh, OK.
G1: So, we’ve been doing this wrong.
G2: So, it would be zero equals two, negative one, two.
G1: Want a piece of gum?
G2: Sure.
G1: OK, hold on.
G2: What’s negative one to the second power?
G1: What?
G2: What’s negative one to the second power?
G1: Negative one to the second power…ubihhh, I don’t know. Zero? One?
G2: Wait, <asks a boy in the class>, what’s negative one to the second power?
B: What’s negative one times negative one?
G2: One! I thought it was a lot harder than that.
G1: Oh, OK, yeah. OK.
G2: So, zero equals two, one. That would be two times one, which is two. Zero equals two, so it doesn’t work. So, a is not the right answer.
G1: A is not the right answer.
G2: So, now, you would substitute x and y for...
G1: You would substitute x and y for...
G2: That would be zero equals...
G1: Wait. Zero equals...hold on.
G2: Two.
G1: Zero equals two.
G2: Times.
G1: Times.
G2: Negative one.
G1: Negative one.
G2: To the second power.
G1: To the second power.
G2: Plus one.
G1: Plus one.
G2: So, figure that out. So, what’s, um, two times negative one?
G1: No, you’re doing, no, wait.
G2: What’s two times negative one?
G1: No, you did this wrong. It’s for b. It’s zero...
G2: Equals two times negative one to the second power plus one. You don’t have to have the x in there, because you are substituting it.
G1: Oh.
G2: So, what’s two times negative one to the second power plus two? So, it’s PEMDAS, remember? You gotta follow PEMDAS, parentheses, exponents, multiply, divide, add, subtract.
G1: Uh-huh.
G2: So, then, which one, what step would you do first? Would you multiply these two? Do exponents?
G1: Parentheses.
G2: Right. So, it’d be two...
G1: …two times negative one.
G2: Which is what?
G1: <sings to the tune of Row, Row, Row Your Boat> Same signs add and keep, different signs subtract.
G2: No, that’s for subtraction and addition, it’s that, it’s that song. But, then for multiplication and division, it’s remember? If your eyes were the same, you’d be happy.
G1: So, it’s two?
G2: No, it's negative two because they don't have the same sign. 'Cause remember? It's like sad face, happy face...remember that? If your eyes were the same, you'd be happy, too. Remember that?
G1: Yeah.
G2: OK. So, then it would be negative two. So, negative two...
G1: Negative two.
G2: ...to the second power plus one. So, now what are we going to do? Now, what would you do?
G1: Two times negative two? Negative two times negative two?
G2: Which would be what?
G1: Positive four.
G2: Yep.
G1: So, then, four...
G2: Four plus one equals five equals zero. So, it doesn't work.
G1: Ugh, so many steps to take.
G2: I know. You do c. So, you do one equals...wait, no, just kidding.
G1: No, you gotta do...
G2: Two equals one...
G1: No, you do y equals and then you do...
G2: No.
G1: Ugh. Where are you getting the two from?
G2: 'Cause you substitute. 'Cause you substitute x and y for these two. X and y, so those two. The y is, um, two, so that's where I'm getting the two from...equals...what's x?
G1: One.
G2: So, it's y equals x to the second power...minus what?
G1: Wait, wait, wait. One to the second power minus one?
G2: Two, because x is two, or, yeah, x...oh, no, yeah, you're right. X is one. Sorry. So, what do you do first?
G1: You do...exponents.
G2: So, what would that be?
G1: Uh...uh, that would be...
G2: What's one squared?
G1: Isn't that just one times one?
G2: Uh-huh. So what is it?
G1: One.
G2: Yeah, so, one equals one minus one.
G1: One equals one minus one.
G2: So, what is that?
G1: Zero.
G2: So, it's obviously got to be d, so, but let's check it first. So, y, so, six equals two the second power plus two. So, what's two squared?
G1: Um, two times two...four.
G2: So, four plus two...what's four plus two?
G1: Six.
G2: So, six equals six. That’s right! Yeah! So it’s d.
G1: Yeah, d!
G2: Finally! We just finished the first problem. Isn’t it ridiculous, we just finished the first problem? We’ve been working on it for, like, ten minutes. OK, whatever, but...OK, so, now, we’ve got to do the second one. Alright, so, uh, I’m going to get a separate sheet of paper, because I can’t fit all my work. OK, alright, now we’re gonna do two. So, you substitute the y and the x and the y, right? So, it would be, so, it would be, um...
G1: You’ve got to talk to the recorder.
G2: So, it would be one equals three times negative one plus two, ’cause remember, you substitute the x and they. Do you want another sheet of paper?
G1: Yeah, I can get one out.
G1 & G2: <sing> Girl put your record on tell me your favorite song. Just go ahead let your hair down.
G2: OK, so it’s y equals, it’s one equals three times negative one.
G1: Oh, my God. What just happened?
G2: OK, OK, plus two.
G1: Oh, my God.
G2: OK, plus two.
G1: Plus two.
G2: So, what’s, what do you do first, according to PEMDAS?
G1: Um, parentheses.
G2: Negative three plus two equals one. What is negative three plus two?
G1: Huh?
G2: What’s negative, what’s negative three plus two?
G1: <sings to the tune of Row, Row, Row Your Boat> Same signs add and keep, different signs subtract.
G2: Same signs add and keep. Are they the same sign? Are they the same? What’s um, what’s the difference? Different signs subtract.
G1: One. One.
G2: It’d be negative one because you take the sign of the larger number.
G1: Negative one.
G2: One equals negative one, so it doesn’t work.
G1: We just did...wait, what are you trying to get, one equals negative one?
G2: No, you’re trying to get what this equals. Y equals negative y they’re not equal that’s why it’s not this. Remember this one? Six equals six. That’s why it worked.
G1: Oh, OK.
G2: They have to be the same number.
G1: So, we have to get nine to equal nine?
G2: No. Do you know in the first one, we finally got it down to d, which is the right answer, because it was six equals six? We got it down. Remember? Two to the second power is four plus two is six and you had to get it to equal the six, so then six equals six. That’s why it worked.
G1: Oh.
G2: That's what you're trying to get.
G1: I get it.
G2: It doesn't matter about these. That's why you substitute in the \( x \) and \( y \).
G1: Now you hold the recorder because I've been holding it the whole time.
G2: OK, so, now that one doesn't work so we go on the next on. So, you substitute \( x \) and \( y \). So, it would be, um, one equals three times zero plus one. So, what would you do first, according to PEMDAS?
G1: Parentheses. You do three...
G2: No.
G1: ...one plus zero.
G2: Which is what?
G1: One.
G2: Yep. Times three equals, or, yeah, equals one. So, what's three times one?
G1: Three.
G2: No. This one goes with that one. This one goes with that one. This one goes with that one. Wait. What? Oh, my God! Am I doing the wrong... Oh, my gosh! I'm gonna kill myself.
G1: We're doing it all wrong.
G2: Ugh.
G1: We have to start all over.
G2: We did everything wrong. Well, I love life. So, this one goes with that one.
G1: We just did everything wrong. We did the wrong answers to the wrong block. So, we just got that wrong and we've got to do it all over again. Yeah!
G2: We've got to do it all over again. Yahoo! Alright, let's try this again and make sure we do it right.
G1: Alright. So!
G2: You substitute \( x \) and \( y \). So, what's the first one going to be, girl #1?
G1: Uh...negative three...three equals three times negative two...I'm on the wrong one.
G2: No, keep going. You're on the right one.
G1: No, we just did the first...
G2: Don't cross these out, because we need them still. We did the wrong one. So, y equals three times, times negative one plus two, right?
G1: Yeah.
G2: 'Cause it's from the top, so, then we got the answer out. So, what do we do first?
G1: Wait, wait, wait. What is it?
G2: Negative three equals three times negative two plus two. So, what do you do first, according to PEMDAS?
G1: Parentheses.
G2: Right. So, what's three times negative two?
G1: Three times two...different signs subtract.
G2: No, that's for addition and subtraction.
G1: One.
G2: No, it's times.
G1: Oh.
G2: Remember? Negative six. Remember? Right, because this is negative and that's positive, so it's negative. So, what's negative six plus two?
G1: Four.
G2: Negative four, right? Because you take...
G1: Yeah.
G2: OK. Equals negative three, so that doesn't work, so we go on to the next one. So, what's the next one now?
G1: Zero equals three times negative one plus one.
G2: So, what do you do first?
G1: You do...negative one plus one.
G2: Which is what?
G1: Equals...uh, two, negative two, one...
G2: It's zero, because...
G1: Zero.
G2: ...you subtract it, so it's just zero.
G1: Zero.
G2: What's three times zero?
G1: Zero.
G2: So, zero equals zero. We got it!
G1: Weeeeee!
G2: So, it's b.
G1: B!
G2: Rolling on to the second question now. OK, so, now...
G1: On the third one.
G2: That's what I meant. So, now, what do you do for the ... so, now, this one goes with this one. So, what's the first one?
G1: Actually, could we not do this one and move on to a different one?
G2: Yeah, 'cause we've already done this one before.
G1: Uh-huh.
G2: OK, so, let's do... OK, so, now, um... now, you have to find out, decide if each one of these are linear or non-linear. So, let's figure them out.
G1: Um... how do you do this?
G2: First, you always start out with case one to see if it's case one. So, is there a pattern in these?
G1: Um, let's see...
G2: How do you get from one to two?
G2: What about five to six?
G2: So, then, OK, your... then it would be y equals... um... trying to think... um, teacher?
G1: No, you gotta do two x.
G2: I always forget how to set these up.
T: OK, so, now you divide. Rise divided by run. What's one divided by one?
G2: Um, zero... no, one.
T: I'm going to give you guys a calculator. If you need to just plug it into your calculator, so you guys can figure it out. That goes in front of your x. So, y equals one x. Now you try it. If you put one in for x, what's one times one?
G1 & G2: One.
T: But that's a five.
G2: Right.
T: So, how do we get to five?
G2: Plus four.
T: Plus four. Girl #1, do you see why it's plus four?
G1: Yeah, because we need to get the five.
G2: We need to get the five.
T: Right. Nice job. Try another one. Let's see if you girls can do it.
G2: So, is that linear or non-linear?
G1: Linear? How do you know?
Group 2: Day 1 (January 20)

G2: OK, so...
G1: OK. So you go up before you run, right?
G2: Yeah. What two points should we do?
G1: This one right here and then this one right there.
G2: OK. So, are we gonna go with the right one or the left?
G1: We need to go up first.
G2: Yeah.
G1: So, one, two, three.
G2: OK.
G1: And then to the right. It doesn’t really meet the point.
G2: Wait. Isn’t it two?
G1: We have a dilemma.
G2: Isn’t it two?
G1: Yeah.
G2: Because you have to go up two and then it meets this one.
G1: Oh right. I knew that. This one right here?
G2: Um yeah. So you go up, one, two.
G1: One, two, three, four, five, six, seven?
G2: And, then, it’s positive because it’s going to the right. So...
G1: So, two over seven.
G2: Yeah, wait. One, two, three, four, five, six, seven. Yeah.
G1: So, two over seven.
G2: Two over seven and it can’t be reduced.
G1: So, that’s our final answer there folks.
G2: OK. So, b. Should we go to the others? So, one, two, three, four, five, six. Did you get six?
G1: Yeah.
G2: And then one, two, three. So, it’s...
G1: No, you go right two...
G2: Wait. I have a question are you suppose to count from here because I’m not sure.
G1: Um, you know what, whatever, we’ll just count it for now.
G2: OK, so, what is it?
G1: I forgot.
G2: One, two, three, four, five, six.
G1: Over three.
G2: One, two, three. Yeah.
G1: Yeah.
G2: OK, so.
G1: C.
G2: C. Where is c? It’s straight, so it’s zero, so it’s just zero.
G1: Right.
G2: And d, what about d? Oh, wait, yeah. Uh.
G1: OK, d, these are the two points.
G2: So, you go up two, right?
G1: Yeah.
G2: One, two. And, over two.
G1: Up two, over two.
G2: Up two, over two. And that equals one, right? So, OK, so, two over two equals one. OK, so e...where's e?
G1: There's e.
G2: Right, so zero.
G1: Zero.
G2: So, f, is...
G1: I don't see the points.
G2: I don't see the points.
G1: F is zero.
G2: Oh, no, I think these are the points.
G1: Oh, ok.
G2: Uh, no, wait, that doesn't make any sense. So, zero again.
G1: OK, so, g is...
G2: You have to start with this one and it's one, one, two. So, it's one, negative two, over negative two, because it's going to the left. OK, h.
G1: H. It should start right here and, then, um, we go up three, up three, and then you go over, um, one, two, three,..
G2: No, you don't count that one.
G1: Yes, you do. One, two, three,..
G2: Oh, wait.
G1: Four, five, six. One over...wait, what was the number again? Darn it. I forgot it.
G2: One, two, three. Three. OK.
G1: Isn't it one half?
G2: Three over six. One half.
G1: Very good.

**Group 2: Day 2 (January 21)**

G2: OK, so, we have to graph the point.
G1: OK, so, we have to, like, graph.
G2: So, negative two. One, two.
G1: So, you go negative two.
G2: Then you go and then right here. Wait, one, two.
G1: So, if it has and it has a slope of three. So, what does that mean?
G2: I'll help you, girl #1.
G1: OK, thanks, girl #2.
G2: Alright, um, you have to do, wait, you have to, um, you have to do...
G1: You have to do...
G2: The three goes here and then you do that.
G1: And then, yeah.
G2: You get it?
G1: Yeah.
G2: OK.
G1: We got it. It's all good.
G2: OK.
G1: So, then you have to draw lines through the points and then you draw arrows going out. OK, next one.
G2: OK, so, (4, -4). So, one, two, three, four.
G1: One, two, three, four. Negative four is down here.
G2: One, two, three, four.
G1: So, then, the slope is negative one. So, you go like this and then like this.
G2: And then you have to go like that, right?
G1: And then you draw a line through it and you draw the arrows at the end.
G2: Wait, I don't get this girl #1. Explain this to me.
G1: OK, so, you go a negative one distance, since the slope is, like, negative one.
G2: OK, I get it. Thanks. OK.
G1: Next one.
G2: So, through (0, 2). So, go up two.
G1: And then, the slope is...
G2: No, wouldn't it be negative?
G1: No.
G2: Why?
G1: Zero.
G2: Oh, yeah. I knew that. And then, um, up one over four.
G1: So, you go negative one. And then you go one, two, three, four. And then that's, like, the little line thingy and then just draw a line with the arrows.
G2: OK, so then, yeah, you keep doing that.
G1: Very good.
G2: OK.
G1: OK.
G2: OK, so we have to label the points x and y.
G1: So, you do negative five minus zero.
G2: Zero.
G1: Negative five minus zero is negative five, because you don't minus anything.
G2: I knew that.
G1: So, negative five and then you do zero, oh, negative eight.
G2: So, it's negative five...
G1: Over negative eight. And then it equals...can’t it not be reduced? Oh, wait, no. Two negatives make a positive. So, isn’t it positive five over negative eight, I mean over positive eight?
G2: Yeah.
G1: Yeah.
G2: Alright, OK. So, um, then we have to do this one. Wait, is that it? Is that just the answer?
G1: Yeah, that’s all you do.
G2: Oh.
G1: Where have you been?
G2: Alright, see ya. Bye.

Group 2: Day 3 (January 24)

G2: Good morning! This is girl #2.
G1: And girl #1.
G2: OK.
G1: Alright.
G2: So, a...
G1: Uh, the thing you have to, like, do is x is five
G1: So, six is x and y is two. And, then, five is x and y is three. So, then you draw an arrow over to, like, that and then over to there, you know, just to remind you where you are subtracting.
G2: So, six...Wait, we subtract?
G1: Yes, we subtract. OK, so, three minus six is negative three. So, negative three over, like put a little dash.
G2: Over five minus two is just regular because. So, we have negative three over three.
G1: Positive three, yeah.
G2: So, that equals one.
G1: Negative one?
G2: It equals negative one.
G1: Alright b, number b, oh.
G2: Number b. OK, so, negative two and two and then negative one and zero. And then it’s x, y, x, y.
G1: OK, so, negative two and two. Negative two minus two...
G2: Minus two. Zero!
G1: Is zero, and, then it’s zero over and then we do...
G2: Zero minus...
G1: Negative one...
G2: So, that’s negative one. And that equals...
G1: And that equals nothing, so you can’t really reduce that, so, yeah. So, x, y, x, y. Draw the little arrows, so four and one and negative five and three. So, four minus one, three...over negative five minus three is...

G2: Negative eight.

G1: You know what girl #2? Negative eight.

G2: And, then we can’t reduce that because it won’t work. Yeah, we can actually. No, I’m just kidding, we can’t.

G1: So, we figured out that helping, or that working with each other really works.

G2: It does. It really does.

G1: Thank you. Bye-bye.

G2: OK, so, now we have to graph them

G1: Graph each line. Negative one comma two with slope three over two, right? And then you should graph the three over two or do you have to find the slope? Like, I’m really confused.

G2: With the slope. So, we have to slope that.

G1: <Giggles> You have to slope that.

G2: So, three over two, so one, two, three, over two.

G1: No, you graph it like...

G2: Yeah, I know. Then you draw a line through it, arrows.

T: This is your point negative one, two. You did your point right. Now you’ve got to do your slope of three over two. What does that mean?

G1: Um, don’t you have to graph it and then...?

T: OK, you did the point right, the negative one, two.

G2: And then we pointed that one.

T: No.

G2: No.

T: Because this right here means rise over run.

G1: Oh, yeah.

T: So, you’re rising three, running two.

G2: Oh, right!

G1: Oh, you know what, I thought the whole time when I was doing the homework that you had to run before you rise.

T: Oh, no, you’re falling up the stairs.

G1: Yeah, it was not fun.

G2: OK, so, then for the next one we have to do two, one, two, and then negative three and the negative is down here, so one, two, three.

G1: Where did you get? Oh, good job, girl #2.

G2: And then we have to run negative one which is here and rise one, two, three.

G1: No, rise over run.


G1: Yeah.

G2: So, then it’s rise negative one, so it’s right here? So, you have to...

G1: You have to negative one, no, negative one and then to the right one, ...
G2: Right? If it's negative, then it goes to the left.
G1: No-uh. Oh, yeah, sure. Whatever you say, girl #2.
G2: So, did I help you?
G1: Yes. You did help me.
G2: OK. Bye.

Group 2: Day 4 (January 25)

G1: OK, so, um, the product of x and y is always the same number. Sometimes slope just doesn’t make sense, dot, dot, dot, there is no steady pattern. These are all nonlinear.
G2: Yes, because it's not a straight line.
G1: No, wait, yeah, yeah.
G2: So...
G1: So, alright, we have to, like, find the pattern of the table. So,...
G2: So, this one is one.
G1: This one is plus one.
G2: OK, so this is two, two, two, two. Goes up by two’s.
G1: Um, plus two all the way down.
G2: So, y equals...
G1: So, it’s y over x, so then your slope would be two over one, right?
G2: So, it’s y equals and then two divided by one is...
G1: Yeah, and then y equals two x.
G2: Right, we did it.
G1: No, we have to do this. So, it’s just...look, like look at this, y equals five x because we did five over one. So, now y equals the product of two over one. So, what’s two over one?
G2: One?
G1: Good job...no, it’s two.

Group 2: Day 5 (January 26)

G1: Forty-two, negative forty-two.
G2: Yeah, it'd be negative forty-two. OK. OK.
G1: What is this going up by?
G2: OK, so this is going up by...no, this is plus two.
G1: Plus one. Zero, one, two.
G2: Oh, right. Plus one. And then five and then minus five, so, plus five, minus five.
G1: What do you mean minus five?
G2: Plus five. These are minus five.
G1: Oh, wait a second. Is that a...Oh, I forgot the six.
G2: OK.
G1: So, then you do, what number?
G2: Oh, look, it’s...
G1: That’s really cool, girl #2. Is it on?
G2: Yeah.
G1: So, you do y equals five x...
G2: X.
G1: Plus one.
G2: Plus one. Yes! I did this right. OK.
G1: OK.

G2: Welcome to the girl #2 and...
G1: Girl #1.
G2: Show. Yeah.
G1: To figure out the right side of the table you have to do two hundred thirty-seven minus one five one, so, that’s eighty six. So, this is, like, being added by eighty-six. I don’t know if you get that. So, then you have to see if it works for two thirty-seven and three twenty-three.
G2: Wait, I don’t get this.
G1: I’m explaining it. So, then three twenty-three...mmm...three twenty-three minus...
G2: I don’t get this.
G1: Minus two three seven. OK.
G2: OK. We have to do minus two three seven.
G1: OK, so it goes up by eighty-six.
G2: It goes up by eighty-six. OK, so, it goes up by eighty-six every time then this goes up by one. So, we have to do, we have to...OK, bye.

G2: Welcome to the girl #1 and girl #2 show. OK, um, hey guys what’s going on?
G1: You guys want to not listen?
G2: OK, so, you have to do...OK, so,...OK, so, we have to fill in the chart. It’s seven, nine, eleven. Alright, and then it’s...OK, so, this goes up by plus two and this goes up by plus one. So, write a function rule, which is an equation, to show the relationship between the number of hearts and the figure number.
G1: OK, so, this is n and this is h.
G2: So, h equals...
G1: Number hearts.
G2: So, it hearts equals two x...
G1: H equals two x...
G2: Right.
G1: Plus...
G2: Plus one. No, plus...
G1: Yeah, plus one.
G2: Why one?
G1: Three minus, three minus two is one.
G2: Three minus two is one. Right, so plus one.
G1: And that’s our answer.
G2: That’s our equation. Using the rule in part b, which is \( h = 2x + 1 \), determine the number of hearts in figure one hundred.
G1: OK, so, what you would have to do, you would plug in for \( h \).
G2: Right.
G1: Then you do equals two \( x \) plus one. So, you divide both sides by two. So, one hundred divided by two is fifty plus one is...um...uh...fifty-one.
G2: So, then, wait, left is fifty and then equals \( x \) plus one?
G1: Oh, we did this wrong. Don’t we have to do minus one on both sides?
G2: Boop, boop, boop.
G1: Yeah. Do that before the variable. So, minus one, minus ninety-nine.
G2: That just \( x \)'s out, so it’s ninety-nine divided by, no equals two \( x \).
G1: Divide it by two.
G2: Yeah, but I’m gonna rewrite it first. And then we have to divide by two.
T: Just be careful, because you have to use the same variable.
G2: Yeah, we’re redoing this.
G1: Yeah, I meant to do \( n \).
G2: So, then, it’s, so, then, it’s \( n \) equals ninety-nine divided by two, which is not gonna get an even answer. It’s just forty-nine point five equals \( n \). So, it’s forty-nine point five equals the number, the figure number.
G1: You don’t have to write that.
G2: Why?
G1: I’m not gonna explain it to you.
G2: Have a good day.
G1: You too.

Group 2: Day 6 (January 27)

G1: We’re suppose to find the points that these align. So, the slope, so, you want to pick the most innermost, because then you don’t have to reduce.
G2: So, do you want to do these two?
G1: Yeah, they’re more together.
G2: So, you go...
G1: You have to rise before run. One, two, three.
G2: One, two, three. Over one.
G1: So, three over one and you can’t reduce that.
G2: One, two, three, one. Is it, any negatives? No.
G1: Uh-uh.
G2: Three over one.
G1: And then for this one do you want to do these ones?
G2: Yeah, one, two, and then one, two, three, four.
G1: So, it’s two over...
G2: Equals one half.
G1: It’s negative four though ‘cause you go to the left. Equals one, negative two.
G2: Wait, this one’s zero?
G1: Zero, ‘cause it’s a straight line.

G2: OK, so, we have to find...
G1: Um, so, you have to label the x and y.
G2: So, three minus three over negative two minus four.
G1: OK, so, ...
G2: Then, it’s...
G1: It’s uh...
G2: Three minus three is zero, so it’s zero over negative two minus four. So, it’s zero...
G1: Three minus four is negative one and you do boop, boop, and it’s negative six. So, that’s, you get...no, it’s negative one over six, negative six.
G2: It’s just still a negative.
G1: OK, so, negative two minus negative four, minus four...Girl #1, when you do negative two...Girl #1.
G2: The three and the three and negative two and negative four.
G1: Girl #1 when you do negative two minus four you, boop, boop. No. Do you know what boop, boop is?
G2: ...you minus four, not negative four.
G1: You do boop, boop.
G2: Why?
G1: Because you have to. That’s what you always do.
G2: No. Boop, boop is when it’s like two minus a negative four and then you do boop, boop for the plusses.
G1: OK, we’ll do this in the calculator, then. Um, negative two minus four...negative six.
G2: Yeah, over negative six.
G1: I put negative six.
G2: OK, where are you getting the four?
G1: We’re on b.
G2: I know.
G1: You should do negative six, you got negative one.
G2: No, this is a. OK, look, three and three and two, negative two and negative four.
G1: It’s negative one over negative six.
G2: Three minus three over negative two minus four, right? That equals zero and that equals negative six.
G1: Alright, chill.
G2: Alright.

**Group 2: Day 7 (January 28)**

G1: Hello!
G2: This is girl #2.
And girl #1.

G2: And this is day seven on the...  
G1 & G2: Girl #2 and girl #1 show!

G2: This is the half marking of our recording session.

G1: And it’s sad. Try not to cry. I know.

G2: Try not. I know it’s hard, but...

G1: Hold back the tears.

G2: Yeah. And we just want to let you know that working in groups...

G1: Very fun.

G2: It’s more fun then ‘cause you get it, you get it done quick.

G1: Yeah.

G2: Now, we’re gonna start our review sheet.

G1: Number one. Match the equations with the table below. So, what you want to do here...

G2: OK, so number one. One of the equations is y equals two x squared.

G1: So, you have to find them out, so you plug in...

G2: Plug in y.

G1: So, you plug and chug.

G2: Zero equals two times negative one...

G1: I’m gonna go get a calculator.

G2: You go get a calculator. OK.

G1: So, so, zero equals, so, so we plugged in the numbers...

G2: That doesn’t even make sense ‘cause zero can’t equal all that.

G1: Yes it can girl #2.

G2: No it can’t.

G1: Yes, you do two times negative one...

G2: Zero can’t equal that, right?

G1: Yeah!

T: No, ‘cause if you put in negative one for x that’s one times two. What’s one times two?

G2: Negative, or would it still be negative two?

T: Well, no. Negative one squared is?

G2: What?

T: You square the one first.

G1 & G2: Oh!

T: It’s one times two.

G2: That doesn’t make any sense, but alright.

G1: So, a doesn’t work. On to letter b.

G2: So, it’s, this doesn’t even make any sense, because it’s zero, zero.

G1: So, b doesn’t work according to girl #2.

G2: I think, OK, so y equals two...

G1: So, negative one squared would be positive one, wouldn’t it?

G2: No, yeah, wait. Alright, negative one to the second power...

G1: No, it’s that one.
G2: No, it’s not. Look. OK, so, y is two. So, we have to do two equals one...
G1: Oh!
G2: ...squared minus one.
G1: Oh, I was plugging it into this one.
G2: There you go. So, it must be d, but we can still try it. So, six equals two squared plus two. Two squared plus two is six. So, six equals six. So, it’s d. Alright.
G1: D is the answer. Yeah!
G2: Yes it is. Me and girl # 1 are smart, so we figured it out.
G1: Yes we are. I need to reset this. OK. Did you clear it?
G2: Yep it bothers me. OK, back to math. OK, so the first one’s negative three equals three times negative two plus two. So, three times negative two plus two equals negative four. Negative three does not equal negative four. So, it cannot be a. It cannot be a. Now y is zero equals three and then negative one plus one, so...OK, wait. Three times negative one plus one is negative two. Negative two does not equal zero. So, it is not b. So, it must be either c or d. I have a feeling... You know what? I have a feeling it’s gonna be c. Six equals two times one plus one.
G1: What?
G2: So, two times one plus one... do you get it?... is three. So, it’s not. So, one equals three. No.
G1: So, it’s d.
G2: So, it must be d, but we can still try it. So, nine equals three times two minus one...
G1: Three times two is six minus one is...
G2: Three times two minus one equals... five!? 
G1: We did something wrong here.
G2: Who?
G1: Let’s see what the calculator...
G2: This calculator is very sensitive.
G1: OK, so, let’s go back to letter a. I’m talking to the calculator, wow!
G2: Oh, no!
G1: OK, so, let’s try c again. So, six times two times one... no, that doesn’t work. OK, so c doesn’t work. For sure. I’m gonna cross out c again. B. Zero. No that doesn’t work. OK, so, it must be a that works, girl #2.
G2: How is it a? Because look...
G1: Getting a calculator.
G2: ... negative three equals three times negative two plus one, or plus one, yeah. So, three times negative two plus one.
G1: No, plus two... right here.
G2: Oh, yeah, plus two.
G1: Oh my God.
G2: I am... [inaudible]. I did that up here, though. I did plus two. See. You know what? Let’s just skip this one. Wait, til we go over it. OK, we’re going to skip number two because...
G1: ... because we are, we are in a dilemma. Alright?
G2: A sticky situation.
G1: Very sticky.
G2: OK, so it’s one equals two times negative one to the power of... oh, well, whatever, so, two
G1: Two times negative one to second power...
G2: Negative one to the second power minus...
G1: Minus... minus one equals... negative three.
G2: A is not right because one does not equal negative three. Now, ...
G1: That doesn’t work.
G2: So, bye-bye.
G1: Alright. This doesn’t work either ‘cause this has a zero in it.
G2: OK.
G1: OK, so, one...
G2: One equals one squared minus one...
G1: That doesn’t work ‘cause one squared minus one is zero.
G2: Right. So, it’s probably d, but we can still try it.
G1: It’s always d.
G2: I know. Why is it always d? So, seven equals two squared plus one...
G1: Two squared plus one.
G2: Equals five. That doesn’t work either, so...
G1: Oh my Gosh. Teacher, this isn’t working for us. I don’t know what we’re doing wrong.
G2: I’m gonna pause it and we’ll be back.

G1: You know what we did wrong, girl #2? We can’t type the whole equation in at a time. We should do one thing at a tim, like, one...
G2: At a tim?
G1: One thing at a tim. <giggles and makes a lululululu noise> OK, so, to the second power you should do two to the second power equals four and then you do plus that. So, ...
G2: Alright, um, linear or non-linear?

G1: OK, so, we have to decide if an equation is linear or non-linear. I don’t know how to do this. Will you help me, girl #2?
G2: Yes.
G1: Is it recording right now?
G2: Yes. Alright, so, now we have to find the linear and non-linear.
G1: And you know if it’s linear if there’s a pattern, like, one, two, three, four.
G2: This is linear. This is all linear. This is linear. Fifteen, thirty-five, fifty-five. This one’s linear. This is so easy. This is...
G1: Not linear.
G2: Yeah, because this is up two and this is plus one.
G1: Oh, yeah it is. Linea... no, not linear because this doesn’t have a pattern.
G2: Yeah it is. It goes down by, uh,...
G1: One, two, four, eight?
G2: Down by eight, down by four, down by two.
G1: This one, you’re talking about? One, two, four, eight. That makes no sense.
G2: Wait. Yeah. If you double this, it’s two. Double that it’s four. Double that it’s eight. And then this is divided by two is eight, divided by two is four, divided by four...
G1: You know what girl #2? I don’t want to hear it.
G2: And this is not, obviously.
G1: This is not.
G2: Non-linear.
G1: Three, six, nine, twelve, yes it is.
G2: No, because look at the other side. Up by three, up by three, up by three. Linear. This one is two, five, three, zero. Plus three, minus three, minus three. So, this is...wait, four, thirteen, seven...no, it’s non-linear. This one is non-linear.
G1: Non-linear.
G2: OK. Find the slope...oh, this is easy. You have to do x, y, x, y
G1: X, y.
G2: Four to the eight and one to the negative two. OK, so, we have to do four minus negative eight over one minus negative two. They both turn into hoop, hoop. And they equal...
G1: Would four, no, four minus two.
G1: Four minus a negative eight and then one minus a negative two, turns into hoop, hoop.
G2: Yeah.
G1: And hoop, hoop is...
G2: Then it’s twelve over three.
G1: Twelve over three.
G2: Yeah, that’s what I got. Can that be reduced? Yeah. No, ‘cause it’s, oh yeah. OK.
G1: Good job, girl #2.
G2: Four. Thank you. Four minus zero and zero minus negative two. Zero minus negative two turns into hoop, hoop. So, it’s four over two. Did you get that?
G1: Um, not yet.
G2: OK. And, now this four, negative four minus negative six. Two minus three. The top one turns into hoop, hoop, but it’s still, it’s two. OK, so, it’s two over five. Do you get it? Do you get it?
G1: <makes a fake crying noise>
G2: Minus three and then two over five. Do you get that?
G1: Yes.
G2: No, you don’t.
G1: Yeah, I got it.
G2: I’m sure you did. OK.
G1: OK, girl #2.
G2: Number...number a, letter, no, yeah four a.
G1: y = mx + b on the graph. We have to find the slope.
G2: The y-intercept. You just have to write m, b.
G1: Do we really?
G2: Yeah.
G1: What is m and what is b? Oh, the slope is m.
G2: Oh, God!
G1: Ok, so the slope is two and the y-intercept is one. Right?
G2: The m is negative two and the b is one.
G1: Yeah, so...b is the slope is one over three and the y-intercept is negative five.
Negative two over three and then five. I've been, I've been doing this the whole time and you've been singing to the recorder.
G2: Well I, well, I did these, so we're even.
G1: Girl #1, I don't need that.
G2: No, you didn't. I had to prove one right to you.
G1: I had to prove one right to you too.
G2: No you didn’t.
G1: Yeah, I did. This one I had to prove right to you.
G2: I'm talking about these. OK.
G1: OK.
G2: OK, so, yeah, so I'm not sure about this. OK, so, we have to connect the intercepts.
G1: I already graphed them.
G2: Yeah, I know. Thank you, girl #1.
G1: You're welcome. So, negative five is what we're going to graph. Go up three, I mean up one.
G2: Wait. Negative five, what? Negative five, two? Or...
G1: The intercept. The intercept.
G2: Like if we do it here, it...
G1: Over one, girl #2!
G2: OK!
G1: OK, so,...you don't need it over one, because it...
G2: Sorry. OK, so, if this is negative six then where? Is it just here?
G1: Yeah, no, negative six is right here, girl #2.
G2: No.
G1: Yeah, it is.
G2: Oh, it’s on the y?
G1: Uh-huh.
G2: Then we have to go...One over one, two, three.
G1: No, girl #2. I want to explain it to you.
G2: Yeah, I'm listening.
G1: OK, so, no let me...it makes me feel special. <makes fake crying noise> Up two, one, two...
G2: I know how to do it, girl #1.
G1: One, two, three...you just said you didn’t.
G2: Calm down. Oh my!
G1: We have ten more minutes. OK, number five. A pizzeria charges eight dollars for a large cheese pizza, plus two for each topping. OK, so...this goes up by two, I hope.
G2: Yeah it does. Fourteen dollars, sixteen dollars, eighteen dollars.
G1: Write an equation that represents the table, so...OK, so, we have to write an equation or a function rule that represents this table that we just made. We’re going to ask the teacher.
G2: You want me to help you?
G1: Do you know how to do it?
G2: I really do.
G1: OK. So what does this mean, girl #2.
G2: OK, an equation means it’s with the equal sign and an expression is without.
G1: So, with equals.
G2: OK, this is awkward. And, um, and uh, and uh, alright.
G1: Teacher, we have a question.
G2: So, uh...with the equal sign you have to do...
T: What’s up?
G1: Would it be like y equals?

G1: Girl #2, what are you doing?
G2: Look at mine. I’m confused.
G1: You wouldn’t let me explain it to you. Oh my God.
G2: What?
G1: So, girl #2, I taught girl #2 how to do the graph. Right, girl #2?
G2: Yeah, you did. Can you explain it one more time?
G1: Yeah, OK, so...let’s just take number d, letter d, for example, OK. So, let’s just...OK, so, your y-intercept is five. So, that means that you have to like graph it on the y. Do you get what I’m talking about here?
G2: What do you mean the y?
G1: You have to graph it right there, though.
G2: Y, don’t deny.
G1: Oh, right, so you start right here.
G2: Yeah, that’s what I thought.
G1: No, I had to teach it to you.
G2: Y, don’t deny.
G1: My God! Did you see your graph lately?
G2: Did you see your graph?

G2: OK. What? Alright, so, it’s eight l because it’s eight large plus two t, two toppings, equals...equals x. No, equals p, price. Get it?
G1: Do you have to...Yeah.
G2: Right, so, it's... Alright, the question says the pizzeria charges eight dollars for a large pizza two for each topping. So, we did eight l because eight large plus two t, two toppings, equals price, equals p. So,...yeah.

Group 2: Day 8 (February 1)

G1: OK, so, today we're doing a new unit. And we're doing exponents. And, um,... so, we just have to count the number of letters and put the little exponent thingy next to it. Who are you texting? OK, um,... one, two, three, four, five, five t's, OK. So, ten a...
G2: Doing exponents and we have to find out how many are in each. I think this one negative three it just throws you off. I don't...I think it's...
G1: There's an example right here. You just do negative three.
G2: Yeah, I know. You have to do negative three a...
G1: Two b two.
G2: A, b two.
G1: No, that means that there's only two for b and zero for a.
G2: We didn't label that one.
G1: Because that means there's one x. Yeah. You don't need to write a one if there's only one.
G2: Yeah, I know.
G1: OK. One, two... We're recording right now, but girl #2 is just not cooperating.
G2: Hahaha. Yeah, I am.

Group 2: Day 9 (February 1)

G2: Day thirteen of recorder... on the girl #2 and girl #1 show. Girl #1's crying right now.
G1: Yeah.
G2: 'Cause she's so sad of this going to be ending in one day. OK, so, for...
G1: We're working on exponents.
G2: ... number six and seven we have to do...
G1: We have to divide twenty.
G2: Twenty and five, so...
G1: Twenty divided by five...
G2: Four. Negative four 'cause it's negative.
G1: Negative four over one and then you do m three, so three minus one and it'd be three... wait.
G2: Well, it's on the bottom 'cause this has more.
G1: Well, yeah, but is but is it three minus two or three minus one?
G2: Minus one.
G1: OK. So, then, it'd be m two.
G2: M two. M to the second.
G1: And then c to the...?
G2: So, they’re both the same, so, what, where does it go? We can just put it on the top.
G1: No, there’s nothing there because it’s zero.
G2: OK, so, just leave it like that? So, you don’t do anything?
G1: So, negative four over one m two.
G2: OK, and seven...twenty-one divided by negative twenty-one that’s zero. So, zero, it’s just zero.

Group 2: Day 10 (February 3)

G2: OK, so, oh geez, girl #1. So,...
G1: It’s our last day.
G2: Yeah.
G1: I’m gonna cry and we have to do exponents.
G2: So, I don’t know if we add a one here.
G1: I am not going to.
G2: So, I think it’s four a four c four.
G1: Uh...
G2: Fifteen, fifteen x. Seven, eight, nine, ten, eleven. Y three. Did you get that?
G1: Yes. Is this eleven or twelve?
G2: X four, five, six, seven, eight, nine, ten, eleven, I think. I think it’s eleven. That’s what I got. I don’t know. Yeah, girl #1 is very upset today.
G1: One over one.
G2: Don’t know why. Actually, I do, but I can’t tell you.
G1: <fake cries>
G2: OK. I know what will cheer you up.
G1: I burned my tongue.
G2: I know what will cheer girl #1 up.
G1: I burned my tongue.
G2: Girl #1, I know what will cheer you up.
G1: No, it won’t cheer me up.
G2: No, wanna bet?
G1: No.
G2: <fake giggles>
G1: Can I take a break real quick?
G2: <fake giggles> OK, so, and then this...
G1: Did you see the burnage on my tongue?
G2: No. Yuck. Ewww!
G1: It hurts.
G2: OK, this is five a, b six, c four. Six n, five, six, seven, eight, nine, ten, eleven, twelve, m, eight, nine, ten. Twenty-one x six, seven, eight, nine. Nine, not a g, nine. Y six, z, five, six, seven, eight, nine, ten, eleven, twelve. I don’t know how to do these, girl #1. Do you?
G1: Why is it six? Where are you getting six from?
G2: Because four, five, six, seven. Oh, dang! You have to minus.
G1: Yeah!
G2: No, I’ve been doing this all wrong. Oh, dang it!
G1: <giggles>
G2: I’m not doing the others. I’m doing this.
G1: Girl #2 did it wrong, but that’s OK. OK, so, when you divide...yeah. OK, so, um, what was I talking about? OK, so, when you divide these, you have to subtract the exponents, OK.
G2: Yeah, well I don’t feel like it.
G1: So, um,..hey, I get this. It’s two. And z, z would be on the...z would be on the bottom and it’s two because there’s more z’s, so...
G2: What do we do with this a ‘cause it doesn’t have any? Do we just leave it out?
G1: It’s just zero. You don’t even put it down.
Appendix F

Observations

T: How do you know where slope is? Slope is always in front of the variable. What does the b stand for? Start on y, don’t deny. Girl #2 in group 1, does that make sense?

Girl #2 is not sure and her partner helped her understand.

Girl #2 in group 2 volunteered in class to answer a question. To get x by itself, divide by four.

Girl #2 in group 1 said then x equals two.

T: Asked what x equals two would look like.

Girl #2 in group 1 motioned up and down.

T: So, we know x has to always be two, what can y equal?

Girl #2 in group 1 volunteered information of y being zero, one and two.

T: What is the slope and y-intercept of a line that is undefined?

Class members raised hand for this information.

T: We have a problem with c, \( y - 3x = 2 \). We always want \( y = mx + b \). How do we get it to say \( y = mx + b \)?

Girl #1 in group 1 asked if we should divide.

T: Asked students to cover up \( y \).

Girl #2 in group 2 said the -3x.

Girl #2 in group 1 said you divide by 3x.

Girl #1 in group 1 said you add it.

T: Why can’t you add the 2 and the 3x?

Classmate shared that those are not like terms.

T: Raise your hand if you know the slope.

Girl #2 in group 2 knew the slope and then asked how did you get 3 over 1 for the slope.
T: The slope is always in front of x.

Girl #1 in group 1 shared that the y-intercept is 2.

Girl #1 in group 1 was confused when it came to graphing and said, “I’m so confused. I don’t get this. I’m so confused.”

T: Asked students in the class to raise their hand if they understood. None of the girls in the study raised their hands.

T: Asked students to take paper and flip to the front next. Told students that they needed to use the letters given to them. (d = 8t)

T: Went over homework with students.

Girl #1 in group 2 had a question.

T: Who knows the difference between an expression and an equation?

Classmate raised hand to give the answer.

T: 15h + 28 is the expression for A. B is asking for an equation. $43 cuts one person’s hair.

Girl #1 in group 2 made the error of adding $28 every time. She realized that this is where her mistake was. The problem stated that a person earned $15 for each haircut she gives during one day. She was also given $28 in tips during the same day.

T: For six haircuts you should have $118. You have to know slope formula.

Girl #2 in group 2 said that for number four on the homework the second problem, she got six over negative two. Girl #1 in group 2 said it was negative two over negative four and told her friend she subtracted wrong and showed her where it went wrong.

T: Here comes the lesson. We are going a little out of order. This packet looks just like the test. Start at number 12. Find the slope with your math buddy. Go ahead.

T: Be careful, you don’t want to trip up the stairs. It’s rise over run. You are not running before you rise. We’ll joke, but we need you to come back.

Group 2 is talking during class. They were not paying attention.

Girl #2 in group 1 said you rise zero.

T: No, you run 2.

T: When will it be undefined?
Girl #1 in group 2 said when it’s up and down.

Worked on number 13a in class with teacher and then 13b and 13c were done with their math buddy.

T: Said that she wants to see work. For the most part, those who have been showing work are getting it right. Don’t do work in your head.

T: What happens if you get zero in the denominator? Classmate answers.

T: You want to do the points in the same order.

T: Go back to the front page. 7, 8, and 9, you are writing equations from a table. Remind me again, what you need to do. Classmate volunteers that you must look to see if there is a pattern.

Girl #1 in group 2 thought that two divided by a negative two was zero. Teacher asked what two divided by two was and she gave an answer of one. Then said that two divided by negative two was a negative one. Girl #2 in group 2 said that there was not a pattern for number 8.

Girl #2 in group 1 said that for number 8 it was the other thing.

T: X times y gives you what value? Classmates answer negative six.

T: What is a monomial?

Girl #1 in group 2 raised her hand and said when there is no plus sign.

T: xy + 9x, what is this? How many terms does it have? Classmate answers.

T: In (9x)(4x²), what are the nine and four called? Classmate answers coefficients.

T: What is the exponent on the x with the coefficient of nine? Classmate answers one.

T: Write PEMDAS this way:

(PEMDAS)

(The teacher wanted students to write it this way to provide a memorization technique when working with exponents. When multiplying, you multiply the coefficients and add the exponents. When dividing, you divide the coefficients and subtract the exponents.)
Students in the class do something called Power Chair when going over homework questions. A student will volunteer and will come up to the front of the room to share what they got as their solutions to homework problems. If they miss one as they progress through the answers, a student in the class will raise their hand and give what they believe to be the correct answer. If they are correct, they take over in the Power Chair. If they are incorrect, a different student gets to answer. If you are the one remaining in the Power Chair at the end of going over the homework, you receive a prize (usually a piece of candy).

Girl #2 in group one and girl #2 in group two were both in Power Chair. Girl #2 in group two made it very far, but had to sit down after giving an incorrect answer. Her friend, girl #1 in group two, said that she was still a winner in her eyes.

While working through the lesson, girl #1 in group one volunteered the answer to the following questions: If you have n to the sixth power, how many n’s do you have on top? She responded with six. If you have n to the third on the bottom, how many n’s do you have? She responded with three. Girl #2 in group one asked, “We can just subtract, right?”

T: Explained that this was a tug of war. Whichever coefficient was larger whether it was in the numerator or in the denominator is where the resulting subtracted exponent with its variable would be placed.

Girl #1 in group one asked, “What if they are the same exponent?”

T: Good question. She opened this up to the class and asked them what happens when we have the same exponent.

The one girl group (Group #2) is talking and the teacher addresses the talking. Girl #2 in group two asked why one of the problems wasn’t negative. The teacher said that if she wasn’t talking with her friend she would know. The teacher just explained why the problem was positive and not negative to the class.
Appendix G

Group Work

Day 1:

Determine the slope of each line named below.

a) slope = \( \frac{1}{3} \)

b) slope = \( \frac{2}{3} \)

c) slope = 0

d) slope = \( \frac{2}{2} = 1 \)

e) slope = 0

f) slope = undefined

g) slope = \( -\frac{1}{2} \)

h) slope = \( -\frac{1}{2} \)

Day 2:

d) through = (-2, 0)

slope = \( \frac{3}{1} \)

e) through (4, -4)

slope = \( -1 \)

f) through (0, 2)

slope = \( -\frac{3}{4} \)

\[
\text{d) } (-8, 0) \text{ and } (0, -5)
\]

\[
\frac{-5 - 0}{0 - (-8)} = \frac{-5}{8}
\]
Day 3:

a) (6, 2) and (5, 3) 
\[
\frac{3-2}{5-6} = \frac{1}{-1} = -1
\]

b) (0, 2) and (-1, -2) 
\[
\frac{-2-2}{-1-0} = \frac{-4}{-1} = 4
\]
c) (-3, 1) and (-5, 4) 
\[
\frac{4-1}{-5-(-3)} = \frac{3}{-2}
\]

Day 4:

3) 

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

\[m = \frac{\Delta y}{\Delta x} = \frac{2}{1} = 2\]

\[y = \frac{2}{1} x + 1\]

\[y = 2x + 1\]

\[2(1) + ? = 3\]

Day 5:

Example 4) 

a) Continue the pattern and fill in the last section of the table.

<table>
<thead>
<tr>
<th>Months</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>151</td>
</tr>
<tr>
<td>2</td>
<td>237</td>
</tr>
<tr>
<td>3</td>
<td>323</td>
</tr>
<tr>
<td>4</td>
<td>409</td>
</tr>
<tr>
<td>5</td>
<td>495</td>
</tr>
</tbody>
</table>

b) Write an equation to represent the data in the table.

\[C = 80m + 65\]

c) Use the equation to find the cost of joining the health club for 1 year = 12 months.

\[C = 80(12) + 65\]

\[C = 1032 + 65\]

\[C = 81097\]
Example 6) Danielle is making a pattern using hearts.

![Hearts pattern](image)

a) Dan starts a table to show the number of pennies of each figure. Fill in the missing numbers in the table.

<table>
<thead>
<tr>
<th>Figure Number (n)</th>
<th>Number of Hearts (h) in figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>13</td>
</tr>
</tbody>
</table>

b) Write a function rule (equation) to show the relationship between the number of hearts and the figure number.

\[ h = 2n + 1 \]

c) Using the rule in part b, determine the number of hearts in figure 100.

\[ h = 2(100) + 1 \]
\[ h = 200 + 1 \]
\[ h = 201 \]

Day 6:

12) Find the slope of each graphed line.

a) \[ m = \frac{2}{1} = 2 \]

b) \[ m = \frac{-2}{4} = -\frac{1}{2} \]

c) \[ m = 0 \]

13) Find the slope of the line through each pair of points. Show work.

a) \((3, 1)\) and \((-2, 6)\)

\[ m = \frac{\Delta y}{\Delta x} = \frac{6 - 1}{-2 - 3} = \frac{5}{-5} = -1 \]

b) \((4, 3)\) and \((-2, 3)\)

\[ m = \frac{\Delta y}{\Delta x} = \frac{3 - 3}{-2 - 4} = 0 \]

c) \((-5, 1)\) and \((2, 15)\)

\[ m = \frac{\Delta y}{\Delta x} = \frac{15 - 1}{2 - (-5)} = \frac{14}{7} = 2 \]
Day 7:

1) Match the equations with the table below

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

a) \( y = 2x^2 \)

b) \( y = 2x^2 + 1 \)

c) \( y = x^2 - x \)

d) \( y = x^2 + x \)

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

a) \( y = 2x - 1 \)

b) \( y = 2x^2 + 1 \)

c) \( y = x^2 - 1 \)

d) \( y = x^2 + 1 \)

2) Write an equation for each table. Decide if the equation is LINEAR or NONLINEAR

3) Find the slope of the given points using the slope formula

a) \((-2, -8)\) \((1, 4)\)

\[ m = \frac{\Delta y}{\Delta x} = \frac{4 - (-8)}{1 - (-2)} = \frac{12}{3} = 4 \]

b) \((-2, 0)\) \((0, 4)\)

\[ m = \frac{\Delta y}{\Delta x} = \frac{4 - 0}{0 - (-2)} = \frac{4}{2} = 2 \]

c) \((3, -6)\) \((2, -4)\)

\[ m = \frac{\Delta y}{\Delta x} = \frac{-4 - (-6)}{2 - 3} = \frac{2}{-1} = -2 \]
4) Graph each of the following using slope and y-intercept \( y = mx + b \) on the graph

a) \(-2x + 1 = y\) 
\[
\begin{align*}
m &= -2 \\
b &= (0, 1)
\end{align*}
\]

b) \(y = \frac{1}{3}x - 5\) 
\[
\begin{align*}
m &= \frac{1}{3} \\
b &= (0, -5)
\end{align*}
\]

c) \(y = -6\) 
\[
\begin{align*}
m &= 0 \\
b &= (0, -6)
\end{align*}
\]

d) \(5 - \frac{2}{3}x = y\) 
\[
\begin{align*}
m &= -\frac{2}{3} \\
b &= (0, 5)
\end{align*}
\]

5) A pizzeria charges $8 for a large cheese pizza, plus $2 for each topping.

a) Complete the table below

<table>
<thead>
<tr>
<th># of Toppings</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8.00</td>
</tr>
<tr>
<td>1</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>12.00</td>
</tr>
<tr>
<td>3</td>
<td>14.00</td>
</tr>
<tr>
<td>4</td>
<td>16.00</td>
</tr>
<tr>
<td>5</td>
<td>18.00</td>
</tr>
</tbody>
</table>

\[
\frac{\Delta C}{\Delta n} = \frac{2}{1} = 2
\]

b) Write an equation (function rule) that represents the table

\(C = 2n + 8\)

c) Graph the data below
Day 8:

\[-3aabb = -3a^2b^2\]

Day 9:

6) \[\frac{20mc^2}{-5m^2c^2} = \frac{-4}{m^2} \]

7) \[\frac{21x^4}{-21x^5} = \frac{-1}{x}\]

Day 10:

2. \((a^2bc)(4a^2c^3)\)  
   \[4a^4bc^4\]

3. \((10x^4y)(5x^7y^2)\)  
   \[50x^{11}y^3\]

1. \[\frac{20ab^4c^3}{4ab^2c} = \frac{5b^2c^2}{n^2m^6}\]

2. \[\frac{6n^7m^8}{6n^5m^2} = \frac{1y^2}{2x^3z^2}\]

3. \[\frac{7x^3y^4z^5}{14x^6y^2z^7}\]