2000

Teaching Mathematical Discourse Through Characters and Scripts

Marcia DeJesús-Rueff
St. John Fisher College

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Teaching Mathematical Discourse Through Characters and Scripts

Abstract
The research project conducted for this thesis determined whether the use of characters and scripts would help teach middle school students good mathematical discourse skills. It was conducted in a suburban eighth grade remedial mathematics classroom for three days during the month of March 2000. The four social aspects of good mathematical discourse formed the basis for the scripts; the topics included dedication to the group, helping each other understand, active listening, and not giving in to authority. Data included information from audiotapes of small group discussions, videotapes of the entire class, student journal writings, lesson plans, and teacher notes. The audio transcripts and journal writings of four students were placed in chronological tables to determine the relative progress of each student. An assessment was made each day for each student’s progress in the four social aspects of mathematical discourse. It was found that students made significant progress in mathematical discourse as a result of this project. Additionally, they were enthusiastic about the characters and scripts, used the principles of mathematical argumentation in a socio-axiomatic framework, and showed individual transformation within their small collaborative groups.

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MS in Mathematics, Science, and Technology Education

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TEACHING MATHEMATICAL DISCOURSE
THROUGH
CHARACTERS AND SCRIPTS

MASTERS THESIS

Marcia DeJesús-Rueff
Graduate Program in Mathematics, Science, and Technology Education
St. John Fisher College

May 1, 2000
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ABSTRACT

The research project conducted for this thesis determined whether the use of characters and scripts would help teach middle school students good mathematical discourse skills. It was conducted in a suburban eighth grade remedial mathematics classroom for three days during the month of March 2000.

The four social aspects of good mathematical discourse formed the basis for the scripts; the topics included dedication to the group, helping each other understand, active listening, and not giving in to authority. Data included information from audiotapes of small group discussions, videotapes of the entire class, student journal writings, lesson plans, and teacher notes. The audio transcripts and journal writings of four students were placed in chronological tables to determine the relative progress of each student. An assessment was made each day for each student’s progress in the four social aspects of mathematical discourse.

It was found that students made significant progress in mathematical discourse as a result of this project. Additionally, they were enthusiastic about the characters and scripts, used the principles of mathematical argumentation in a socio-axiomatic framework, and showed individual transformation within their small collaborative groups.
CHAPTER ONE:

THE PURPOSE OF THIS STUDY
Language is not in the brain – it is among us.
Knowledge is not in the brain – it is in the interaction. (Tomm, 1989)

Introduction

Two years ago, as a requirement for my first class in the MST program here at St. John Fisher College, I made a videotape of myself leading an eighth grade class. During this class, students spent most of their time working in groups while I moved about from one group to the next answering questions and giving advice or prompts. Students were clearly engaged in their work; there was little off-task behavior. As the videocamera followed me around the classroom, everything looked great. To all appearances this was a successful lesson focusing on collaborative learning.

Near the end of the class, each group presented its findings, and things began to unravel in the class discussion that resulted. Students had several misconceptions, including basic misunderstandings of the difference between a variable and a constant and poorly formed understandings of the meaning of negative slopes. How could I have overlooked such basic errors while checking on each group? I had carefully monitored these groups. The students were not off-task; they were not playing around. Indeed they gave all appearances of understanding the problems and of working together to solve them. Something important was missing in these groups, however. Simply telling students to work collaboratively and monitoring their behavior did not automatically result in their learning mathematics.

Seeing this reality on videotape inspired me to learn more about what really happens in collaborative groups and how to ensure that collaborative groups are not only on-task but that they are also actively working together to build solid mathematical understandings. In order to study this
issue more closely. Dr. Allen Emerson, Dr. Carol Freeman and I worked together on a small research project in which we videotaped and audiotaped a series of lessons in which students must work collaboratively to create mathematical understandings about the concept of function and slope. Our analysis of this research suggested that in those groups exhibiting strong group discourse skills (based on models developed by Cobb and Emerson), all group members were successful on their final individual assessments. The highlights of this research were presented last spring at the National Council of Teachers of Mathematics annual meeting in San Francisco.

My question now became: How can a teacher actually teach students good mathematical discourse skills? Getting students to learn good mathematical discourse is not easy. I knew I could not simply lecture the students on what to do and then expect them to follow through. I toyed with the idea of showing them the videotapes from last year’s classes, but I knew that would violate student confidentiality. I also knew that these videotapes would probably be quite boring to my eighth grade students because there is so much missing from the videotapes including being able to see clearly the graphs the students are working on and a lack of good sound.

I needed a vehicle to help students make major cognitive shifts in the way they interact in collaborative groups. Having a student group argue in front of its peers in a “fishbowl” format would help the entire class see immediately what was going wrong in a given discussion; it could also run the risk, however, of embarrassing individual students. Dr. Emerson suggested the possibility of plays. This solved the problem of student confidentiality and embarrassment. Students would not be playing themselves; they would be playing a specific character. That character would be the one making the mistakes. That character would be learning how to work better in collaborative groups. And that character could improve over time. This would also provide the opportunity for students to improvise, to deviate from the script in order to answer “What if”
questions. What if this character had listened more? What if that character had not agreed to someone’s ideas without argument?

Having students learn mathematical discourse via characters and scripts has not been done before. Could it really help students become stronger members of collaborative groups in middle school mathematics classrooms? The research I undertook attempted to answer this question.

**Research Questions**

My overall question for this research was: Can characters and scripts help collaborative groups develop stronger mathematical group discourse in middle school classrooms? My hypothesis was that students who role play the important characteristics of mathematical discourse would develop skills necessary to be stronger members of collaborative groups in the mathematics classroom. Through the characters and scripts, students had the opportunity to “try on” a variety of good and bad roles as well as to watch other students do the same. They would determine which “roles” were the most successful and would begin using these “successful roles” in their own collaborative group discussions. These successful roles would thus become a part of each student’s “inner dialogue” and would help the collaborative groups construct new mathematical knowledge more efficiently. I also predicted that this stronger collaborative discourse would result in better individual understandings as well.

Additional questions I had included:

1. Would students respond to the idea of characters and scripts?

2. How close would the students come to true mathematical argumentation?
3. Did the characters and scripts make a difference in how the students behaved within their small collaborative groups? In other words, would there be evidence of individual transformation?

My scripts were based on the NCTM videotape project I completed last spring. The discourse from these student groups provided numerous examples of both poor and excellent collaborative group discussions. Each of the elements necessary for good mathematical discourse was found within these tapes. They also provided excellent springboards for asking the important “what if” questions that could get my students thinking about small group discussions. Finally, they are also based on the same material (bottle graphs that teach students about function and slope) that I planned to use with my class again this year.
CHAPTER TWO:

THEORETICAL FRAMEWORK

AND LITERATURE REVIEW
Nerida Ellerton (1996) states: "While there is no single ‘best’ way of teaching mathematics, extensive interactive communication seems to be a common feature of quality mathematics learning environments." (p. 2) According to Paul Cobb (1990), research supports establishing mathematics classroom environments that incorporate the following qualities:

1. Learning should be an interactive as well as a constructive activity. There should always be ample opportunity for creative discussions in which each learner has a genuine voice;
2. Presentation and discussion of conflicting points of view should be encouraged;
3. Reconstructions and verbalization of mathematical ideas and solutions should be commonplace.

I believe that students construct mathematical knowledge by interacting with each other in specific content-rich environments. An example of this is having a group of students collaborate to determine the shape of a bottle from a graph of the height of water inside the bottle as a function of the number of measures added. This is a rich problem with many interesting paths to the solution. Without strong group dialog, however, the problem might be “solved,” but the group will definitely not construct meaningful new knowledge and understandings (DeJesus, Emerson, Freeman, 1999).
I define mathematics discourse as Pirie does. Thus, *Mathematical Discourse* is:

*Purposeful Talk* (characterized by well-defined goals even if not every participant is aware of them. These goals may be set by either the teacher or the group, but they are accepted by the group as a whole).

*About a Mathematical Subject* (The goals themselves, or those goals developed during the group’s work, are expressed in terms of mathematical content or process.)

*In Which There are Genuine Pupil Contributions* (At least some of the pupils give input which moves the talk or thinking of the group forward.)

*And Interactions.* (The movement within the talk is picked up by other participants.)

Discourse through which group participants actually build knowledge exhibits the following:

1. A background for group procedures including
   - Dedication to the group.
   - Helping each other understand.
   - Actively listening to each other.
   - Not giving in to one member’s ideas because of his/her perceived “authority.”

2. Sound mathematical argumentation which includes
   - Backing for all discussions.
   - A level of rigor appropriate to the grade of the students.

3. Intersubjectivity: Taken-as-shared meaning is developed
   - After good group interactions are established
   - And recognized, used, understood by all group members.
The above elements of good group discourse have been observed, identified, and categorized by Cobb, Pirie, and Emerson. It is known that these characteristics lead to strong group discussions which, in turn, create the environment in which all group members will construct new mathematical knowledge at both the group and the individual levels (Pirie 1998), (DeJesus, Emerson, Freeman, 1999). What is less well understood is how to get students using strong mathematical reasoning and argumentation with their peers. As mathematics educators we need to teach our students what good group mathematical discourse is and then get them to use good group discourse consistently within their own small collaborative groups. The only article on how to foster mathematical discourse (Laughlin & Moyer, 1998) suggests teacher modeling as the primary mode of transmission.

Erikson (1902) considered adolescence a time when humans need to “try on” many different roles. Elkind (1931), too, stressed the importance of adolescents’ rehearsing various scripts and roles in their minds. Adolescents are, however, deeply fearful of appearing stupid in front of their peers. Although video depictions of good group discourse could be helpful in providing both a model and empathetic characters, I want students to become much more active in their roles.

Indeed, activity is the hallmark of the constructivist philosophy. Von Glasersfeld (1996) states: “Learning is a constructive activity that the students themselves have to carry out...The task of the educator is not to dispense knowledge but to provide students with opportunities and incentives to build it up.” (p. 5) I wanted to give my students the opportunity to construct their own knowledge of good mathematical discourse.

By creating emotionally charged scripts through which students act out and portray other people, my students practiced good group discourse and determined what is impeding discourse. They were able to play someone else’s mistakes, not their own, which helped alleviate their fears of
arguing in front of their peers. I was also hopeful that by creating empathetic characters and emotionally charged scripts, my students would retain, rehearse, and use what they learn. (See Jensen (1998) for a discussion of the importance of employing the emotions in learning.)
CHAPTER THREE:

METHODOLOGY
Overview

I wrote scripts based on my previous research and had students practice these scripts in small groups, then present them "fishbowl" style to the class as a whole. The entire class critiqued these presentations, not just on the merits of the acting, but on how the individual characters took part in their group's discussion. Gradually the class began asking "what if" questions about how certain changes could affect the group's discussion for better or worse.

At the same time, the real student groups worked through many of the same mathematical issues facing the characters in the small plays, namely the concept of function, variables, and slope. As they held their own group discussions, I audiotaped each group and later asked for a group and individual post-discussion analysis of how well the group was able to apply the principles of good group discourse. I required students to write about the mathematical concepts they were learning. As the groups progressed through these scripts, the entire class drew up a list of good group discourse to post in front of the room. This helped students remember what to do in their own small group discussions and also provided the framework for each group’s post-discussion analysis.

Demographics

I teach in Bay Trail Middle School, the only middle school in the Penfield Central School District. This suburban school has an enrollment of approximately 1300 students in grades six through eight. The overall enrollment is 95% white, and the majority of families fall within the upper-middle to upper class income brackets. Our school has a large urban-suburban program which brings students from the City of Rochester; we also have a minority of lower income students whose families live in the apartment complexes, trailer parks, and farms within the Penfield district.
I completed this teacher research in my eighth grade remedial (PCEN) class of fifteen students. Most of these students had been part of my NCTM research project; many have great difficulty using good mathematical argumentation in small collaborative groups. This class has ten male and five female students. One male student is an African-American urban-suburban participant, and one female student is Hispanic; the other students are white. I have a teaching assistant, Mrs. Cathy Combs, helping me in this class. Students are placed in this class either by scoring in the lowest quartile on standardized mathematics exams or through teacher recommendation at the end of seventh grade. The students in this class run a high risk of failing the new state Math 8 Regents Exam; therefore, any strategy that may help them improve is looked upon favorably by both parents and administration.

The Unit of Study

My students worked on the concept of slope and graphing functions, a continuation of the unit on bottle graphs from the previous year. The scripts were also based on the same material; the problems my students discussed in their own small groups were the same as those discussed by the characters in the scripts. The unit was taught on three days, March 1, March 3, and March 14, 2000. On the fourth day, March 24, 2000, I audiotaped the four students I had chosen to analyze in depth for this research project.

This unit of study is one that I created from several different sources, primarily resources available from NCTM. I believe its strength lies in the way it begins with very concrete, hands-on experiences and then moves into the more abstract concepts of slope. The most important aspect of this unit is that it requires students to work together to build up their understanding of this concept.
The teacher does very little direct teaching, relying instead on mini-lessons as needed for clarification about a specific skill or piece of information.

**Scripts**

I created eight small (5 – 10 minute) plays based on the information about group discourse errors I gleaned from my NCTM video and audiotapes within the framework of good mathematical group discourse outlined above. Two scripts, illustrating good and bad mathematical discourse, were devoted to each of the following topics:

1. Dedication to the group
2. Helping other group members understand
3. Active listening
4. Not giving in to authority (especially to those students with high social status)

The other three aspects of good mathematical discourse, providing backing, maintaining an appropriate level of rigor, and developing intersubjectivity (taken-as-shared meaning), remain to be developed into scripts next fall. This research project focused primarily on the social aspects of good mathematical discourse.

**Characters**

Developing characters that would both attract middle school students and provide an avenue for teaching was a major consideration for this project. I finally based my four characters on historical personalities (Jack Kennedy and Amelia Earhart), literary characters (Nancy Drew), and actors (Lou Diamond Phillips). My students remained unaware of the roots of these characters.
then fleshed out their personalities to highlight specific strengths and weaknesses each character
would have within a collaborative mathematics group. Additionally, I am planning to write the
scripts so that the characters change as we progress; these characters should be viewed as real people
who grow, change, and learn better over time.

The Personality Cards that I gave my students on the first day of the project are included in the
following two pages.
PERSONALITY CARDS for Students

Note: Read the card for your character each time you play that person. This will help you show his or her true personality better as you role play.

NANCY

Nancy doesn't give up. She is a questioning person who is both clever and resourceful. Sometimes, however, she is outspoken. She is extroverted, occasionally moody, and she plays the trumpet. She doesn’t avoid arguments and will keep talking until she wins. Because she is a natural leader, Nancy sometimes just expects that others will go along with her point of view. Nancy lives with her parents in a huge house with lots of land and woods all around it. Her friends love coming over to her house, but Nancy gets lonely when she’s home by herself. She can’t wait until she turns 16, because her father promised that if she keeps up her grades, he’ll buy her a little car to tool around in.

AMELIA

Amelia is quiet, but very funny and brave. She has a naturally cheerful disposition, and she loves adventure as much as she loves reading about far away places. She is kind-hearted; her friends often tell her their troubles because they know she doesn’t spread gossip. Unfortunately, often she will do anything to avoid arguments within her group. Amelia’s parents are divorced; she lives with her mother in a small house near the center of town, but she often stays with her father, stepmother, and their two kids on weekends. She often leaves schoolwork at the wrong house and has to get her parents to bring her books, notebooks, projects, and gym clothes to school. She likes school, but sometimes she finds it hard to keep up and keep organized the way she’d like to.
JACK

Jack is quick-witted, athletic, adventurous, and outspoken. He is also wealthy and somewhat spoiled and self-centered. He is very friendly and loves working in groups but sometimes he has a hard time settling down to work. Jack’s groups always have a good time; unfortunately, they don’t always get much accomplished. Jack lives in an even bigger house than Nancy, but he has lots of brothers and sisters, both younger and older, to keep him company. People are always coming to stay at his house, and he always has interesting things to tell his friends about his parents’ colleagues, since they both run an international business and must travel frequently. They have threatened Jack that if he doesn’t pull his grades up, they may send him to private boarding school “where your teachers will watch you and tell you what to do 24 hours a day!”

-------------------------------

LOU

Lou is quiet, resourceful, and kind of mysterious. Other students think he is “cool.” No one knows too much about his background or his family. He came to our school a year ago and lives in an apartment with his older brother. Although never involved in trouble himself, he always seems to be nearby whenever other students are fighting or creating trouble, both in and out of school. He often hangs out with his older brother’s friends. Lou is kind of detached when he works in groups. Talking over ideas in math class is hard for him, even though he almost always gets very high grades in math. He won’t just go along with the group’s ideas. Other students find it hard to work with him, because he doesn’t have an opinion until he’s heard all sides of an argument.
and written journal work provide a quick overview of their daily progress in learning and using good mathematical discourse. I have also rated each student’s daily group work for each of the four elements studied on a simple rubric, with scores ranging from N for never to A for always. This refers to how often the student uses these skills.

Finally, I have provided my own analysis of each student’s growth during the month we studied these four elements of good mathematical discourse. This analysis looks at what happened in small group discussions and attempts to answer the question of why it happened. Although subjective, I have consistently tied my interpretations to the data gleaned from audiotapes of group discussions and from the student’s own written journals in addition to my personal observations as their teacher.

It is especially important to remember that I had used small discussion groups throughout the year with all my eighth grade classes. Therefore, I cannot attribute the growth demonstrated by each student merely to their getting used to the small group format. Something very important happened in March, something that had not taken place in the previous six months of this school year: Within a few weeks, the students exhibited significant gains in their abilities to hold strong mathematical discussions. I believe these gains are directly attributable to the characters and scripts I used to teach the first four elements of strong mathematical discourse.
**Student by Student Analysis**

**General Information**

Each of these four students has been placed in PCEN Math, a remedial mathematics program in Penfield. Their placement was made through a combination of test scores, grades in previous mathematics classes, and teacher recommendations. Most students in this class would struggle in a regular eighth grade mathematics class. Few know their basic arithmetic facts or algorithms; all of them must work very hard to use mathematics in context. Most of these students have failed a mathematics class at some point.

In order to help these students receive more attention from their teacher, the PCEN Math classes are limited to 15 students and are provided with a Teaching Assistant, Mrs. Cathy Combs. Mrs. Combs also provides an important link to the Learning Center, where she works most of the time. The Learning Center is a special study hall scheduled for students who have difficulty doing their assignments; teaching assistants keep track of the work the students need to do and provide them with help as needed in completing their work. Disruptive students are generally discouraged from being part of the Learning Center, since they often keep the other students from doing their work.

It is important to note here the differences between these students and the average Penfield student. On the whole, students in Penfield score above the 85th percentile on national standardized tests, such as the Stanford Achievement Test. The average score on the Otis Lennon Intelligence Test is in the range of 110 – 115. Therefore, although some students in my study rank well within national averages on these tests, they remain significantly below the averages for the Penfield School District.
James Trammell

Academic Background

Grade 7 Testing (all National Percentiles)

Stanford Achievement Test (SAT): Total Reading 25 Total Math 14
Comprehension 26 Problem Solving 18
Vocabulary 18 Process 11

Otis Lennon Intelligence Test DIQ: Total 85
Verbal 88
Nonverbal 85

8th Grade Report Card Averages: Mix of C’s and D’s with an A- in music.

James’ test scores are significantly lower than those of the Penfield District’s averages. He is in the lowest quartile in his reading scores; his math scores lag even below those. These combined with a below average I.Q. suggest that James is at risk for failing the important new Regents exams which would mean he might not be able to graduate from high school. Despite these seriously low scores, however, James is a very likeable, seemingly capable young man. He has tremendous social abilities and is sometimes very capable at solving mathematical problems.

Social Background

James is from an intact African-American family. James is a part of our Urban/Suburban program; he lives in the city of Rochester and is bused to Penfield schools. Although his economic status is very low compared with other Bay Trail students, he is very popular and has many friends. James is a very high-energy student who has difficulty remaining still or quiet for more than five minutes at a time. Despite his low test scores, he has considerable academic ability; however, he enjoys being social much more than paying attention in class. He is often in trouble academically;
his grades hover just above the failing mark. He has not been a part of the Learning Center because he tended to disrupt the activities of others there with his incessant talking. This is James’ second year in my remedial math class.

James loves music and knows the words to all the current songs. He plays basketball and is often a part of social life at Bay Trail, even though it is difficult for him to get rides home from social events. He occasionally receives a disciplinary referral, primarily for showing off in class or for inappropriate actions in the hallways.

The Project

Day One: “Oh, yeah! That’s me!” (Small group discussion.)

“Can we go? Can we go up next?” (To the teacher during a Fishbowl.)

(To Erica in a small group discussion.)

Day Three: When people are new and they want to make friends, they will do desperate things.
(Journal about when small group members give in to authority.)

Day Four: “I’m dedicating. I have a lot of authority, too.”
(Joking around in his small group discussion.)

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<th>DAY ONE</th>
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<td>S</td>
<td>S</td>
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<tr>
<td>AUTHORITY</td>
<td>F</td>
<td>F</td>
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Rating Scale: N = Never  R = Rarely  S = Sometimes  F = Frequently  A = Always

Included above are a few quotes and the daily discussion ratings which highlight James’ process during the four days of taped group discussions, days which were actually spread throughout the month of March. Day One’s group discussions were typical of James’ group skills. He was
easily distracted, frequently disrupted the group process, and not at all concerned about doing the work assigned; he was particularly strong, however, in not giving in to authority. James was, however, very enthusiastic about the scripts and about the characters, as evidenced by his quotes from the first day. He quickly identified with Jack, the character who is “quick-witted, athletic, adventurous, and outspoken.” Indeed, James played Jack in every single script.

James’ small group discussion skills peaked on the second day. He was able to acknowledge Erica’s contribution to the group effort, as evidenced by the quote from Day Two above. This is the first time I ever heard him giving credit to someone else. He was highly dedicated to the group, consistently worked to help others understand, was a much better active listener, and continued to be strong in not giving in to authority.

On the third and fourth days, which were separated from the original two by a period of ten and twenty days respectively, James’ small group discussion skills went down somewhat but were still considerably stronger than they had been when we began the class work on role plays. There were, additionally, some distractions on the fourth day since it was the school’s “Hawaiian Day,” and many students had worn Hawaiian clothing to school. Interestingly, although James was intent on singing into the microphone and making jokes during the group’s discussion, his mathematical discourse remained strong:

1. He did get the work done; this was clear when Mrs. Combs came over and James showed her his work.

2. Additionally, James was much less mean than usual when he teased Rick.

Ordinarily James made fun of Rick in class, often to get a laugh from the other classmates. During this group discussion, James teases Rick, but the teasing is
much kinder. Indeed, there are moments when they actually joke around together, and James treats Rick as an equal.

3. He also gives Cindy credit for the work she completes and shares with the group, again a rarity in my experience with James.

4. Finally, he jumps at the chance to share his group’s work in front of the entire class, and he does so without any kind of joking around.

James chose to represent Jack, a character that fit his own personality closely. The scripts then gave him the opportunity to “flesh out” this character in his own way, because the group had to assign the lines to the characters. Although I had originally thought the lines about hip-hop and BTV might fit the character Lou, James latched onto them immediately because they verified his own experience.

James is a highly verbal person; he learns much better when he can talk. He is also, however, often unfocused, distracted, and disruptive. Clearly his verbal abilities need to be prized and used in a structured way. The scripts provided James with the structure he needed to learn to focus himself in a way that his teachers had not been able to do despite years of encouraging, lecturing and nagging him to focus on the work at hand. James learned that he could have fun and still get the group’s task done. He found that presenting the task to the entire class, whether it was a problem solved or a skit carefully rehearsed, made him a real leader, more so than his disruptive techniques did. He is finally getting the attention of his peers in a way that is acceptable to his teachers.
Vicki Villareal

Academic Background

Grade 7 Testing (all National Percentiles)

Stanford Achievement Test (SAT):
- Total Reading: 60
- Total Math: 38
- Comprehension: 66
- Problem Solving: 48
- Vocabulary: 50
- Process: 26

Otis Lennon Intelligence Test DIQ:
- Total: 95
- Verbal: 95
- Nonverbal: 98

8th Grade Report Card Averages:
- Primarily C's with an A in physical education.

WISC-III (from 6th grade)
- Verbal: 98
- Performance: 115
- Full Scales: 106

Although Vicki’s test scores all rank near the national averages, she is well below the averages for the Penfield School District. In sixth grade, she was classified as Learning Disabled and was placed in inclusion classes for the next two years, classes with both a regular subject-area teacher and special education support teacher. Vicki was declassified at the end of 7th grade. She now has a 504 plan, which allows her to receive additional time for testing and special access to the Learning Center, but otherwise does not make special provisions for her.

Social Background

Vicki is from a divorced family; her father is Mexican-American, and her mother is Italian. She moved to Penfield from Austin, Texas after her parents’ divorce, during the summer after 5th grade. Her family is on the lower end of the socio-economic structure in Penfield. Vicki is,
however, very active at Bay Trail, both socially and athletically. She is an excellent softball player. and she seems to know just about everybody in the eighth grade.

Vicki is not a sound student academically. She turns in about half of her homework assignments and rarely studies for tests. Her overall demeanor suggests that she is not really interested in learning. This is the first year I have had Vicki in my PCEN class. Her grades last year were low, even with special education support, and her teacher recommended her for the remedial program.

Vicki is fun-loving and kind, and she has many friends. She is on the “fringe” of the students who cause trouble in school, but she has never been involved in any disciplinary action herself.

The Project

Day One: “Mrs. DeJesús, can you help us?” (During small group discussion.)

Day Two: “Which one did you pick, Rick?” (Small group discussion)

Day Three: Keep telling your group to get back on task and if they don’t get on task, then do all your work and talk to the teacher about the other people. (Journal on how to get a group back when they are starting to get off task.)

“More people were participating.” (Explanation of why the second “Helping” script group was better.)

“James, you’re good in math.” (Small group discussion as James presents his explanation. Vicki acknowledges James emerging stronger academic position.)

I felt listened to in this class because my group was asking me questions and wanted to know more and we all gave each other the respect that they gave me. (Journal on a time when you were in a small group that really listened. Vicki gets recognition and begins to find her own growing self-confidence.)

I was in my science group and I knew that someone knew what they were doing and I had no clue so I gave in to their answers. (Journal on when you were part of a group in which some members gave in to the authority of others.)
Day Four: "We're going to take your mike...." (Threatening James, who is goofing around during their small group discussion. This is the first time I have heard Vicki stand up for her group by going against another student's actions.)

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Rating Scale: N = Never  R = Rarely  S = Sometimes  F = Frequently  A = Always

Vicki’s usual method of interacting with her group prior to the roleplay experience was to giggle at everyone’s jokes, do very little work on her own, and then whine until her teachers bailed her out by showing her step-by-step what to do. This is clear in the first audiotape. Vicki laughs at James’ silliness then whines to the teacher, “I don’t get it.” She had very little dedication to her group, rarely helped other group members, never used active listening techniques and almost always gave in to authority. She herself explained in the above quote that when she felt clueless in science class, she simply went along with other group members who seemed to know what they were doing.

On the first day we used the skits, Vicki chose to be Nancy, apparently giving in to the group’s norms of girls playing female characters; the next day she began playing Amelia, but quickly exchanged roles with Rick. Vicki began playing Lou, a character who fit her personality much more closely. Lou is described as “quiet, resourceful, and kind of mysterious.” “No one knows too much about his background or his family. He came to our school a year ago...” Vicki herself came to Bay Trail from Austin, Texas, in sixth grade, and, although popular, she is not well known by the other students. She herself could well be considered “mysterious.” Like Lou, Vicki also knows many of our school’s troublemakers well, but she herself is never involved in disruptions in or out of class.
The key point of Lou's character that is very different from Vicki's is that he "won't just go along with the group's ideas." This is what Vicki learns from the scripts; she begins taking charge of her learning by asking the group for help and by carefully using active listening techniques to be sure she understands. Her skills appear to have developed consistently over the four days of role plays until by the end she is not giving in to authority at all; she is very strong in helping others and in active listening, and she is dedicated to the group process. In the final group discussion, she actively brings Rick into the group's fold by asking him questions about the song he says he loves, she clarifies her own understanding of the work Cindy is doing, and she even threatens James with "We're going to take you mike" to get him to settle down. At the end of this project, Vicki has emerged as a leader in keeping her group on task and working as a cohesive unit.

The scripts gave Vicki the practice she needed to be able to use the skills of active listening to increase her own learning. She found a character she could identify with, yet one that pushed her into an area of social interaction that she was not yet comfortable with, asking questions of and even challenging her peers. The scripts forced her, as the character Lou, to stretch beyond herself; even after the scripts were over, Vicki retained their lessons in group discourse. Her progress suggests that characters and scripts can have a prolonged effect even after a short initial exposure.
**Rick Phelps**

**Academic Background**

**Grade 7 Testing (all National Percentiles)**

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<th>Stanford Achievement Test (SAT):</th>
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**8th Grade Report Card Averages:** Consistently B’s with a smattering of lower grades.

Rick’s test scores show a student who is above the national average in reading ability but who is significantly deficient in mathematics. His I.Q. is exactly average, yet it is below that of the average Penfield student.

This is Rick's third year in my class. Like Cindy, he was with me for extra help in 6th grade and has been a member of my class in both 7th and 8th. He does not go to the Learning Center, because he usually does not have trouble getting his assignments done. He has good grades in math most of the time, but occasionally he really flounders with certain topics. He definitely needs the support of a small class. Rick has difficulty focusing in class and requires the smaller classroom atmosphere to do well in math.

**Social Background**

Rick is a white student from a divorced family. His family is in the lower mid-range of Penfield families, middle class by national standards. Rick is a very immature eighth grader who has strong academic abilities; unfortunately, he often has trouble paying attention in class, and his grades suffer for it. He just hasn’t yet pulled himself together academically or socially yet.
Rick is often overwhelmed by middle school. Larger boys frequently bully him, and he is terrified of physical threats. Rick has few friends and is rarely picked to be a part of groups or teams. He is not involved in any sports or music activities. He is an immature young man who is very insecure socially.

The Project

Day One: “I’m Amelia!” (Copying James, exactly.)

“Could that line be me?” (small group discussion when handing out lines for the different characters)

Day Two: Give a speech about feeling good and staying out of trouble if we do the work / work on it myself – I’ll get all the credit. (Journal on what to do when your group starts to get off task.)

“I’m quiet, and I’m funny. I’m not very brave, though. I have a cheerful disposition. My parents are divorced. I fit her description perfectly!” (Reading and commenting on the character Amelia.)

Day Three: “OK, you can be Jacqueline, and I’ll be Emilio.” (To the student playing Jack during a small group discussion)

“I think I’m going to do cartwheels.” (Small group discussion)

“It’s a noise machine!” (Talking about the tape recorder during a small group discussion)

I don’t think people have ever listened to my ideas – then again I usually don’t have anything to say. – In all classes every group project. (Journal writing about a time when you felt a group really listened to your ideas.)

Day Four: “That’s exactly what we’re not supposed to do.” (In response to James’ kidding around about giving in to authority.)

“I think we did pretty good. I said everybody participated. We stayed on task most of the time and we agreed but we didn’t let authority take over.” (Small group discussion of how well they followed the four components of good mathematical discourse)
"OK, you can stop now so we can continue our work." (To James, asking him to stop playing around so the small group can continue its discussion; evidence of constructive assertiveness.)

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Rating Scale: N = Never  R = Rarely  S = Sometimes  F = Frequently  A = Always

Because he is so often the target of jokes and cruel remarks, it has been easy for me to overlook Rick’s own lack of interpersonal skills. Although he was dedicated to the group, Rick was very poor in helping others to understand, in active listening, and especially in giving in to authority.

We see this in his initial choice of character; he is simply given the leftovers by his group both the first and the beginning of the second day. The first day he plays Amelia because the other group members have taken the male characters. Rick goofs around, following James’ lead, and announces, “I’m Amelia!” On the second day, he is assigned to Lou, since the other boy in his group has already taken the role of Jack. Rick soon decides that this role is not right for him and reads the personality card for Amelia, who much more closely resembles him. He switches roles with Vicki, and from this point on Rick portrays Amelia as Emilio, and Vicki continues to portray Lou. He states that he himself is also quiet but very funny. Additionally, Amelia is from a divorced family, lives in a small house with her mother, and often stays with her father and stepmother. This situation almost exactly parallels Rick’s own. She is also a bit disorganized because of her dual living arrangements and, like Rick, sometimes leaves with the wrong schoolbooks, gym clothes, etc. Rick feels validated that he is not the only person in such a difficult situation.
Indeed, the only quality Rick feels doesn’t fit him from Amelia’s personality is that “she is brave; I’m not very brave.” It seems as though these scripts gave Rick permission to try being a bit braver. Over the course of Days Two and Three, Rick’s group skills get a bit stronger, but by Day Four, he is able to completely reverse his usual tendency to give in completely to authority. On this day, he even challenges James, who is goofing around, with “OK, you can stop now so we can continue our work.” He is also listening better and helping others in his group understand. Additionally, Rick is able to join in the fun of the group without the kind of harsh teasing he usually gets from James. He sings, talks about a particular song he loves, and chats easily with Vicki who asks him whether he owns the CD. He is being treated as a real member of their small discussion group, not like a cowering and socially inept idiot, even though he does get silly during this final discussion in a way very much the same as earlier. Rick has changed from being acquiescent to saying what he really thinks, not just what he thinks others want him to say. Part of this results from practicing the scripts, but part of it arises from his group’s accepting him, too.
Cindy Kunkle

Academic Background

Grade 7 Testing (all National Percentiles)

Stanford Achievement Test (SAT):
- Total Reading 26
- Total Math 24
- Comprehension 24
- Problem Solving 36
- Vocabulary 38
- Process 15

Otis Lennon Intelligence Test DIQ:
- Total 98
- Verbal 105
- Nonverbal 92

8th Grade Report Card Averages: Primarily B’s & C’s with a few lower grades.

Cindy’s I.Q. shows her as about average nationally, yet she is lower than average for the Penfield School District. She consistently scores in the lowest quartile on national achievement tests, very significantly lower than Penfield’s typical scores that rank in the top quartile.

Social Background

Cindy is a white student whose family is in the lower socio-economic segment of Penfield, lower middle class for the nation as a whole. Her parents are divorced, and her father was diagnosed three months ago with inoperable pancreatic cancer for which he is now receiving chemotherapy.

Cindy is a very quiet and shy student who nonetheless has several close friends. She is a struggling student, and her progress is sometimes impeded because of her shyness. Last year her other teachers considered having her tested for special education because she was lagging behind academically. Cindy had me as her teacher in 6th grade for a special extra help mathematics section and has been my student for two years in PCEN Math 7 & 8.
Cindy usually does well in my math class. She consistently turns in all homework assignments and studies regularly. She also attends our school’s Learning Center for extra help with homework assignments.

Cindy is often “left out” of Bay Trail’s mainstream social life. She and her friends are on the edge socially and economically. A couple of her close friends are students in our alternative education program and sometimes get into more trouble than the average students in our school. Cindy, however, has never been in any type of trouble at Bay Trail, but she is consistently not a part of any of our school’s many social, athletic, or musical activities.

**The Project**

Day One: “And then I don’t know.”
(To herself as she is asking the teacher for help with her graph.)

*You could remind them to get back on task and hope they will.*
(Journal on what to do if your small group starts to get off-task.)

Day Two: “I don’t care.” (About which character she wants to be. There are already two girls in this group. One girl picked Nancy and the other Amelia. Cindy ends up playing Lou.)

*I think role play is a good way for learning because everybody can be involved.*
(Journal on what do you think of role play in order to learn about group dynamics?)

Day Three: “I think we need to practice out loud with the parts.”
(Getting her group back on task.)

“No, Lou has to say it here. It’s on the paper.”
(To A.J. who has missed writing down one of the parts.)

*Yes, I think it does, because we can actually see what people think and you can act it out and you understand it better.* (Journal on whether you think the scripts we read and acted out as a class will help you discuss mathematics better?)

Day Four: “Not.” (In response to James’ saying that she is his girlfriend.)

“Why?” (Asking for an explanation. Cindy is seeking justification, something she has not done before.)
“Like this, you go over here for ten shirts and don’t go up for zero pants.” (Helping others in her group understand how to graph the coordinate pair.)

“Should we use m for money?” (Asking for group consensus.)

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Rating Scale: N = Never  R = Rarely  S = Sometimes  F = Frequently  A = Always

In Day One’s discussion, Cindy is a meek, silent student. She rarely interacts with the other two group members at all. By the final day, she is still much quieter than the other group members, but she is standing up for herself, helping others to understand, listening and reflecting out loud on others’ ideas, and is strongly dedicated to her group. James and Rick both credit her with getting a solution to the group’s problem and look to her as the real leader of their group. Rick states, “Yeah, Cindy’s the authority.” James chimes in with, “She’s quite an intelligent girl.” Indeed, Cindy is the one who is really looking for mathematical taken-as-shared meanings when she asks, for example, “Should we use m for money?”

Cindy changes the most dramatically of the four students in this study. The first day she is barely a part of the group; she rarely acknowledges the presence of the other two group members except to give in to their playing around. The only time she asserts herself is to say that she would like to play Nancy; since she was the only girl in that group, she could have her pick of the two female characters. Her passivity continues into the next day when she agrees to play Lou after the other two girls pick Nancy and Amelia; she listens, however, and asks a few questions and
sometimes helps others understand the work. By the third day, Cindy insists on playing Nancy in the last two scripts, even though she also agrees to read Amelia’s lines.

Nancy is a character quite different from Cindy. Nancy is from an intact, extremely wealthy family with an indulgent father. Cindy’s own family situation is quite removed from this; her father, who is divorced from her mother, is dying of cancer, and her family’s economic situation is not strong. The role of Nancy provides the opportunity for Cindy to take control of her life in a world that is crumbling around her right now.

Nancy may also represent a way for Cindy to try on personality traits that she is not brave enough to do for herself. Nancy doesn’t give up; this is a strong contrast to Cindy’s profession on the second day of “I don’t care.” Nancy is a “questioning person who is both clever and resourceful.” She is also sometimes outspoken. By taking on the personality of a character so different from herself, Cindy can speak and practice the words that are so hard for her to say on her own. The scripts provided her with a safe way to practice being a more assertive person. By the fourth day Cindy is able to simply state “Not” when James suggests she is his girlfriend; previously she would probably have just let the remark pass. Just as importantly, she is able to ask for group consensus, explain her thinking to the other group members, and even ask them for clarification. She is still a quiet person, but she is no longer passive.
Summary of Analysis

The characters and scripts gave students the ability to try new ways of interacting with each other, along the guidelines of good mathematical discourse. Students were no longer locked into familiar patterns; they were forced to try something new, in the guise of a different persona. This provided a non-threatening way for students to experience how good mathematical discourse feels as opposed to examples of poor discourse.

The scripts also provided the students with a sense of self-esteem. Rick, Vicki, and James all picked students relatively close to themselves in personality. Each of these similar personalities also had something new to teach these students. James learned that he could have fun and still get the work done in a small group. Vicki learned that she could assert herself and take personal responsibility for understanding what other group members were discussing. Rick learned that he could be brave enough to disagree with other group members and that he could be a real part of the small group discussions.

Cindy’s situation was a bit different. She chose to portray someone very different from herself, someone much more outgoing and personable. She also chose to place herself in a socio-economic situation the exact opposite of her own; in doing so, I believe she was able to transform herself beyond the reality of her own home situation, a reality that has become increasingly difficult this year. Cindy found that she did not have to become a loud person to joke around a little in a small group or to be recognized as a real leader; she simply needed to learn to assert herself, help others understand her work, and listen carefully to them. She also progressed the farthest in promoting argumentation based on taken-as-shared meaning.

By “fishbowling” their skits in front of the entire class, the students were able to practice new identities and ways of interacting in an acceptable way. No one was ever teased or made fun of their
efforts, even when their reading was not smooth or they acted silly. In this way, students could pick and choose the pieces of each identity that they wanted; they were not forced by peer pressure into acting differently.

Students became cognizant of the fact that they were working within a socio-axiomatic system. In our classroom’s system the axioms became the first four requirements of good mathematical discourse: Dedication, helping, active listening, and not giving in to authority. Additional axioms were provided by the characters’ personalities. By putting on new personalities, the students figured out the best way to interact with each other. They applied these axioms as they negotiated with their groups in assigning lines appropriate for each character. Students were then able to begin transferring these negotiations into stronger mathematical argumentation. Vicki, for example, makes sure she understands what the others are doing by actively asking questions; she also keeps the group on task. James validates others while at the same time making sure he understands the work, and Rick asserts himself in asking James to not give in to authority. Cindy develops the farthest by beginning to ask for taken-as-shared meaning while working on writing an equation.
CHAPTER FIVE:
RESEARCH IMPLICATIONS
AND CONCLUSIONS
Research Implications

Several important concepts became apparent as I completed the analysis of this project. First of all, there were three reasons why I believe this project helped students become stronger in their mathematical discourse:

1. The scripts made the rules of good mathematical discourse transparent to the students; they were no longer expected to simply guess what was expected of them. Indeed, we could even think of these rules as the axioms of good mathematical discourse.

2. The characters were what helped the students negotiate these skills. Their roles provided built-in protection against public embarrassment. If they couldn’t handle the skills as their real selves, they could try as a character.

3. The negotiations the students had to make with the axioms of good mathematical discourse and the given characters’ personalities were of the same kinds of discussions and arguments they had to do for real mathematical discourse to take place.

Additionally, it did not seem to matter to these middle school students whether they were portraying a male or female character; instead they looked to the character attributes to guide them. Thus, Vicki played Lou consistently on the second and third days, and Rick portrayed Amelia, in the name of Emilio. Both students felt drawn by the more important aspects of personality than by gender.
The implications of this research extend well beyond mathematics. Students could role play group discussions in any discipline. The basic social premises for good discourse is exactly the same across disciplines, only the specifics of argumentation and taken-as-shared meaning will differ.

When I continue this research next fall, I plan to make a few changes:

1. I will include male/female names, i.e. Jack/ Jackie (Jacqueline), Lou (Louis or Louise), Nancy/Nate, Amelia/Emilio. This will make even clearer the importance of personality traits over gender.

2. I will extend the work across the entire time from September until Christmas vacation by emphasizing one of the aspects of the model approximately every other week. I will then reinforce that skill for the time between script days by keeping lists and posters of “Elements of Good Mathematical Discussion Chart” up on the wall where we can refer to it.

3. I will develop scripts which reflect stronger mathematical argumentation in order to teach students the specifics of mathematical backing and rigor.

4. I will test the idea that characters and scripts provide a socio-axiomatic basis from which mathematical argumentation can develop.
I still plan to use the same characters, and I may even increase character choices. I will also continue the same lesson format including ample time for journal writing and reflection by students. The goals of the research will ultimately be a wider, however. The question we now need to ask ourselves as educators is how can we incorporate a wide variety of social means to help middle school students learn many different subjects?

Conclusion

Discourse is of primary importance in helping students construct mathematical knowledge. As Hermione Sinclair (1990) states: “...Human beings do not only interact with objects and natural phenomena...but also, and in a sense primarily, with other human beings...” (p. 34)

My overall question for this research was: Can characters and scripts help collaborative groups develop stronger mathematical group discourse in middle school classrooms? As highlighted in the Summary of Analysis, my answer was a resounding “yes.”

In addition to this question, however, I had three secondary questions:

1. Would students respond to the idea of characters and scripts?

2. Did the characters and scripts make a difference in how the students behaved within their small collaborative groups? In other words, would there be evidence of individual transformation?

3. How close would the students come to true mathematical argumentation?

The answers to these questions provide yet another layer of understanding why characters and scripts were able to help students become much stronger in their ability to use good mathematical discourse.
Would students respond to the idea of characters and scripts?

From the very first time I presented the characters and scripts, when the students were absolutely silent and still, it was clear they were completely engaged. They were able to read the personality profiles and scripts and they were thoroughly absorbed by the process. Moreover, the way they vied for certain roles and lines proved their dedication to this project. Joe, for example, begged for a line by stating: “Please, please let me say this line. I’ll never ask you for anything else ever again!”

How close would the students come to true mathematical argumentation?

I wanted to find out how to get students conversing well in mathematics classes. By having students assimilate characters and act out scripts of mathematical discussions, I have shown that they can develop the skills they need to communicate ideas mathematically. My research has also illustrated how important it is to teach middle school students via social methods. This is an area mathematics educators, and indeed all educators, must explore further. As Vygotsky (1978) explains:

Every function in the child’s cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological), and then inside (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relations between human individuals. (p.7)
Did the characters and scripts make a difference in how the students behaved within their small collaborative groups? In other words, was there evidence of individual transformation?

Middle school students are hungry for these kinds of opportunities to understand and work on their social position. Remember how strongly James and Rick identified with specific characters, even when those characters crossed gender lines. Note, too, how Cindy was able to take on a new identity of a leader, something that had eluded her during the previous two and a half years of my class. I found also that the overwhelming majority of my students read and reread the personality cards; some even asked for more characters. Students this age are eager to understand themselves in terms of other people. Clearly, students want to learn about themselves, the social order of our culture, and how they as individuals fit into the social order of the culture at large.

Characters and scripts provide an active, social way to get students to take an active part in their own learning within the social context of a small discussion group. They show students how to work in a group both positively and negatively. The lines in a script, for example, show them how to get a group back on track as well as the importance of doing it. They also clearly illustrate how to use active listening, a weak skill for most students. Through the characters and scripts the elements of good mathematical discourse were made explicit to the students. My motives were transparent: I wanted them to be better participants in small groups in order to learn more.

The primary goal of middle school students is to figure out how a social system works and how they can work within it. The scripts made the “rules of the game” transparent to these students. They also provided the students ways to use those rules for their own best advantage. The characters, however, were of paramount importance in this study. The students used them as protection in testing out new ways of interacting and, I would argue, even “grew into” the characters themselves. Rick became braver, Vicki found her own voice, James discovered he could be a strong math student, and Cindy found the true leader within herself.


APPENDIX ONE:

SCRIPTS

NOTE: These scripts appear exactly as the ones given to each student except for the bold italicized statements at the end of some lines referring to a specific element of good mathematical discourse emphasized by that line.
SCRIPTS

Script 1: Dedication to the Group (Discussion about Review of Bottle Graphs) — Version 1

We did this last year! It’s dumb!

Not really, she pretty much left us alone as long as we were quiet.

But she was all over our butts when we sprinkled the water drops on each other....

Well, it did get a little crazy at times ... It was more of a mess than a few drops, remember. We did have a good time, though... And remember we got to go over to the high school!

Oh, yeah! That was OK. I wonder if we’ll get to do that again this year... at least we’d get to miss science. That teacher really has it in for me— all he does is yell and yell just because I forgot a little assignment!

Or two!

Or three!

And lunch!

Oh, man!

Did you see that new KORN video on MTV the other day? I thought it was really cool, the music was the best — I really liked the music and they had the best computerized effects — kind of like strobe lighting from the sixties but whacked out with all these bright neon colors and changing locations — it was so cool!

Yeah, I liked it a lot but I still would rather watch hip hop — you know the kind of stuff on BTV.

TEACHER: Two more minutes to finish your group’s worksheet.

Guys, we’d better get our discussion going about what we remember about those bottle graphs ... we’ve only got a few more minutes!

Yeah, it was OK last year, but I don’t want to do exactly the same stupid thing over again!

It doesn’t seem to be exactly the same as last year. What’s this stuff about role play and scripts and stuff?

Are we going to have to role play in front of the whole class?

What do you think — maybe we could videotape ourselves or something.
What is it we’re supposed to be discussing anyway? I guess we’d better put something on this worksheet....Oh, geez, it’s supposed to be a summary of our discussion! What am I supposed to write down???

TEACHER: Time for Our Whole Class Discussion!

----------------------------------------

NOTE: This entire discussion shows a lack of dedication to the group. Interestingly, it closely parallels many of the first discussions audiotaped for this research project.
Script 1: Review of Bottle Graphs & Dedication to the Group (The Better Version)

We did this last year! It’s dumb!

Not really, she pretty much left us alone as long as we were quiet.

But she was all over our butts when we sprinkled the water drops on each other....

Well, it did get a little crazy at times ... It was more of a mess than a few drops, remember. We did have a good time, though... And remember we got to go over to the high school!

You know, guys, this worksheet is going to take us a while – and she only gave us five minutes to work together!

She is such a pain!

Yeah, but we’d better get going ... After my last report card, I can’t afford to have any more teachers call home to my parents – they were really pissed! [Here is where the group switches and all members become more dedicated.]

So, what do you guys remember most about last year’s work?

Well, I know that when the bottle is straight, like these are, that the graph makes a straight line, too.

I remember something about how steep the line is – were the really steep ones the bottles that are larger?

Remember how the tops of those graphs were straight across – because they couldn’t hold any more water and it would just keep spilling over the top?

TEACHER: Two more minutes.

Are you writing this all down for us?

Wait a minute, I know you could tell from the graph how narrow the bottle was, but I can’t remember now how you could compare it. [Active Listening]

Come on, Lou. You haven’t said much of anything – and I remember your group did really well on this stuff – How do you tell how narrow or fat the bottle is from the graph? [Pulling Lou in, encouraging him to be more dedicated to the group]

LOU: I can’t remember exactly, but I think it’s just the opposite from how it looks – like if the graph goes up steeply, then the bottle is narrow, but if the line slants more to the right it’s fatter.
OK, but what about those curved bottles? They were fun – we graphed one that was shaped like a heart.

But did the graph make a heart? Nooooo!

Well, you could sort of figure out the shape of the bottle by looking at the graph, but it was confusing!

TEACHER: Time for our whole class discussion!
Alright! This is easy – it’s just like ski slopes – some are steeper than others.

What do you mean – I know some hills and mountains are steeper than others, but how does that relate to a graph?

Just like I said – some are steep and make steep straight lines and others are not so steep and their graph lines to more to the right. [Lack of helping each other understand]

Ok, but remember, graphing is not the same as drawing a picture of what you think. Remember how some of those graphs can look real different from what the bottles look like? So, how could the graphs look just like a mountain or hill? I don’t get it.

I said, just think of them as mountains or hills – it’s simple, stupid! [Lack of helping each other understand]

She’s right, you’re saying some stuff that sounds ok, but I don’t get it either!

TEACHER: Take a minute, finish getting your group’s thoughts together, and then we’ll discuss them together as a whole class.

Oh, man! Why does she always cut our time so short! She’s really being a big pain!

You keep saying that, yet you haven’t explained stuff to us.

What do you think, Lou? [Encouraging Lou to be a dedicated participant]

I think Jack’s probably right, but slope has something to do with how fast the water goes up in the bottle, so it’s tied to…

TEACHER: Time’s up – let’s get all our ideas onto this paper!
Script 2: Helping Each Other Understand (Introduction to Slope)
Intro to Slope – Brainstorm what it means in the “Real World”
(The Better Version)
Alright! This is easy – it’s just like ski slopes – some are steeper than others.

What do you mean – I know some hills and mountains are steeper than others, but how does that relate to a graph?

She’s right, you’re saying some stuff that sounds ok, but I don’t get it either!

Just like I said – some are steep and make steep straight lines and others are not so steep and their graph lines to more to the right. [Lack of helping each other understand]

Ok, but remember, graphing is not the same as drawing a picture of what you think. Remember how some of those graphs can look real different from what the bottles look like? So, how could the graphs look just like a mountain or hill? I don’t get it.

Well, I’m not exactly sure why some graphs are steeper than others….. [Beginning to help]

Maybe it has to do with how fast they’re going up -- It’s like this- Some bottles and graphs are the same height but some get filled up faster than others. [Helping]

Oh, yeah, like when a bottle is skinny – remember how the water level went up really fast? [Helping]

Yeah, and when the bottle was really wide, it took forever to fill it up! [Helping]

OK, but what does that have to do with slope? [Active listening]

Well, slope is how steep the mountain -- or the graph – is, so it makes sense that the narrower the bottle, the steeper the graph. [Helping]

TEACHER: Take a minute, finish getting your group’s thoughts together, and then we’ll discuss them together as a whole class.

Oh, man! Why does she always cut our time so short! She’s really being a big pain!

Look, we’re almost there!

What about this, the narrower the bottle, the steeper the graph? [Helping]

What do you think, Lou? [Encouraging Lou to be dedicated to the group]

I think Jack’s probably right, but slope to do with how fast the water goes up in the bottle, so it’s how much the water goes up each time you add another fourth cup of water. [Helping]
It's starting to make some sense to me now.

TEACHER: Time's up – let's get all our ideas onto this paper!
Script 3: Active Listening (Other Graph Clues)

OK, she said we need to figure out how else we can know which bottle goes with each graph.

Yeah – like I think the shape of the bottle probably has to do with the way the graph goes up fast or slow. [Lack of active listening from here on]

Well, maybe we could look at how many measures you need for each bottle.

But, wait a minute – that shows up on the graph but it doesn’t show up on the bottle, does it?

I think we need to see how tall the bottle is – that way we could check against the height on the y-axis each time.

What about the idea that the more measures it holds, the bigger the bottle is.

Look, if you see how fast the line goes up on the graph, then you can pretty well figure out which bottle it is by how fat or thin the bottle is.

But if you know how many cups you needed to fill the bottle, you could just try it out.

Guys, it’s the height! Don’t you see that the height is really what matters here???

But if you have a big bottle, you just need to see how many measures you need to fill it up, then you could compare it to the other bottles and see which one is bigger.

You know that if the bottle is thin, then it goes up fast – it looks to me like that line is going up pretty fast. So it should be the bottle in the middle.

TEACHER: Time to come back together as a group. Take 30 seconds to finish up.

What are we supposed to put down on this paper??

Just put down everybody’s ideas and we’ll sort through them later.

Ok, Jack, what do you think?

I think it’s the number of measures you need to put into the bottle.

But it has to be that the height is more important because you can read that on the graph.

What about…?

TEACHER: OK, let’s get together for a discussion about what your groups have figured out here.
Script 3: Active Listening (Other Graph Clues)
(Better Version)

OK, she said we need to figure out how else we can know which bottle goes with each graph.

Yeah – like I think the shape of the bottle probably has to do with the way the graph goes up fast or slow.

But, wait a minute – that shows up on the graph but it doesn’t show up on the bottle, does it? [Active listening]

Well, maybe we could look at how many measures you need for each bottle. [Lack of active listening]

Look, guys, we’ve got a bunch of ideas, but we need to all think about them. How about taking each one – one at a time. That way we’ll keep from just going around in circles. [Active listening & encouraging others to actively listen to each other first]

OK

Good idea.

Let’s start with the idea of slope.

I say we already covered slope last time and I think she’s looking for us to figure out some other ways to make a match. [Active listening]

Yeah, I agree. If we’ve already done slope, we probably don’t need to talk about it right now. [Active listening]

OK, What about the idea that the shape of the bottle determines how fast or slow the water rises?

Yeah, but that just shows up on the graph. How can you tell from looking at the bottle how its shape makes the graph different? [Active listening]

Yeah, I guess you’re right. We haven’t figured that out yet. ...But wait a minute, what you’re saying is that we need to be able to tell something both from the graph and from the bottle? Is that right? [Active listening]

Yeah, if it’s just on one or the other, we can’t use it to figure out which bottle goes with the graph. [Active listening]
OK, that means that my idea about how many measures the bottle holds won't work too well either, because we'd have to try it out with each of the bottles. [Active listening]

What about the height of the bottle, like I was saying earlier? I think it would work with your idea that it has to show up on both the bottle and the graph.

Yeah, it's on the y-axis of the graph and you can easily measure the bottle with a ruler – [Active listening]

Yeah, it's not like you have to run out and fill up a bucket with water or anything! [Active listening]

TEACHER: Take a minute, finish getting your group's thoughts on paper, and then we'll discuss them together as a whole class.

I think we need to see how tall the bottle is – that way we could check against the height on the y-axis each time.

TEACHER: Time to come back together as a group. Take 30 seconds to finish up.

What are we supposed to put down on this paper??

Just put down the idea we pretty much agreed on – that the height of the bottle can help us figure out which graph goes with it because you can get the height from both the bottle and the graph – without getting wet!

YEAH!!

TEACHER: OK, let's get together for a discussion about what your groups have figured out here.
Script 4: Authority (Bottles to Graphs)  First Version

OK, guys, she said we need to figure out what the graph will be like for that bottle up there.

Yeah, but how are we supposed to know without putting the water in it?

Look, all the graphs so far have been straight lines so it has to be a straight line, right?

Right! [Giving in to authority]

So we just make it a straight line, that’s all. Nothing to it!

Ok, but how steep should it be?

Well, it’s kind of like that medium sized bottle we looked at a little while ago, so my idea is to just make it look like the graph we saw before …. Like this!

OK. [Giving in to authority]

Well, I guess it’s OK, but how can we be sure?

Look, it’s like the one before, right? So the graph has to be the same too, right?

Yeah. [Giving in to authority]

Right. [Giving in to authority]

OK. [Giving in to authority]

Several minutes go by and the group does no more work.

TEACHER: OK, let’s get things together – take 1 minute, finish up, and then we’ll discuss this as a class.

We’re done!

TEACHER: Wow, you guys really finished quickly – Are you sure you had time to discuss everything carefully?

Oh, yeah. We got it right away!

TEACHER: OK, time for our class discussion.
OK, guys, she said we need to figure out what the graph will be like for that bottle up there.

Yeah, but how are we supposed to know without putting the water in it?

Look, all the graphs so far have been straight lines so it has to be a straight line, right?

Right! [Giving in to authority]

So we just make it a straight line – that’s all. Nothing to it.

Ok, but how steep should it be?

Well, it’s kind of like that medium sized bottle we looked at a little while ago, so my idea is to just make it look like the graph we saw before .... Like this!

I see what you mean, but I still think we need to be sure. [Not giving in to authority]

Yeah, we know how tall the bottle is, so we know where the graph will stop, right?

Right. [Giving in to authority]

But I’m still not sure how many measures it will take to fill it up.

OK, I think we should look at the other stuff we did today. [Not giving in to authority]

Yeah, that makes sense, then we could sorta estimate how many measures it will take. [Active listening]

OK. See, this one we looked at was much skinnier than the bottle we’ve got now, so we know the graph needs to slope more to the right before it reaches its full height.

Yeah, but this bottle was a lot fatter than the bottle we’ve got now. We can’t have it slope this far over. [Not giving in to authority]

OK. What about half way in between?

Sounds good to me.

I’m not sure this bottle is really half way in between the other two. What do you guys think? [Not giving in to authority]

I think it’s really closer to the skinny one. [Not giving in to authority]
Yeah, me too. Maybe we could make it about two-thirds of the way in between – You know, closer to the skinny one, but not really that steep. [Not giving in to authority]

Yeah, that makes sense.

OK.

TEACHER: OK, let’s get things together – take 1 minute, finish up, and then we’ll discuss this as a class.

We’re almost done!

Let’s just put down our thinking onto paper really quick.

OK, (writing) we compared this bottle to two others and decided it was in-between, but closer to the skinny one. So we decided to make our graph more like the skinny one, but not going up quite as sharply – Kind of like two-thirds in-between the fat and skinny ones.

Sounds good to me.

Yeah, I think we’ve got a good explanation.

Yeah, it didn’t take too long at all, either!

TEACHER: OK, time for our class discussion.
APPENDIX TWO:

TRANSCRIPTS, JOURNALS,
AND DAILY LESSONS
OVERVIEW

The following tables include an outline of each day’s lesson combined with a summary transcription of each small group’s discussion plus individual student’s journal writings. The highlights of the discussion are listed for each of the four students whose progress I am tracking. Everything is presented in chronological order; I correlated the groups’ activities with each other as well. Whole class activities such as the fishbowls and whole class discussions are written out horizontally. Quotes from individual student journals are written in italics.

Each class included the following elements, not always in the same order:

1. A problem for small groups to work on together.

2. A script revolving around the same problem with the characters Nancy, Jack, Amelia, and Lou.
   a. Students assign a character for each student to portray.
   b. They assign lines for each character.
   c. They practice their parts.
   d. One or two small groups “fishbowl” their play in front of their peers.

3. Whole class discussion of the scripts or the problem itself, documented on chart paper.

4. A journal question is assigned, usually two or three times per class.

DAY ONE: DEDICATION TO THE GROUP

MARCH 1, 2000
JAMES  
(w/ Jesse, Courtney, Vicki)

“He’s crazy – Look at him!”

“Alright, we gotta make our graph, dude.”

Begins to explain his graph: “the distance from the bed…”

Gets off track talking about his house alarm that goes off sometimes when he comes downstairs, his sister staying up late to watch movies, etc.

“Don’t you get it? It’s easy!”

Begins talking again about his graph and then immediately launches into an explanation about having had French toast sticks for breakfast.

As soon as Mrs. Combs leaves, James begins singing into the microphone and tapping on it.

VICKI  
(w/Jesse, Courtney, James)

Vicki spends a lot of her time giggling at James’ antics

RICK  
(w/Chad, Joe, Erica)

Lots of playing around and talking into the microphone.

Joe and Rick briefly discuss the task.

Erica and Joe explain their graphs.

Rick: “That’s why you have to take a cold shower; it wakes you up.”

Joe & Erica discuss; Rick doesn’t explain his graph.

Rick: “Ten minutes from your room to downstairs – that’s a huge house!”

Mrs. DeJesus comes over and offers help to Jesse and Vicki; both state they “don’t get it.”

Mrs. Combs comes over and asks questions about Erica’s graph, about the possibility of instantaneous change.

Rick: “I’ve got a loop in my graph. That means I went back in time. I shouldn’t have that loop there…” He then plays with the recorder by talking into the microphone and making the red button go on.

CINDY  
(w/ Ted, A.J.

“This on the side…” (to self)

Asks teacher for help.

Little interaction with her group.

The rest of the group discusses their graphs.

“And then I don’t know.”

Side discussions between Ted and A. J. – the two boys show the group their graphs.

Mrs. DeJesus asks Cindy to explain her graph.

She explains to the whole group with Mrs. DeJesus listening.

Once Mrs. DeJesus leaves, the boys start to goof off again; Cindy remains silent.
JOURNAL

Students are asked to write what they remember about bottle graphs. Once they write, they review briefly with the whole class and then are asked to discuss this in their small groups.

<table>
<thead>
<tr>
<th><strong>JAMES</strong></th>
<th><strong>VICKI</strong></th>
<th><strong>RICK</strong></th>
<th><strong>CINDY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>We looked at different graphs and vases.</td>
<td>Everytime you added water the height rose. After you put 4 ½ cups in the beaker then it was full and it’s a straight line on the graph.</td>
<td>• we measured bottles and cylinders  • we recorded our data in graphs.  • we compared different bottles and how much water they could hold.</td>
<td>The graph shows that water was put in evenly, and the water level went up evenly. The water levels off.</td>
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</tbody>
</table>

SMALL GROUP DISCUSSION FOLLOWS:
Mrs. DeJesus urges James to tell the others about what the class did last year. (Vicki and Jesse were not in the class the previous year.)

James begins: “Doing the same thing we are now, but different graphics and stuff....” He starts singing again.

Mrs. Combs comes over and James explains a little more.

---

Group discusses who was and who was not a part of the class last year. All were except for Joe.

“We measured bottles and cylinders. We recorded our data in graphs.”

Joe: “Why are the graphs different?”

“Because they are different bottles in how much water they can hold.”

“Well, we measured with rulers.”

Chad explains that he thinks water and rulers were important in the experiments last year because you have to have the tools to do the job.

Rick: “Very good. What about you?.. Oh, OK.”

Erica: “What about you?”

“I said I got what I said.”

The boys get off topic talking about music groups. Erica tries to get them back on topic,
WHOLE CLASS DISCUSSION: INTRODUCING THE IDEA OF SCRIPTS

Mrs. DeJesús calls the class back together and explains the idea of playing roles to learn about group discussions about mathematics.

SMALL GROUP DISCUSSION

<table>
<thead>
<tr>
<th>Mrs. DeJesús calls the class back together and explains the idea of playing roles to learn about group discussions about mathematics.</th>
<th>While Mrs. DeJesús is still talking, this group starts assigning roles.</th>
<th>A.J. tells Cindy to pick a character; she selects Nancy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I want to be Amelia.”</td>
<td>Erica directs the group in assigning roles.</td>
<td>Mrs. DeJesús explains how to assign characters to lines in the play.</td>
</tr>
<tr>
<td>“I never really got into reggae.”</td>
<td>Rick: “I’m Amelia!”</td>
<td>A.J. and Ted begin assigning parts, then ask Mrs. Combs if this is alright. A.J. then continues to assign the lines.</td>
</tr>
<tr>
<td>Mrs. Combs comes over and helps the group get organized.</td>
<td>Erica parcels out the lines by going around the group in turn.</td>
<td>Mrs. DeJesús comes over to check.</td>
</tr>
<tr>
<td>“I don’t get it, where are the people’s names?”</td>
<td>“Alright.”</td>
<td>The boys goof around.</td>
</tr>
<tr>
<td>James starts assigning parts: “OK, first Nancy, then Amelia, then Lou.”</td>
<td>While Erica reads over the character descriptions out loud, the boys play around.</td>
<td>Cindy remains silent.</td>
</tr>
<tr>
<td>He starts making noises into the microphone.</td>
<td>They argue over whether she has to do this.</td>
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</table>
better."

"Oh, yeah, that’s me!"

"Do we assign our parts or their parts?"

Mrs. DeJesús explains that they assign the parts to the characters, not really to themselves.

Mrs. Combs begins working with this group.

"...Then Jack. I want to be Jack because he does say hip hop."

"Who says, ‘Oh, man’?"

Mrs. DeJesús stops briefly at this table.

They read over their assigned roles all at the same time.

They discuss whether a guy or a girl should say each line.

They continue selecting lines for their characters.

They don’t get through handing out lines.

Mrs. DeJesús tells the groups to start rehearsing.

“We’re not that done yet.”

“Jack says the next line because he’s self-centered.”

They finish handing out lines and then begin practicing.

They still haggle over lines when they get to one they like or they think fits one of their own or the character’s personality.

They go through the lines fairly evenly discussing occasionally.

Finally, this group begins rehearsing.

Mrs. DeJesús explains they need to practice enough to present in front of the whole class, but that they do not have to memorize their lines.

The group practices.

Good job of reading through it. Occasionally, they still

The boys talk off task. They do not want to perform in front of the
audio passage of the three students practicing. They are really into the play!

Mrs. DeJesus picks another group to perform in front of the class.

"Can we go, can we go next?"

discuss who should have which line.

They sometimes comment briefly on how the others are acting out their parts.

Rick complains that he only has two lines.

Erica reassures him they'll figure it out.

whole class.

Mrs. Combs comes over and insists that they practice.

They read through it once.

FISHBOWL

The first group performs the skit in front of the entire class then Mrs. DeJesus selects a second group to perform.

"That's not fair! We wanted to go!"

This group performs first.

The next group performs in front of the class using the same script.

Here Courtney arrives late to class.

Mrs. DeJesus reprimands Rick for playing around with the equipment and acting silly. She tells him this is 8th grade: “We’re not doing that this year.”

WHOLE CLASS DISCUSSION

The whole class discusses what went wrong with this group.

Mrs. DeJesus passes out the second script in which the group does a better job of being dedicated to the group.

SMALL GROUP DISCUSSION

<table>
<thead>
<tr>
<th>Mrs. Combs encourages the group to assign parts really quickly.</th>
<th>They quickly assign parts.</th>
<th>The three students assign lines, mostly A.J. and Ted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>They practice.</td>
<td>Rick asks for clarification about which lines go with</td>
<td>“This is my first line?”</td>
</tr>
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</table>
which character.
They get right down to practicing. They take turns trying out each character's interpretation of each line.
They then try out silly voices with the lines.
“Come on everybody, follow Nancy (Erica) as the lead.”
“Could that line be me?”
Joe: “I'm begging you, I want that line! I'll never ask you for anything ever again!”
“Now that we have that figured out, can we go on to Lou?”
Mrs. DeJesus checks on microphone.
“Ok, we have to go back to Lou now.”
They practice.

Mrs. Combs comes over to help them assign the lines.
Cindy: “This is Jack.”
“OK.”
They practice.

**FISHBOWL.**

James, Vicki, Jesse, and Courtney go up to present their skit to the entire class.

James comes back to the table, sings into the microphone and then makes piggy noises.
WHOLE CLASS DISCUSSION

Mrs. DeJesus leads a class discussion about what was better in the second script. Are the characters still having a good time in the second script? While they are talking about what they're supposed to be talking about?

<table>
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<tbody>
<tr>
<td>“Uh, no...yeah.”</td>
<td>Cindy: “Uh, huh.”</td>
</tr>
<tr>
<td>(Gives in to group ideas.)</td>
<td></td>
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</tbody>
</table>

She then tells the students to Write in their journals about which script their own group more closely resembled, the original script or the revised script.

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<tr>
<td></td>
<td></td>
<td>“Because we do use naughty words.”</td>
<td>Cindy: “Uh, huh.”</td>
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<tr>
<td></td>
<td></td>
<td>They start talking quietly off task about someone they know outside of class.</td>
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<tr>
<td>JOURNAL</td>
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</tr>
<tr>
<td>JAMES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revised b/c they were just fooling around the first one we talked about the vases, beakers and graphs.</td>
<td>VICKI</td>
<td>Revised. Because we were more realistic and mature than the first one. We also stayed on task.</td>
<td>RICK</td>
</tr>
</tbody>
</table>

**END of Class**
DAY TWO: HELPING EACH OTHER UNDERSTAND  
MARCH 3, 2000

PROBLEM FOR SMALL GROUP DISCUSSION

Directions: Go through these three statements together, talk them over in your group, then pick the graph that goes with each statement.

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(w/Molly, Erica, Cindy)</td>
<td>(w/A.J., Courtney, Rick)</td>
<td>(w/A.J., Courtney, Vicki)</td>
<td>(w/Molly, Erica, James)</td>
</tr>
<tr>
<td>Mrs. Combs asks the group to focus.</td>
<td>They begin tossing out ideas, then Courtney points to the one she thinks is right, &quot;because it stops here.&quot;</td>
<td>To Courtney: &quot;Why do you think this one...?&quot;</td>
<td>She explains the wall is here.</td>
</tr>
<tr>
<td>They quickly move from the topic of going to Washington, D.C. to looking at the work.</td>
<td>Vicki: &quot;No, that just means that it's going along faster.&quot;</td>
<td>&quot;This one because it goes up and then down like this....&quot;</td>
<td>&quot;It stops then it drops.&quot;</td>
</tr>
<tr>
<td>&quot;OK&quot; – James brings the group to focus.</td>
<td>&quot;That's where it (the graph) goes down.&quot;</td>
<td>&quot;He climbs the hill...&quot;</td>
<td></td>
</tr>
<tr>
<td>Molly says she doesn't get it.</td>
<td>They agree and go on to the next statement. A.J. and Courtney agree on which one it is.</td>
<td>&quot;It goes up and then down...&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;A wagon moves along, then crashes into a wall and stops. I think A.&quot;</td>
<td>&quot;Which one did you pick, Rick?&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erica: &quot;I get D.&quot; Erica explains her choice to Mrs. Combs and Mrs. DeJesus who tell her to explain it to her group.</td>
<td>&quot;Me, too. That's good. That's good. That's marvelous.&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>She does this.</td>
<td>&quot;Then the second one...&quot;</td>
<td>Courtney reads and then gives her explanation of the third statement.</td>
<td>&quot;Yeah...&quot;</td>
</tr>
</tbody>
</table>
They climbed the hill and then sledded down it.

"Sledded down it - that doesn't sound right. Oh, well."

"I picked B because it looks like a little slopey hill thing."

Molly and Erica clarify.

"Yeah, you got it! You got it!"

Then they decide you wouldn't speed up.

"Erica, it's a picture."

Molly agrees it's B.

"Because it's kind of like a snow day."

James starts singing into the microphone.

"Cindy, what's going on? Never mind, never mind."

This group is silent.

Mrs. DeJesús asks if they're all satisfied.

They all agree that they are finished.

(reading): 'They climbed the hill and then sledded down it.'

WHOLE CLASS DISCUSSION

Mrs. DeJesús stops to have a whole class discussion about the scripts the students acted out in the previous class. She reads notes from other classes, too. (These were written on the poster paper on the easel in front
of the class.) Did the other classes say anything different or did they pretty much say the same stuff that you guys did?

“Well, when we did the revised script, it looks like they (the other classes) added more things like that they kind of proved their points more.”

Mrs. DeJesus expands on the idea of proving a point. She then asks about something another class said about compromising and giving different options along with their own thinking. She stresses how important it is to explain our thinking in math class. She also talks about dedication to the group, which they looked at in the previous class. She then talks about steepness of hills and slopes.

**PROBLEM FOR SMALL GROUP DISCUSSION**

Directions: Share in your group ideas about where slope occurs in the real world and why slope is important.

**JAMES**
Molly suggests you go quickly down a hill and slowly up a hill.

“You go down a hill...that’s slope.”

**VICKI**

“You go down a hill...that’s slope.”

**RICK**
Rick yawns loudly.

**CINDY**

Reminder: You have about one minute to decide why slope is important in the real world.

“Oh, lock, locks, like the water gets lower and you go down.”

Erica suggests that if there were no slope, water would just spread everywhere.

No further ideas from this group.
“I gotcha. I gotcha. You’re pretty smart (to Erica) – sometimes.”

James then starts making noises into the microphone.
WHOLE CLASS DISCUSSION

Erica offers her suggestion. James offers his idea of waterfalls and also mentions Molly's idea of steeper slopes making things go down faster. Molly talks about waterslides. Mrs. DeJesus talks about water bottles. Shows a graduated cylinder and a beaker. She asks which graph would go with which bottle.

PROBLEM FOR SMALL GROUP DISCUSSION

Take a minute in your groups and decide which line goes with which.

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The big triangle thing goes with the beaker.”</td>
<td>Courtney thinks the blue line goes with the graduated cylinder.</td>
<td>Mrs. DeJesus tells A.J. that he's not sharing with his group.</td>
<td>“Well, the one that steeps up like…”</td>
</tr>
<tr>
<td>“...really high that's the graduated cylinder. It fills up faster 'cause I remember from last year...”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“We discussed. We're ready.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Look, it's getting better.”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WHOLE CLASS DISCUSSION

Ok let's take a minute in the whole class. What do you guys think?

“It's better.”

James offers this explanation after Joe states that the blue line goes with the graduated cylinder:

“I agree with Joe because the graduated...”
cylinder is narrower and will fill up faster and the beaker is bigger and wider and will fill up slower."

Erica offers her idea that the steeper the slope the faster the graph goes up.

The class goes on to discuss zero slope and leaking bottles (with the water level going down). Which one is the dependent and which one is the independent variable? They then talk about the difference between variables and constants. Mrs. DeJesús asks if something varies does it stay the same or change?

"It can vary."

The group is very attentive during the whole class discussion even though three of them are good friends who like to talk with each other.

This group was silent the entire time.

**JOURNAL**

Take journal paper and write "What's important in a graph? What do you need to look for?"

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What you look at a graph can tell you they answer of problems sometimes. You can tell what is used by the slopes.</strong></td>
<td><strong>What your graphing</strong>&lt;br&gt;The names on each sides to label what is what.</td>
<td><strong>The line, the measures (axis's), the pattern. -- all important</strong></td>
<td><em>1. you can tell how fast or how slow something is done 2. You need to look at the y &amp; x axis so you can get accurate information.</em></td>
</tr>
</tbody>
</table>

Group writes quietly for a few minutes, then Molly, Erica and James start talking softly off task.

"What's the topic?"

"What's the topic in looking at a graph?"

"I have to answer the question."

Courtney: "Are we supposed to discuss it?"
**JOURNAL**

Mrs. DeJesus asks the group to reflect on their journal paper about how well their groups usually work. How dedicated are those groups usually? Explain why.

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sometimes it depends. So far it has been good.</td>
<td>Dedication&lt;br&gt;Our group was more like the mature revised script. Because we all talked together and answered the questions and worked together.</td>
<td>All of us are dedicated at getting the job done, but it’s 9:03 in the morning. A.M., WE’RE TIRED!!</td>
<td>Our slope discussion was mostly like #2. But at some times it got of topic. We came up with 3 examples at the end. I would say we were on topic for most of the time.</td>
</tr>
</tbody>
</table>

They start talking about the Washington trip and whether they have to bring something to the next class about it.

James asks to go to the restroom.

Group works silently.

“All the groups are dedicated.”

Courtney challenges this.

They talk off topic.

---

**WHOLE CLASS DISCUSSION**

What do you notice when a group is truly dedicated than when it is not? Erica suggests that they stay on topic and that whether or not you can work with the other people is important. They create a classroom list of ideas, including an interesting topic, contributing, everyone all working together. Molly suggests that Courtney and Cindy work well together while she and Erica sometimes goof off.
Mrs. DeJesús asks the students to write down one thing they could do to get the group back on task when they start to go off task. The groups all write quietly and then are told to put their writing away and to take out their scripts.

**JAMES**
Have the teacher talk to them.

**VICKI**
Keep telling your group to get back on task and if they don't get on task then do all your work and talk to the teacher about the other people.

**RICK**
Give a speech about feeling good and staying out of trouble if we do the work/ work on it myself – I'll get all the credit.

**CINDY**
You could remind them to get back on task and hope they will.

---

**SCRIPT**

Mrs. DeJesús hands out the next script about helping each other understand.

“I’m Jack!”

“I’ll be Lou.”

Mrs. DeJesús: “OK, you should have this script ready to present in 5 minutes.”

“I’m Jack.”
Erica: “I’m Nancy.”
Molly: “I’m Amelia.”

They start assigning lines.

“This is Nancy right here, then this is Jack.”

They practice as they assign lines. They occasionally argue over lines using characters personalities to decide.

“Hold on, don’t you think Jack should say

They read the lines out loud and discuss who should say what based on personalities.

“That doesn’t sound like her.”

Once they have assigned the lines, they read and practice the script.

They then all discuss the lines again to see which one should go with which character – refining the script.

“I don’t care.”
that part?"

"Listen, Jack's athletic. You're Nancy right? You don't give up. Anyone who plays the trumpet ... Who do you think should play that part?"

Erica explains.

"OK, you can have it."

They discuss assigning the lines carefully, but not including Cindy.

They continue assigning lines.

Erica accuses James of having the other parts.

He shows that he doesn't.

Alright, let's rehearse.

Erica calls James an idiot.

James calls Erica a loser.

Then they rehearse.

They start discussing whether they want to present this one or the better version and decide they would rather present the better version.

Loudly into microphone: "whoop-de-do!"

They practice again, getting through most of the script.

"I say this..."

"I say, 'He's right.'?"
**FISHBOWL**

A.J., Courtney, Rick, and Vicki present the script.

---

**WHOLE CLASS DISCUSSION**

Mrs. DeJesus then starts a whole class discussion on why this group isn’t getting their work done. They write the ideas on the front easel.

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>“They’re argumentative.”</td>
<td></td>
</tr>
</tbody>
</table>

They then begin discussing the idea of helping each other understand.

---

**SCRIPT**

Mrs. DeJesus then tells them to read the second script to see if these things have been fixed. She also tells them to change words if they don’t sound right.

<table>
<thead>
<tr>
<th>James and Erica start assigning lines.</th>
<th>They assign roles while reading over the script together.</th>
<th>“No, I don’t want to be Lou.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molly and James discuss whether the last line should go to Lou, but Cindy does not join in the discussion until near the end.</td>
<td>“OK, I’ll be Amelia.”</td>
<td></td>
</tr>
<tr>
<td>The three go back to arguing over the parts.</td>
<td>He reads the personality card and decides Amelia fits him.”</td>
<td>“OK, can I be Amelia?”</td>
</tr>
<tr>
<td>“Ok, let’s go.”</td>
<td>“No, wait, how can I say that?”</td>
<td>AJ: “No, you’re Jack.”</td>
</tr>
<tr>
<td>“Let’s rehearse!”</td>
<td>“Ok, let’s go.”</td>
<td>“No, I don’t want to be Lou.”</td>
</tr>
<tr>
<td>Erica talks.</td>
<td>“OK, I’ll be Amelia.”</td>
<td>“OK, can I be Amelia?”</td>
</tr>
<tr>
<td>They read through the script together.</td>
<td>He reads the personality card and decides Amelia fits him.”</td>
<td>“OK, can I be Amelia?”</td>
</tr>
<tr>
<td></td>
<td>“No, I don’t want to be Lou.”</td>
<td>AJ: “No, you’re Jack.”</td>
</tr>
</tbody>
</table>
"Stop talking. Shut up!"
They go over lines one more time.
They practice a few lines.
Mrs. DeJesus asks for a volunteer group and they go up.
They go back to their table.
James: "I'm going to be a movie start!"

**FISHBOWL**

Two groups present the skit.

**WHOLE CLASS DISCUSSION**

Mrs. DeJesus: "What happened in this script? It's kind of subtle – it's not like there were huge changes. What happened?"

The class lists ideas on the large paper – more people participated, people seemed more alive.

Mrs. DeJesus: "What else? Why could they get stuff done here?"

Someone took charge. Mrs. DeJesus: "What about the name calling?" No name calling.

"Like stupid."
Vicki laughs at A.J.'s silliness.
"More people were participating."

Mrs. DeJesus talks about helping each other understand.
On your journal paper real quick....first thing, write what do you think of doing role play in order to learn about group dynamics. On your graphing handout, on page 3, put 3-3 at the top, then answer the questions.

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>It makes it fun and make it more interesting to pay attention to.</td>
<td>I like the role play it makes learning a little bit better.</td>
<td>Role play is really cool we should do more of it we learned a lot.</td>
<td>I think roll play is a good way for learning because everybody can be involved.</td>
</tr>
</tbody>
</table>
Silence.  

A.J. asks about HW.  

“So, apparently we’ve got to stick with that.”  

Silence.

END OF CLASS.
DAY THREE: ACTIVE LISTENING & NOT GIVING IN TO AUTHORITY  MARCH 14

Note: This is the last day the entire class spent on the role plays. It takes place eleven days later because two of the houses took their 8th grade trip to Washington, D. C.

WHOLE CLASS DISCUSSION

Mrs. DeJesús reviews the importance of mathematical discourse and the concepts they’ve already covered, dedication to the group and helping each other.

PROBLEM FOR SMALL GROUP DISCUSSION

She holds up a couple of unusually shaped bottles. Which graph goes with which bottle. Decide in your groups.

<table>
<thead>
<tr>
<th>JAMES (w/Jesse, Courtney, Vicki)</th>
<th>VICKI (w/Jesse, Courtney, James)</th>
<th>RICK (w/Chad, Joe, Erica)</th>
<th>CINDY (w/A.J., Ted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“This one because it takes longer to fill up. Here it’s narrow and goes up faster.”</td>
<td>Vicki goes along with James ideas</td>
<td>“I think this one goes with this bottle…the triangle.”</td>
<td>The boys decide the red one goes with the heart-shaped bottle.</td>
</tr>
<tr>
<td>“This one starts wide and then narrows, then gets wider at the top.”</td>
<td></td>
<td>Other group members don’t respond. Joe starts talking with David who comes by their table.</td>
<td>Mrs. Combs comes by and comments that she doesn’t hear any conversation.</td>
</tr>
<tr>
<td>“Do we write about it now?”</td>
<td></td>
<td></td>
<td>A.J. explains his reasoning.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cindy says nothing.</td>
</tr>
</tbody>
</table>

JOURNAL

Mrs. DeJesús tells the groups to take a few minutes and write about this on their journal paper now, being sure to explain why the graph belongs to the bottle.

Groups work silently.

| I thought the heart went with the red line because | I think the red line goes with the heart shaped | Blue = Flask | Red = Heartbottle | I think the pink line goes with the heart shaped |
it can fill up faster at the bottle because it is narrow and it get wider at the top. I thought the flask was the blue line because it wider at the bottom and takes longer to fill up. And the top is skinny and can fill up quick. bottle because it takes a shorter amount of time to fill up. I think that the blue line goes with the flask because it takes longer to fill up because it's bigger & wider at the bottom so it takes longer to fill up. because the Blue starts out slow and ends up filling fast = (picture of graph). The red line starts up fast and ends up slow = (picture of graph), like a heart, or an upside down flask. container, because. At the bottom of the bottle it is skinny & the graph goes up fast, & then the graph starts to curve. I think the blue lines goes with the flask because at the bottom of the flask it is fat & the graph goes up slowly & the flask gets skinnyer & the graph goes up faster.

Write about whether your group is dedicated and whether you are helping each other to understand. Tell me what happened in your group.

Groups work silently.

| We worked together and we were dedicated because we explained our thoughts to each other so they can understand. | Our group worked very well together and we were all dedicated because we all said an explanation to help everyone understand in the group. | I think we all stayed on the subject and Erica helped me to understand here feelings about the graph. I don't know about the others though – I wasn't paying attention. | Our group was kind of dedicated, but all of us agreed. We discussed the topic & never said anything else. So we were dedicated to this discussing. |

**SMALL GROUP DISCUSSION**

Take out your script. Please turn to the third script, the original version.

Go through it and with your group, quickly assign parts.

"Then that’s Jack, of course."

They read out loud.

"Wait a minute, this doesn’t look right."

They continue.

They start laughing.

Vicki giggles at her turn. Then she starts laughing at the way Courtney is reading (in a rather exaggerated way).

"I can’t help it!"

That doesn’t make sense -- why would Amelia say that about the bottle when she already knows?

“OK, you can be Jacqueline and I’ll be Emilio.”

They assign parts, occasionally discussing personalities of the characters.

They check back and forth with each other with Erica and Joe taking the leads.

They start practicing, sometimes stopping to switch parts.

The boys start to goof around just as a group goes up to present.

They practice.

**FISHBOWL**

A group (David, Chris, Duncan, Molly) goes up to present.

Mrs. De Jesús: “What you’re looking for here is where the group breaks down. What is happening here that makes the group not quite work?”

The group presents.

**WHOLE CLASS DISCUSSION**

Mrs. De Jesús: “What’s happening here?”

Molly: “Lots of different ideas.”
Mrs. DeJesus: “What else? Is that all that’s happening? They’re not sure what to do?”

Courtney: “Maybe they should try listening to each other more?”

Mrs. DeJesus: “So they’re not really sorting out their ideas and not really listening.”

**SCRIPT**

Mrs. DeJesus: “Read through the revised script by yourself for a minute first.”

<table>
<thead>
<tr>
<th>Courtney: “Can I be Amelia again?”</th>
<th>“OK.”</th>
<th>Mrs. Combs comes by the group. Joe wants to add words to the script.</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Yeah, that’s the only class.”</td>
<td>“It’s just that the way you were reading sounded funny.”</td>
<td>Chad and Joe take charge of assigning parts. Rick adds an occasional, “That’s Emilio.”</td>
</tr>
<tr>
<td>They work on assigning lines.</td>
<td>“Go ahead.”</td>
<td>They discuss the parts a bit as they assign them. Rick does not take an active role.</td>
</tr>
<tr>
<td>Vicki joins in here with more ideas about which character should say which lines. She discusses mostly with Courtney and some with James.</td>
<td>“James, you’re good in math.”</td>
<td>They practice.</td>
</tr>
<tr>
<td>“James, you’re good in math.”</td>
<td>Mrs. Combs: “We could start it out with you then....”</td>
<td>Joe starts practicing with a silly voice. Rick then copies with a different silly voice. Chad taps on the microphone and they make noises into it.</td>
</tr>
<tr>
<td>The they assign parts. This time all three actively participate.</td>
<td>Mrs. Combs: “Alright.”</td>
<td>“I think I’m going to do cartwheels.”</td>
</tr>
<tr>
<td>They continue assigning parts, making sure each person has the same thing written down.</td>
<td></td>
<td>Erica: “Don’t do cartwheels.”</td>
</tr>
<tr>
<td>“No, L has to say it here. It’s on this paper.” (To A.J.)</td>
<td>Rick: “Alright, I’m not.”</td>
<td>They start to practice.</td>
</tr>
<tr>
<td>Mrs. Combs: “OK, practice.”</td>
<td>Chad starts drumming</td>
<td></td>
</tr>
<tr>
<td>They start to practice.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Rick: "It's a noise machine!"
**FISHBOWL**

Mrs. DeJesús: “I want you to follow this new script and find out where this script changes – where it starts to go right instead of just presenting a lot of ideas.”

A group goes up and presents the new script (Courtney, James, Vicki, and Jesse).

**WHOLE CLASS DISCUSSION**

Molly suggests Jack says “Let’s take one idea at a time.”

Mrs. DeJesús: “Why does such a little thing like that make such a big difference? Now look at this script again, and let me know what happens as they discuss one idea at a time.”

David: “There’s controversy.”

Mrs. DeJesús: “Is it good controversy or bad controversy. Put a check mark everywhere someone is asking for more information about an idea someone else already made.”

The class discusses the script more carefully altogether.

Mrs. DeJesús: “What happens every time someone puts out an idea in this group?”

Erica: “People talk about it.”

Chad: “They respond.”

Joe: “They got back to work, even when the first idea didn’t work.”

Mrs. DeJesús then launches into an impromptu role play with Molly about active vs. passive listening. She has Molly trying to tell her about her weekend. In the first role play, Mrs. DeJesús acts really busy and caught up in her own work. In the second, she takes time to respond to Molly’s statements by asking for more information. The students appear to understand the difference between simply “listening with their ears” vs. “listening with ears, brains, and voice.”

The class then discusses the difference between passive and active listening.

**JOURNAL**

Take your journal paper, draw a line below where you wrote before, and here’s what I want you to write about now: I want you to write about a time in a group where you felt people were really listening to you – actively listening.
Groups write silently.

<table>
<thead>
<tr>
<th>JAMES</th>
<th>VICKI</th>
<th>RICK</th>
<th>CINDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>When all of the members are interested in the topic. In art Molly was telling some of her farm stories.</td>
<td>I felt listened to this class because my group was asking me questions and wanted to know more and we all gave each other the respect that they gave me.</td>
<td>I don't think people have ever listed to my ideas – then again I usually don't have anything to say. – In all classes every group project. There were a couple of times when people did listen to me because they had to and wanted to. Soc st w/ Duncan &amp; Jeff.</td>
<td>I have been in a group when people were listing to me when I was in music class doing a group worksheet.</td>
</tr>
</tbody>
</table>

“Do we have to write down what class it was?”

James starts to make noises into the tape recorder.

Mrs. DeJesus: “Explain why. Always explain why.”

“You need to explain why.” (Checking someone else’s paper.)

James and Vicki work silently for a few minutes, then start an off-task discussion about Abercrombie & Fitch.

Vicki responds with giggling.

Joe: “Like when we did the survey in this class?”

They write in silence until the very end.

Start talking about who Ted likes and whether he asked her out.

“Yeah....?” (interest)

**PROBLEM FOR SMALL GROUP DISCUSSION**

In your group, I'd like you to draw a graph for the tall narrow bottle there. Talk to your group members about it, too.

| The microphone stopped working in this group.— | Silence. They work by themselves. | Silence. They work by themselves. |

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or someone turned the volume way down.

Joe shares his idea.

Rick: “That’s what I got.”

They stop working and start talking about people who work for a shoe company.

A.J. and Cindy discuss the possible graphs.

“Well, I think it’s like this….”

Ted: “Which one, the first one?”

Cindy and Ted explain parts of the graph together, finishing each others phrases while looking at each other’s graphs.

A.J. listens.

Whole Class Discussion

Mrs. DeJesús assigns lines for the next script on Authority.
She then goes on to the next script and lists the names for each line. Students copy down the names. The class is then does a choral response, each person with that character reading the lines. Then each group reads through the script.

Mrs. DeJesús asks them to figure out what went wrong with this group.

“They’re not really doing any work, they’re just assuming.”

“They’re just assuming that all the graphs are straight lines.”

Joe: “They’re lazy.”

Class then has a whole class discussion that leads to the idea of authority. Mrs. DeJesús gives examples of David knowing a lot about cars and how she would listen to David (bow to authority) since he knows more. She also tells about popularity and trying to get on the good side of someone. They discuss these ideas about times when people have done this in small groups, including trying to impress someone else in the group. I see this with boys all the time…making faces across the room trying to show off to each other.
Mrs. DeJesus: “We call this giving in to authority. This is giving in to people we are trying to impress or to people we think know more about something than us. They’re just all going along…”

**JOURNAL**

Mrs. DeJesus: “On your journal paper, you have one minute to write the following: When have you been in a group when people gave in very quickly because people thought others knew more or they were trying to impress each other?”

| When people are new and they want to make friends. They will do desperate things. | I was in my science group and I knew that someone knew what they were doing and I had no clue so I gave in to their answers. | All the time. People are lazy and would follow “that smart kid.” Otherwise they’ll guess on they’re own answers. | I have been in a group in LA when we had to do a book work sheet & they just gave in to other people. |

End of Class.
JOURNAL QUESTIONS asked on 3-16-00 as a follow-up to the role play activities.

1. Do you think the scripts we read and acted out as a class will help you discuss mathematics better? Please explain why or why not.

   Yes, because if you express your reasoning to the other people who don't understand it it can help them out. Or if you don't know it they could put ideas in your head.

   Yes, I think the scripts helped because we had examples in the scripts, showing us how to explain mathematics.

   Yes because if we learn from the script, we can learn to cope w/ each other, then we can work quicker and easier.

   Yes I think it does, because we can actually see what people think and you can act it out so you understand it better.

2. What did you like about these scripts?

   The original versions were sort of similar to reality.

   I like the scripts because they were fun and sometimes exciting and helpful.

   They had a very good dialogue form and were well scripted.

   I like how there are two of them alike but different. And I like how they are set up.

3. What could make these scripts better?

   I think they were good the way they are.

   I think you could make these scripts better by relating them more to the students, or their personalities.

   Making them "more realistic." Like adding in more of what we do and like.

   I think if you already had the names of who says it would help a lot and save time, so more people can practice and present.
Note: This group activity took place ten days after the final work on scripts. This time, I had selected four students to look at more closely, and I put them together in the same group.

Mrs. DeJesús briefly reviewed the points they had covered about mathematical discourse, namely dedication to the group, helping each other understand, active listening, and not giving in to authority.

**PROBLEM FOR SMALL GROUP DISCUSSION**

Mrs. DeJesús gave them a problem from a practice set for the New York State Math 8 Assessment.

**JAMES**  **VICKI**  **RICK**  **CINDY**

Reading, "Which graph represents the Volume of a cube as a function of its side length."

James makes noises into the tape recorder.

“Oh, I know.”

You can’t do that, Rick.

Mrs. Combs comes over and asks the group if they’ve figured it out.

“This one here looks really good…”

“Well, I agree, because everyone else says so.” (laughing)

Vicki laughs.

“Uh, we have to get back to this.”

Rick makes noises.

“It goes in a constant pattern. I think it will be F because it goes in a straight line. And it’s the only one in a straight line.”

That’s exactly what we’re not supposed to
"Well, he can agree." (Jokingly)

"Yeah, that's a good one, right there."

"Hey, Mrs. Combs, are you going to party tonight? It's Friday."

"I'm dedicating. I have a lot of authority, too."

Mrs. Combs: "Show mathematically why you picked F."

Mrs. Combs illustrates the volume formula.

Mrs. Combs: "So what's this one going to be?"

Mrs. Combs: "OK, keep going."

James sings into the microphone.

"We're going to take your mike..."

Rick starts to sing, too.

"Three times three times three........27"

Vicki giggles.

"Shut up, Lee Bay."

"Cindy's my girlfriend."

"That's the first thing I've heard her say all year -- 'not'!"

"I like her idea."

"'Cause it looks like cubes!"

"One times one times one."

"Well, I did that..." (to Mrs. Combs)

"Not."
Rick sings.

Giggles some more.

“I can do it that way.”

“You’re right, I can’t, that’s because I don’t dance.”

“Four times four times four. Four times four is sixteen. What’s sixteen times four?”

“64.”

“It’s this one.”

“No, let me do it.”

“Yeah, you’re right.”

Starts singing.

---

“Length times width times height.”

---

“No, Rick, you don’t have it! You can’t do it like that. See you right here....”

“You can’t do it like this, though.....Or like this. No-ooo!”

“You can’t do it like this.” Makes a noise.

“Shut up.”

James starts to sing again.

James and Vicki laugh at Rick’s efforts.

Mrs. DeJesuis asks:
“How are you guys coming?”

“Cindy came up with a unique idea.”

Mrs. DeJesus: “Guys, what is the volume formula for a cube?”

Mrs. DeJesus: “Here, let me show you something.
If you make a chart like this ... edge and volume...”

Mrs. DeJesus: “1 x 1 x 1 =? 2 x 2 x 2 =?”

Mrs. DeJesus: “OK, keep going now...”

“You’re right!”

Mrs. DeJesus: “James, you’ve got to write these down.”

“J fits the data. Hello, J does!”

Starts singing again.

“It was J!”

“Yeah!”

“Is that e?”

8

“Three times three times three...”

“I’m starting to think that it’s H.”

“Because that’s the only one that goes into double digits.”

“Why?”

“Sounds good.”

27

“Now why would it be J?”

“Because it’s....”

WHOLE CLASS DISCUSSION

Mrs. DeJesus brings the class together to discuss the ways they solved the problem.

“We had made a chart with edge and volume equaled up to it. Can I make the chart?”

James goes up front to show the class his group’s chart on the overhead.
Mrs. DeJesús: Why is it a good idea to make a chart like this?

"So you can match it up with the graph?"

The discussion continues with other students pointing out ideas and Mrs. DeJesús explaining a bit more about showing your work on the Math 8 exam.

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**JOURNAL**

Mrs. DeJesús: OK, now I want you to take a minute and think about how well your group worked together. Think about those scripts. How did your group fit with dedication, helping, active listening, and authority?

Students write on the back of their paper.

| We were all putting our ideas together. We were brainstorming each other's idea. | Our group was dedicated to getting the work done. We helped each other get the answers. Cindy helped us get on the right track. We were all the authority, we all told each other to get on track. | Everybody participated: we stayed on task — most of the time, And we agreed, but didn't let Authority take over us. | I think that our group was doing OK & got off topic sometimes & we needed a teacher to get us started we worked it out & talked about it. |

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**SMALL GROUP DISCUSSION**

Mrs. DeJesús: Now talk together about whether or not your group worked together.

| | “I think we did pretty good. I said everybody participated. We stayed on task most of the time and we agreed but we |
Mrs. DeJesus: I have another paper you're going to work on. Again, this is for the whole group, not just for an individual.

This problem is one in which your parents have given you $100 for new spring clothes. You have to come up with all the combinations of pairs ($20) and shirts ($10), then graph it.

"There's like a million combinations, though!"

"I had the same ideas."

"Whatever."

"And we got the right answer."

"We all did... we brainstormed each other's ideas. Stuff like that, OK, Vicki, your turn.

"We did good together."

"Sometimes then you started and then you did it."
<table>
<thead>
<tr>
<th>Mrs. De Jesús: “Are there? Get started and let’s see.”</th>
<th>“This is hard.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vicki laughs at James’ antics.</td>
<td>“Five pants.”</td>
</tr>
<tr>
<td>Mrs. De Jesús warns James that this is a permanent tape if he wants her to play it for everyone.</td>
<td>“Four pants.”</td>
</tr>
<tr>
<td>James starts talking about other songs.</td>
<td>“We have to graph this, too.”</td>
</tr>
<tr>
<td>“I love that song.”</td>
<td>“What else is there?”</td>
</tr>
<tr>
<td>“You have the CD, too?”</td>
<td>“Oh, yeah, that song.”</td>
</tr>
<tr>
<td>James sings.</td>
<td>“No, but I know what he’s talking about.”</td>
</tr>
<tr>
<td>Rick joins in.</td>
<td>“Let’s see, what else is there that we can do?”</td>
</tr>
<tr>
<td>“Do you put pants on the bottom (of the graph)?”</td>
<td>“What about two pants?”</td>
</tr>
<tr>
<td>James continues to sing.</td>
<td>“OK, you can stop now so we can continue our work.”</td>
</tr>
<tr>
<td>“This is five or six, something like that.”</td>
<td></td>
</tr>
<tr>
<td>The group discusses the</td>
<td></td>
</tr>
</tbody>
</table>
Mrs. DeJesus: "Did you get all the combinations?

Mrs. DeJesus: "Where are you going to put shirts and pants?"

Mrs. DeJesus: "She's quite an intelligent girl."

Mrs. DeJesus: "What do you guys think—does it matter?"

Mrs. DeJesus: "What do you think the number of shirts you can buy depend on how many pants you buy or vice versa?"

Mrs. DeJesus: "Which is dependent on which?"

Mr. DeJesus: "Both."

Well, I would say shirts are the dependent because you can't buy all numbers of pants. Because if you buy more pants, you have to see how many shirts you can buy because pants cost more.

"Put it here because there's more room."

"Yeah, Cindy's the authority."

Rick explains that Cindy got most of them.

"Put it here because there's more room."

"We're putting shirts on the bottom."

"Shirts and pants...ten shirts...zero pants...ten pants...zero"

James starts with a new song. "Cindy's"
smiling...funny like...

Begins a new rap song.

“Now, I did it that way...the wrong way.”

“Now it’s all messed up.”

“How are we supposed to graph this?”

“Oh, OK.”

“I did it wrong.”

“Again?”

“That’s how mine came out.”

“Which way are we going to do the line? Are we going to do the line this way?”

“It doesn’t matter.”

“Like this, you go over here for ten shirts and don’t go up for zero pants.”

Mrs. DeJesus asks the group to come up with an equation.

Mrs. DeJesus: “But the money is always what?”

She comes back a bit later to prompt them on working in the price of each thing.

“Is this messed up or is it OK?”

“Should we use m for money?”

“$100.”
"We need $100 equals..."

"Why don’t we say $100 equals then something with ten and twenty."

"We have to multiply by ten and twenty."

The group loses focus and Mrs. DeJesus comes back in a few minutes to prompt them to put what they’ve been doing in their heads down on paper.

"But, there’s lots of combinations."

"Let’s choose four and two."

Rick starts talking about how cold it is in science class.

"Anyways, back to the equation...I think we should choose something like four and two..."

Mrs. DeJesus comes over and prompts them...

"WHOLE CLASS DISCUSSION"

Mrs. DeJesus leads the whole class in a discussion.

Cindy participates in this discussion – one of the few times she has.

"JOURNAL"
Mrs. DeJesus: Before you put this away in your folder, please write what worked and what was a stumbling block for your group’s process.

| We worked well together most of the time and at time we were distracted. | Our group was able to work together because we all had good ideas and we almost got the work done. | We worked well together, we all figured most of it out. | Our group worked together good & we got off topic sometimes but we communicated. |

The groups now work individually in their folders.

This group continues to talk and sing while working on their problems. Cindy joins in teasing Rick.

End of Class.