2016

Searching for Answers When Girls Don't Perform Well: Evaluating Classroom Discourse and Microculture in a Sixth Grade Science Classroom

Lauren E. Schwartz
University of Kentucky, lauren.moorhead@fayette.kyschools.us
Digital Object Identifier: http://dx.doi.org/10.13023/ETD.2016.056

STUDENT AGREEMENT:

I represent that my thesis or dissertation and abstract are my original work. Proper attribution has been given to all outside sources. I understand that I am solely responsible for obtaining any needed copyright permissions. I have obtained needed written permission statement(s) from the owner(s) of each third-party copyrighted matter to be included in my work, allowing electronic distribution (if such use is not permitted by the fair use doctrine) which will be submitted to UKnowledge as Additional File.

I hereby grant to The University of Kentucky and its agents the irrevocable, non-exclusive, and royalty-free license to archive and make accessible my work in whole or in part in all forms of media, now or hereafter known. I agree that the document mentioned above may be made available immediately for worldwide access unless an embargo applies.

I retain all other ownership rights to the copyright of my work. I also retain the right to use in future works (such as articles or books) all or part of my work. I understand that I am free to register the copyright to my work.

REVIEW, APPROVAL AND ACCEPTANCE

The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Director of Graduate Studies (DGS), on behalf of the program; we verify that this is the final, approved version of the student's thesis including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Lauren E. Schwartz, Student

Dr. Jennifer Wilhelm, Major Professor

Dr. Molly Fisher, Director of Graduate Studies

SEARCHING FOR ANSWERS WHEN GIRLS DON'T PERFORM WELL: EVALUATING CLASSROOM DISCOURSE AND MICROCULTURE IN A SIXTH GRADE SCIENCE CLASSROOM

THESIS

A thesis submitting in partial fulfillment of the
requirements for the degree of Masters of Science in the
College of Education
at the University of Kentucky

By

Lauren E. Schwartz

Lexington, Kentucky

2016

ABSTRACT OF THESIS

SEARCHING FOR ANSWERS WHEN GIRLS DON'T PERFORM WELL: EVALUATING CLASSROOM DISCOURSE AND MICROCULTURE IN A SIXTH GRADE SCIENCE CLASSROOM

This action research project examines the role classroom culture and discourse can play on student learning, with a focus on female students. A sixth grade science classroom was evaluated through analysis of two videotaped astronomy lessons. The classroom environment utilized qualitative methods to examine teacher and student interactions, student and student interactions, and classroom environment. The research project began in response to a previous research project which found that after completing an astronomy unit male students not only out preformed female students, but female students lost gains in several area. Findings suggested that there may be a connection between the classroom discourse and microculture and the girls' low performance.

KEYWORDS: Discourse, Microculture, Girls in Science

Lauren E. Schwartz

April 11, 2016

SEARCHING FOR ANSWERS WHEN GIRLS DON'T PERFORM WELL: EVALUATING CLASSROOM DISCOURSE AND MICROCULTURE IN A SIXTH GRADE SCIENCE CLASSROOM

By

Lauren E. Schwartz

Director of Thesis- Dr. Jennifer Wilhelm

Director of Graduate Studies- Dr. Molly Fisher

April 11, 2016

TABLE OF CONTENTS

List of Tables ……..v

List of Figures ……vi

Chapter One: Introduction …… 1
Background……..2
Research Question……...6

Chapter Two: Literature Review ……8
The Role of Discourse……8
Factors Affecting Discourse……9
Microcultures and Classroom Discourse…..…...9
Use of Inquiry……10
Justification……11
Non Verbal Communication……..12
Role of Peers……..12

Chapter Three: Methods……15
Background and Purpose……...15
Ethical Consideration…….18
Context of Study……18
Lesson Overview……...18
Subjects/Population……20
Areas of Evaluation……20
Analysis……..21
Variables……21

Chapter Four: Results……22
Lesson Summaries…….22
Measuring Distances…..…….25
Moon Finale Lesson……...27
Teacher Student Interaction……...27
Data……27
Summary……29
Time Spent…….29
Teacher Initiated Interaction……..30
Student Generated Discourse…….30

Chapter Five: Discussion……...33
Summary……33
Teacher and Student Summary……..34
Student to Student Interaction……35
Limitations…….36

Implications for Future Research……………………………………………………...37

Chapter Six: Conclusion……………………………………………………………………38

Appendix A: ………………………………………………………………………………..40

References: ……………………………………………………………………………...….45

Vita: …………………………………………………………………………………………...49

LIST OF TABLES

Table 1.1, Lessons Implemented………….…………………………………………………3

Table 1.2, Lunar Phase Concept Domains……………………………………………...5

Table 1.3, Pre and Post LPCI Overall Test Results for Students by Gender…………....7

LIST OF FIGURES

Figure 4.1, Interactions between Students and Teachers- First Lesson…………………28

Figure 4.2, Interactions between Students and Teachers- Second Lesson………………28

Introduction

Middle school is widely seen as a difficult time for students (Ryan, Shim, & Makara, 2013; Anderson, Nelson, Peterson, Richardson, Webb, & Young, 2011). In addition to struggling with physical and emotional changes, students are faced with academic challenges as well. These academic challenges often result in lower test scores and lower confidence, with females suffering more than their male counterparts (Ryan et al., 2013). While conventional wisdom might have parents believing that these problems are inevitable, research suggests otherwise with some teachers having success even reaching troubled students (Anderson et al., 2011). It is as a teacher knowing that it is possible to overcome the struggles of the middle school years that I came to this action research project.

This project begins after a previous research project ended. The previous research project involved implementation of an inquiry based, integrated math/science curriculum completed in conjunction with a local university. This was the second year that my class and I had participated in the research; my other colleagues had participated for three years prior. Students took pre and post assessments as a part of the unit to measure their growth and it is these assessments that led to this action research project. On the post assessments, I found that not only had my students not made gains in some areas, but more concerning was that my female students lost ground in three areas in which their male counterparts made gains. The knowledge that these declines were not an inevitable part of middle school led me to investigate what could have caused my female students to decline in spite of male growth. However, to understand my research, first a thorough explanation of the research that preceded it must be provided.

Background

The previous research centers around an astronomy unit, with a focus on the Moon and night sky. During the unit, students completed set lessons, which investigated Moon and sky features. The unit contained eight lessons and three projects, all summarized in Table 1. The three projects used in this unit were of special importance as they asked students to engage in a level of problem solving many had not yet encountered in their schooling. The first, called the “Moon Hoax Project”, had students refute claims that the Moon landing was faked. After watching a video that questioned the validity of the 1969 Moon landing, students made a list of the “proof” provided and created models that debunked the skeptics’ evidence from the video. Many students struggled with this project as they had never created a model to answer a question before, and unlike the other lessons in this unit, this was the first year this project had been added.

Shortly after the Moon Hoax Project, students began a project in which they took observations of the Moon and the night sky. After completing two lesson designed to get them interested in the moon’s changing shape and developing the means to take measurements of altitude and azimuth, students began a month long project in which they recorded moon and sky observation in their “Moon Journal”. Each night for a month (weather permitting) students were instructed to go outside at the same time, record the altitude, azimuth, draw a picture of the moon and describe the scene in at least three sentences. Students were encouraged to make daily predictions and make inferences about the data they were collecting. However, getting students to collect all of the data was very difficult. Some students simply struggled with remembering to get the assignment done and others struggled because it was winter and the weather often left the

Table 1.1. *Lessons Implemented*

Lesson 1	*Moon Hoax* – After watching a video in which skeptic's listed off many sources of evidence that the moon landing was a fake, students each chose one of the skeptics claims to disprove. Students supported their answer by creating a model to debunk the skeptic. *Can I see the Moon every night and why does it appear to change shape?* - Students listen to the story, "Many Moons" and discuss the size, distance, and composition of the Moon as a group.
Lesson 2	*How do I measure the distance between objects in the sky?* - Students learn to measure the distance between objects in the sky using their fists. They also use this method for estimating the position of the Moon in the sky. *Moon Journals* - Students keep daily Moon observation journals for 5 weeks. Each day, students record the position (azimuth and altitude angle) of the Moon, sketch the shape of the Moon, and look for patterns in the appearance and position of the Moon.
Lesson 3	*How can I say where I am on the Earth?* - Students explore the concepts of latitude and longitude, including discussing where these angles come from and also how our position on the Earth affects where we see the Sun in the sky.
Lesson 4	*How can I locate things in the sky?* - Students use a sky map to locate stars, planets, and constellations in the sky. They draw each of these as they see them, then students measure the angular distance between stars in the sky.
Lesson 5	*What are the global features of the Moon?* - Students observe the major features of the Moon.
Lesson 6	*What can we learn by examining the Moon's surface?* - Students compare photos of the highlands and the mare on the Moon to determine the relative age of each, the crater density in each area, and to make an inference about what the early Solar System was like.
Lesson 7	*What affects a crater's size?* - Students brainstorm variables that affect a crater's size and then investigate one of these variables by making craters of their own. This lesson includes a discussion of independent and dependent variables and also graphing.
Lesson 8	*The scaling Earth/Moon/Mars NASA Activity* - Students use ratio and proportion concepts to better comprehend the size of the Universe by building a scale model of the Earth, Moon, and Mars using balloons. *Moon Finale* -Students use foam balls and a light to discover the Earth/Moon/Sun geometries necessary to produce the phases of the Moon. Students are asked to refer to their Moon Observation Journals to check whether their geometry matches what was observed in nature.

Note. Adapted from "Mathematical Classroom Discourse in Three Middle Level Science Classrooms by J. Wilhelm, M. Cole, R. Pardee, and S. Cameron, 2015, *Proceedings of the 35th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, " (p. 107). East Lansing, MI: Michigan State University: PME.

sky obscured. Many students had to rely on computer programs for the data needed in their journals. Each day we as a class went over the data collected and made sure everyone had access to correct information. The students' data was used in their final project, "The Moon Finale".

The Moon Finale asked students to determine what caused the phases of the Moon. Students used Styrofoam balls, one for the Moon and one for the Earth, to create Moon phases. Using a desk lamp as the Sun, they had to create each phase of the moon from the perspective of the people on the Earth and used their Moon Journals as guide, checking to make sure that the geometry they observed and recorded in real life matched their model. The students demonstrated both three-dimensional and two-dimensional spatial understanding through their models as well as their sketches of the Sun/Earth/Moon system.

Students completed the Lunar Phase Concept Inventory (LCPI) as a pre and posttest to determine growth during the unit. The LCPI is a multiple-choice assessment that is used to measure student understanding of lunar phase content by evaluating students' skill levels in mental modeling of the Moon phases, time of lunar cycles, direction of the Moon's orbit and the cause of the Moon's phases (Wilhelm, 2009). The LCPI organizes these concepts into eight domains (summarized in Table 2). According to Wilhelm (2009), implicit within the eight domains, were four necessary mathematical concepts: *periodic patterns, cardinal directions, geometric spatial visualization* and *spatial projection*. *Periodic patterns* required students to predict repeated patterns in the Earth/Moon/Sun system. *Cardinal directions* required that students determine an object's direction using north, south, east and west. *Geometric spatial visualization*

Table 1.2. *Lunar Phase Concept Domains*

	Scientific domain	Question topic	Mathematical domain
A	Periodicity of Moon's Earthly orbit	Time to complete one orbit	Periodic patterns
B	Periodicity of Moon's phases	Time between phases (i.e., time between full and first quarter Moon)	Periodic patterns
C	Moon's orbit direction around Earth as viewed from space	Direction of orbit above the North Pole	Geometric spatial visualization, spatial projection
D	Moon Motion	Direction of Moon rise and Moon set	Cardinal directions
E	Phase and Earth/Moon/Sun positions	Alignment to produce various phases such as waxing crescent	Geometric spatial visualization
F	Phase- sky location-time	Time at which various Moon phases rise and set	Cardinal directions
G	Cause of phases	Explanation of why the Moon's appearance changes over time	Geometric spatial visualization
H	Effect of lunar phase with change in Earthly location	How does the Moon's appearance change when view around the world on the same day	Spatial projection

Note. Reprinted from "Gender Differences in Lunar-related Scientific and Mathematical Understandings", by J. Wilhelm, 2009, *International Journal of Science Education, 31*(15), p. 1107.

involved students visualizing the Moon/Earth/Sun system from different perspectives on the Moon/Earth/Sun plane such as above, below and on the plane. *Spatial projection* asked students to imagine the image from another perspective by projecting oneself into a different location. While all four domains are mathematical in nature, both *geometric spatial visualization* and *spatial projection utilize* the act of mental rotation, which has a mental spatial component.

The results of the LCPI found that in only two of these domains, did my students make significant gains (indicated by an asterisk in Table 3). Male students made significant gains in a third area. While this was off putting, much more concerning was the data from my female students. Not only did my female students fail to make gains in three areas: Moon motion, phase and Earth/Moon/Sun positions and phase-sky location-time, they actually lost gains on all of these areas compared to male students, who made gains (as indicated by italics in Table 3).

Research Question

It is the concerning information about my female students that lead to my research question: How could classroom discourse be affecting my female students differently than my male students? This action research study stems from my desire to improve the quality of my teaching practice for all of my students, but especially my female students who are not learning at the same rate as the males in my classroom. This project focused on an evaluation of my teaching through two videotaped lessons provided by the previous research project. I analyzed the lessons for patterns in classroom discourse: teacher-to-student behavior and student-to-student behavior, in an attempt to determine how these features may have affected the classroom discourse and led to an academic decline in my female students.

Table 1.3. *Pre and post LPCI overall test results for all students by gender*

		Total *n*=37			Male *n* = 18			Female *n*=19		
		Pre	Post	Gain	Pre	Post	Gain	Pre	Post	Gain
A	Periodicity of Moon's Earthly orbit	24.0	55.0	31.0*	28.0	50.0	22.0*	21.0	61.0	40.0*
B	Periodicity of Moon's phases	43.0	55.0	12.0	33.0	51.6	18.6	53.0	58.0	5.0
C	Moon's orbit direction around Earth as viewed from space	55.0	81.1	25.9*	47.0	75.0	28.0*	63.0	86.8	23.2*
D	*Moon Motion*	*34.0*	*43.0*	*9.0*	*25.0*	*56.0*	***31.0****	*42.0*	*32.0*	***-10.0***
E	*Phase and Earth/Moon/ Sun positions*	*27.9*	*33.3*	*5.4*	*24.1*	*35.2*	***11.1***	*31.6*	*33.3*	***-1.7***
F	Phase- sky location-time	17.1	13.5	3.4	14.8	13.0	-1.8	19.3	14.0	-5.3
G	Cause of phases	21.6	22.0	0 .4	16.7	17.0	0.3	26.3	26.0	-0.3
H	*Effect of lunar phase with change in Earthly location*	*26.0*	*23.0*	*-3.0*	*19.0*	*25.0*	***6.0***	*32.0*	*21.1*	***-10.9***

Literature Review

The Role of Discourse in the Classroom

Classrooms are more than designed lessons; they are interactions between all parties in the classroom. This discourse of interaction references a variety of features that exist while education is taking place. For the purposes of this paper, discourse was defined by Gee's (2001) definition, "Discourse integrates ways of talking, listening, writing, reading, acting and interacting, believing, valuing and feeling (and using various objects, symbols, images, tools and technologies) in the service of enacting meaningfully socially situated identities and activities," (Gee, 2001, p.719).

The way a student engages in discourse, creates the cultural model in which that student's behavior is shaped (Gee, 2001). Cultural models, what a person accepts to be normal or shared beliefs about what is valuable based on experiences and cultural context, can be very powerful (Stone & Veth, 2008; Crafter, 2011). Cultural models influence a student's efficacy, the belief that they can or can't do something. In one context a student may create a cultural model in which they cannot read- they cannot decode all of the letters in a sentence and understand each word. That same child in the same situation may create a different cultural context that they can read- they can look at a picture next to a sentence and combine that with what they know about punctuation and some words and create a sentence (Gee, 2001). As these cultural models are a summation of experiences, many external factors (discourse) can affect students' cultural models such as parents' opinions and experiences with education as well as students' interactions with the media (Stone & Veth, 2008; Crafter, 2011). In conclusion, the cultural model depends on the discourse, therefore the discourse shapes which model the student uses.

Factors Affecting Discourse

Discourse clearly is an important factor affecting the classroom. Upon reviewing the videotaped lesson of my classroom, I decided to investigate some specific areas of discourse to determine what role they may have played in affecting my female students. Two key areas investigated were microculture and peer relationships. Microcultures affect the way the instruction was delivered and may have affected female students differently than males. In addition, peer relationships could have also affected the discourse of the classroom. Peer relationships can have both positive and negative effects on learning depending on the behavior of the group. While group work in general is can be beneficial to student learning, lower structured setting can lead to toxic discourse especially as many female students may not see their actions as negative.

Microculture and classroom discourse. Microcultures exist in the classroom as groups of people who share many of the same qualities of the larger group (e.g. values, behaviors and history), but differ in some way. These groups often have something, such as a shared language that bonds the microculture together (Neuliep, 2012). Outside of typical microcultures organized by ethnicity or socio economic status, a teacher creates a microculture in his or her classroom by his or her discourse. Enyedy and Goldberg (2004) found in their study of two middle school science teachers teaching a similar unit, the way the teachers adjusted the unit to fit their teaching style impacted what the students did learn. While the researchers were quick to point out that this did not mean that there was a right way and a wrong way to teach, each teacher must balance his or her style with the needs of the class, it did provide evidence that changes in classroom discourse affect student learning. In addition, Squire, MaKinster, Barnett, Luehmann, and Barab (2002), found similar findings in a case study of four teachers teaching a similar science unit. The researchers concluded that the best learning context was when teachers adjusted the curriculum and style to the microculture of the classroom. They concluded a learning context contains more than the curriculum and teacher interactions, it contains the "subjects, tolls, objects, rules, norms, division of labor, etc." (Squire et al., 2002, p.846).

One such way to adjust a lesson is through classroom conversation using inquiry, justification, non-verbal interactions and c. The way a teacher addresses the classroom, whether through traditional means of asking questions and waiting for answers compared to other methods of eliciting a classroom discussion, can affect students' cognitive growth with more inquiry based lessons improving learning (Smart & Marshall, 2012; Zangori, Forbes & Biggers, 2013).

Use of inquiry. Within the research two themes appear in the discourse of successful teachers, the first of which is integrating inquiry into the interaction. According to Zangori, Forbes and Biggers (2013), the act of inquiry is the act of asking why or how and is not being utilized by educator's design of lessons. After decades of teaching focused on memorization, science education is slowly transitioning from rote practice to a focus on understanding and the natural processes of science (Dushl & Osborne, 2002), and at the root of this transition is inquiry. Hall and Sampson (2009) claimed that teachers make "inquiry through questioning" a key piece of the discourse in their classrooms citing that, "an activity designed in this manner can help students understand difficult science concepts. It can also help students develop complex-reasoning and critical-thinking skills, understand the nature and development of scientific knowledge, and improve their communication skills," (Hall & Sampson 2009, p. 21). In the Hall and Sampson study, students were given the task to create models of the Earth/moon/sun system to illustrate the lunar phase phenomena. When doing this modeling, the teachers questioned students to help students further explore the inquiry process. This same style of "support" questioning, (questions asked of students to challenge their understanding and lead them to the correct answer) is reinforced by Smart and Marshall (2012), who identify a key component of questioning is eliciting a student thought. This kind of discourse between teachers and students creates an opportunity for a positive cultural model. Students are supported to create a cultural model in which even if the material is difficult or they struggle the first time, they are still successful and competent science students.

Justification. Another key area is justification. Justification is at the core of science but has not always been at the core of science teaching (Duschl & Osborne, 2002). When students create answers without the challenge of argument, they may gain some knowledge, but they are missing one of the key components of science research- ideas are assumed true until refuted. In addition to teaching students the methods of science, as teachers increase the amount of justification and challenge in their classroom discourse, cognition levels increase (Smart & Marshall, 2012; Hall & Sampson, 2007). Additional support is provided by Duschl and Osborne (2002) recommending that students justify their claims even after they have been challenged and students use science theory as well as challenge misconceptions in their responses, something that is often missing in classroom teaching (Zangori, 2013).

Non-verbal communication. In addition to verbal communication, non-verbal communication is also a part of the classroom discourse. Non-verbal communication is any method in which a teacher communicates that is not using words: gestures, tone, and eye contact. Non-verbal communication has been shown to have a significant impact on students in a classroom, with studies showing that children even as young as Kindergarten affected by their teacher's non-verbal attributes (Chaudhry & Arif, 2012). Chaudhry and Arif's (2012) study of ninety science secondary teachers in both public and private schools, found that teachers who engaged in a higher number positive non-verbal behaviors has students who achieved higher cognitive growth, highlighting again the role discourse plays in success of students.

The role of peers. The role of peers is instrumental in the execution of positive discourse in the classroom. Not only do peers model their behavior after their classmates, but peers play an important role in challenging the work of their classmates. One way that peers are a part of the classroom discourse is through group work. Peers can have a positive effect on group work when it is designed correctly. First, group work must truly be group work. If a group is centered on a situation in which one student can complete the assignment, then the opportunity for argument and discussion is lost lessening the value of the activity (Duschl & Osborne, 2002). In addition, students must participate as audience members in presentations. In the same way that the students challenge the findings of their peers in group work, they must challenge their peers in their presentations leading to stronger cognitive results (Smart & Marshall; Duschl & Osborne, 2002).

However, not all peer relationships are beneficial to classroom discourse. Relational aggression, a form of bullying using peer relationships and behavior to hurt someone else, are common in middle schools with girls suffering more than boys (Crain, Finch, & Foster, 2005). Relational aggression can take many forms such as, ignoring, creating gossip, purposeful exclusion, all to hurt one party. While for many years this type of bullying was considered less serious that more overt and aggressive types, research has shown that is not always the case where relational aggression can lead to peer rejection, loneliness, depression and isolation (Henry, 2012). This form of aggression, while more commonly seen outside of the classroom where students are more likely to have free interaction, can also exist within the classroom as well. In their study of five primary classrooms (grades 1-3) and three junior classrooms (grades 4-6), Atlas and Pepler (1998) looked at bullying in the classroom. While they did not focus strictly on relational aggression (or indirect bullying as it was referred to in this article), they found that female students were much more likely to engage in indirect bullying than their male peers. In addition, female students were less likely to see their actions as bullying. Further, they found that while both males and females equally bullied each other, female students were less likely to stand up and help against a bully than males. Finally, they found that within the classroom setting, incidents of bullying were most likely to happen in situations in which the teacher was not giving direct instruction and students were working in a lower structured environment. These factors fit with classroom setting evaluated in this paper. The students were in a low structured setting, female students may not have created an intimidating environment without identifying it, and it is unlikely if a student did feel intimidated that she would stand up and try to correct the situation.

The Curriculum

The curriculum used in this project was the REAL (Realistic Explorations in Astronomical Learning) curriculum (Wilhelm, 2009). As mentioned in the introduction it is an integrated math/science curriculum focusing developing an understanding of the causes of the moon phases and other night sky phenomenon with an inquiry focus. In addition to inquiry based lessons (summarized in Table 1) student completed a "moon journal" in which they monitored the shape and location of the moon each night for one full lunar cycle. Students use these journals to help them to understand the geometry of the Earth/Moon/Sun system. While engaging with these concepts, students used spatial-mathematical skills to determine the correct locations of the Earth, Moon and Sun. Students were evaluated in eight areas (summarized in Table 2.)

Wilhelm's previous research, using the same LCPI given to my students, showed that males and females made similar significant gains in four areas: *A- Period of the Moon's orbit around Earth, B- Period of Moon's cycle of phases, C- Direction of the Moon's orbit around Earth,* and *G- Cause of lunar phases.* Neither group made significant gains in domains *F- Phase-location in sky/time of observation* and *H- Effect of lunar phase with change in Earth location.* The biggest gender gap was found in domain E- Phase and Sun/Earth/Moon positions. Wilhelm previously hypothesized that spatial reasoning, which research has shown to be stronger in males (Voyer, Voyer and Bryden, 1995), to account for some of the discrepancies in areas where male students out performed female students, especially in domain E which had a strong spatial component. In her research within domain E, male students had a forty-five percent gain while females only had a twenty-seven percent gain.

Many of the domains in the REAL curriculum had spatial features, (see Table 2 for a complete list). At first, this made looking for a spatial connection for the discrepancy between my male and female students. However, unlike Wilhelm, my male and female students had their largest discrepancy in an area that wasn't linked to spatial development- domain D. In addition, spatial does not seem like the culprit for why my female students lost gains in three in areas in which my male students did not. It is because of these questions that I did not focus on spatial reasoning as a possible cause for the discrepancies and instead focused on discourse as a more probable cause.

Methods

Background and Purpose

As a teacher, not only do I want all of my students to succeed academically in science, I also want them to engage with it. This desire contrasted with the data I received comparing my female students to my male students following the previously described astronomy unit. In analyzing the post data, in only two of the eight areas did males and females both make significant gains, (males made significant gains in one additional area). While not all significant, females and males made similar gains in five of the eight categories. However, the area that was most concerning, was that female students did far worse than male students in three of the eight areas- *D: Motion of the*

Moon (males: 31.0, females: 10.0), *E: Phase and Sun/Moon/Earth Position* (males: 11.0, females: -1.7), and *H: Effect of Lunar Phases with Change in Earth's Location* (males: 6.0, females -10.9) - not only scoring poorly, but also showing negative growth. (See Table 3 for complete list.)

To evaluate the possible cause of this discrepancy, two videotaped lessons were evaluated- one from the beginning of the unit and one from the end. Within the lessons, different positive, neutral and negative examples of discourse between the teacher and students as well as students and students were evaluated to determine if there was a difference in the way male students were experiencing class as compared to female students and if that could account for the low growth being shown by female students.

This study was qualitative in nature and because of the emic- etic nature of this project, attention was taken to prevent data contamination according to the guidelines of Gough and Scott (2000). Data contamination was reduced by not using a value added method, in which certain responses or behaviors were given a hierarchy, such as labeling a response from a teacher as "better" or "worse" than another. Instead the "code and receive" method of documenting incidence was used; previously determined "signifiers" were chosen to determine into which category an item would fit and context was used to determine if a phrase fit a signifier. Multiple categories were used and finally each choice was evaluated and reevaluated to determine its type, for example determining if a response to a student was positive because it fit the criteria of the positive category. Student and teacher behavior was logged and categorized through a scale system, which scored all student comments and interactions as positive, negative or neutral interaction. Examples of each type of interaction are as follows: "Don't give up!" was labeled positive.

Listening to a student and nodding without smiling, was labeled as a neutral reactions. Scolding a student, "Don't touch that!" was labeled as a negative. In addition to teacher-student discourse, comparisons between male groups and female groups were made based on amount of time spent with teacher and number of teacher initiated interactions. Finally, discourse was evaluated between students themselves and evaluated based on the tone of the conversation.

The study took place during a sixth grade astronomy unit. The students involved did not have any previous experience in astronomy in a classroom setting, but some had followed interests and learned information on their own outside of the classroom. As the coordinator of this research project, I am both researcher and subject in this assignment. I have been teaching at this middle school for seven years, the last four of which have been in sixth grade. I have an undergraduate degree in education, and am currently seeking a master's degree. At no point during the project did I realize that I would be evaluating myself as a teacher. The lessons were taped as a way to assess my students' understandings, as were the pre and post tests given, to aid another researcher. It is only after the data was returned that I considered investigating myself. This lack of evaluative awareness gives a true portrayal of what happened in the classroom as it was not tainted by knowledge of this research study. The research study emerged months after the actual implementation of the curriculum. At the time of the videotaped Moon Finale lesson (the second lesson videotaped), I had decided to make two groups, one all-female and one all male. This was done to aid my classroom management. I believed at that time that I would need to stay with the boys group longer because they were more likely to "get into trouble", for example throwing the Styrofoam balls.

Ethical Considerations

When working with children, it is important their rights are protected and that their wellbeing is at the core of the project. In this case, students were attending class just as they would if they were not in the study. There were no differences in the education of the students participating in the project and those sixth grade students who were not participating. The only physical discomforts students may have faced were the discomforts associated knowing the lessons were being videotaped.

Context of the Study

A sixth grade classroom in a public, suburban, middle school (grades 6-8) was the subject of this study. The middle school was in a middle class neighborhood where 34% of students qualified for free and reduced lunch. Seventy-seven percent of students were White, seven percent were African-American, six percent were Hispanic, six percent were Asian and three percent identified as other. Students attended science for seventy minutes a day and had been attending class with the same students for five months prior to the study. The school had been undergoing a renovation project, when meant that the students began the astronomy unit in a portable classroom outside of the main school and were moved into the main building two months after the unit had begun. In addition, during the unit it was winter and the city was experiencing greater than normal snow fall leading to high number of snow days which broke up the lesson continuity.

Lesson Overview. The two lessons that served as the focus for this research were at the beginning and the end of this unit. The first lesson, known as Measuring Distances, the second lesson in the unit, asked students to determine distances between objects in the sky (see Table 1 for a description and Appendix A for the worksheet students used). In the videotaped lessons, students were completing an experiment to determine general distances using their arm and fist. In addition, students determined the amount of degrees their fist could represent by making a complete circle around themselves and dividing by 360 degrees. This information would be used later so that students can use their fist to determine distances between objects in the night sky. When the students finished, they worked on questions found on their worksheets (Appendix A). The majority of the questions asked students to graph their findings. Students could ask for help by either raising their hand or approaching the teacher. The teacher also checked on students, unsolicited. The students were grouped based on their typical seating chart. The student seating arraignment was based on who worked well with whom and was not changed for this unit.

In the second videotaped lesson, known as the "Moon Finale" (see table 1), the last lesson in the unit, students were trying to create phases of the moon using Styrofoam balls as models. They began the project by trying to determine the rotation of the Earth on its axis using logic, then attempted to determine different phases of the moon and finished by trying figure out which phases of the moon would rise at which times. The majority of the lesson was focused around students attempting to determine the phases of the moon. The students had to "look" from the perspective of the Earth (usually by holding the ball up to their face) and "see" the correct moon phase. Students try many methods from making a shadow to relocating the balls to different locations. Students must stand and wait to be checked by the teacher before they are allowed to move on. There were only two lights for the students to work around. This meant that there could only be two groups. Half of the class could not be videotaped, so they were working in another section of the classroom, which left only a small number, fourteen, of students to remain. Of these students, about half were boys and half were girls. This seemed like an easy way to divide the students up and, as stated earlier, could aid in classroom management.

Subjects/Population. The students in the study represented a cross section of children in the city. The students were not individually selected; they were simply the students enrolled at the school. Forty-four students participated in the study. Thirty-six were white, three were African American, one was Arabic and four were Hispanic. Twenty-two were female and twenty-two were male. The classes were not grouped by ability, therefore each class contained students that were above grade level, on grade level and below grade level. Of the forty-four, thirteen students were in the taped lessons. Of those thirteen, six were female and seven were male. Two students were African American, three were Hispanic, and eight were white. This provided a well-rounded sample, but did not reflect the lack of diversity in the school.

Areas of Evaluation. Four areas of discourse interaction were evaluated. The first area was interactions between teacher and students. Each interaction was categorized as either positive, negative or neutral. In addition to evaluating student-teacher verbal and non-verbal interactions, three areas of other areas of discourse were evaluated. The amount of student-teacher time was compared between boys and girls groups during group work time as well as the total number of interactions between the teacher and male students and female students. Assumedly, the amount of time students spent with the teacher sends a message about the importance of each group to the teacher and could be a source of negative discourse. Another area of evaluation was teacher-initiated interaction with students, looking at how and when the teacher checked in on students. The final category of discourse was discourse between students themselves. Initially this was not part of the analysis, however when watching the videos the conversations between students without the teacher present, were starkly different between boys and girls. Although this may not seem like a direct indicator of student-teacher discourse, it may show the way girls perceived the class discourse from the classroom environment.

Analysis

Variables. The primary variable in this evaluation was behavior differences between male and female students during the astronomy unit. Behavior was defined as any verbal or non-verbal interaction between two people in the classroom. Behaviors were evaluated by type, number and tone. Type reflected whether a behavior was initiated by a student or the teacher. Number reflected the total number of interactions between the teacher and male students compared with female students. Tone reflected whether an interaction was positive, negative or neutral. Interaction between teacher and student was logged and categorized on three levels. While discourse is not limited to verbal communications, in this case all interactions caught on film contained some verbal element. Both non-verbal and verbal discourse was included in the rating scale developed. Positive discourse was identified as interactions that contained positivity and/or gentleness. Examples include, the teacher giving the student a compliment, smiling while listening or talking to a student, and working one-on-one with a student. The label of one-on-one as a positive was debated as it did not always come across with a clear temperament, but by its nature- seeking out a student who needed assistance and helping that students—coupled with the gentle nature placed it into the positive category. Negative interactions were labeled as any interaction that had a blunt or cold tone and/or were corrective. Examples include, the teacher telling a student to be quiet or to stop a behavior. Initially, the scale only had two categories, positive and negative. However upon starting the analysis, it became apparent that a third category was needed, a neutral category. Neutral was defined as using a frank tone and containing neither positive nor negative elements. Examples include: the teacher nodding in response to a student, but not smiling or agreeing with a student.

Time was simply measured from the moment the teacher arrived to help a group until the time the teacher left. Time comparisons were only done when the teacher was working with groups, and on this occasion the groups were organized by gender. Teacher initiated interaction was defined as any instance in which the teacher chose a group or a student to help without solicitation or if more than one group or person was vying for attention and the teacher had to choose between two groups or people of equal need.

Results

Lesson Summaries

Measuring Distances. The purpose of this lesson was to help students learn that their fist, with arm extended, measures ten degrees in the sky. Students measured how many thumbs it took to cover a specific distance in the room. Students then used data to determine that different sized thumbs yielded different answers. After plotting the points, they realize that there is an inverse relationship between thumb widths and distance. In the next activity students used a piece of string and protractor to determine that the angle of sight between one end of their fist to the other measured ten degrees. Students compared data to see that no matter the size of fist, it was always ten degrees. Students also counted the number of fists it took to make a complete circle around their body and then divided that by 360 degrees. Once they divided they found that each fist was again about ten degrees. The teacher discussed with the students that the reason this works out the same for everyone is that the ratio between arm and fist is about the same for all people. This means that no matter who you are, you can use a fist to represent ten degrees. The students were instructed to use their fist to measure the altitude of objects in the sky, keeping in mind that each fist was ten degrees.

The video began with the teacher (myself) addressing the whole group of students. Students were working on the first two questions of their assignment (see Appendix A.) After students finished, the teacher went over the questions on the worksheet.

> Teacher: What did you get for number one? How do you think people measure distances in the sky? Steve?
>
> Steve: Maybe use telescopes.
>
> Teacher: (Nods.) People use telescopes. Your telescope might have scale inside it. That's true. Tyrone?
>
> Tyrone: (In audible.)
>
> Teacher: OK, you might try to get closer to the object. You might measure something that is traveling speedily. Marco?
>
> Marco: (In audible.)
>
> Teacher: OK good! (Nods.) Like find two stationary objects and find how far it is from each one. Quinn?

> Quin: (In audible.)
>
> Teacher: OK good! (Nods.) We learned that when we were, um, doing our planet projects that they invented a whole system of measurements called astronomical units.

Following the questions, the teacher went over the lesson for the class. Student began to work assumedly on their assignment. Students worked side by side at tables. In the back there were two groups of boys sitting side by side. Further up in the classroom were six visible tables. On the far side of the room, two boys sit together, in front of them a boy and girl sit together and in front of them a boy and girl sit together. The very front table is turned around working with the middle table. Closest to the camera are three rows of one single table. There were two girls at each table, except the front table. The girl in the front table turned to work with the girls at the middle table.

The volume of the room made it difficult to determine exactly what students are saying or doing, but it seemed most students worked the entire time as there was little evidence of off task behavior- throwing things, yelling, laughing, students wandering with no purpose. There was much evidence of on task behavior- when students talked to each other they pointed at their papers and wrote things down, they used rulers for their intended purpose (measuring their arm), and held up their thumbs and appeared to be measuring with them. In addition many students seem to be completing the tasks on the assignment (see Appendix A).

Throughout the entire video, the teacher was walking around the room and squatting next to tables helping students. The first group the teacher visited was a group of two boys. While the boys were working, she scanned the room and then got up and checked on another group of two boys. The teacher moved on to a third group of boys and asked them about a graph pointing to their paper. Quinn raised her hand and the teacher came over and squatted next to the girls. Quinn pointed to her paper, then the teacher pointed at the paper, and then the girls begin writing. The teacher continued walking around the room. Natalie held up her thumbs up and was counting. The teacher circulated the classroom again, helping a group of boys before being called away by a female student.

Moon Finale Lesson. This lesson focuses on students trying to determine why the moon has phases. The beginning of the lesson is teacher driven with students sitting in rows of lab tables. First students describe what kinds of lab behaviors are expected of them. Then they are given their lab supplies, a large Styrofoam Earth and a smaller Styrofoam moon. Each are on a stick and neither the Earth nor the Moon are scale is size relative to each other or in distance. Every student has their own Earth and Moon, which seems to disappoint the students; they complain they wanted to work in pairs. After the supplies are distributed, the teacher began to read off of a PowerPoint slide some questions for students to answer.

Teacher: Is Kentucky in the Northern Hemisphere or the Southern? Marcus?

Marcus: Northern.

Teacher: Good. OK. Is it above the equator or below the equator? Bre?

Bre: (In Audible).

Teacher: Good. I am going to hand out your supplies now.

(Hands out supplies.)

Teacher: Does anyone happen to remember from our scaling lesson how much smaller the moon is than the Earth? David?

David: I remember! I don't remember the number.

Teacher: The moon is about 25% of the Earth.

After the questions, the students being working with their Styrofoam Earth models. They begin by using two points on the Earth (their current location and a point that is east) to figure out what direction the Earth rotates. Students get up and move around two lamps in the back of the room, which serve as the Sun. There is a boys group and a girls group. Then all student must show that they can make their Earth rotate in the correct direction. As the teacher move from group to group to check everyone's project, the students talk amongst themselves. This continues as the teacher asks the students to show day, night, sunrise and sunset for their present locations. Finally, the teacher post a picture of a waxing crescent moon on the PowerPoint and asks the students to replicate that with their Moon and Earth. When the teacher is not present, the groups begin off task chatter. Both groups (the boys group and the girls group) attempt to start the project before getting off task. The boys group seems to not start goofing off until they believe they have the answered the question correctly (even though they are often incorrect), while several in the girls group try then when they are unsuccessful, give up and start talking. Another difference between boys and girls is that the boys seem to engage in true group work as defined by Duschl and Osborne. While they worked independently at first, when member of the group did not understand or complete the task correctly, other boys would step in and try to help. Nothing like this happened in the girls group, which involved students working completely independently if at all. At some point, the teacher works with every student individually to help them get the right answers.

Teacher Student Interactions

Data. Student-teacher interactions were evaluated over the two separate lessons. During each lesson, each statement from a student as well as the reaction from the teacher was logged. In the first lesson, girls had twenty-six interactions with the teacher, while the boys had eighteen. Of the twenty-six interactions, thirteen (50%) were considered positive, seven (27%) were neutral and six (23%) were negative. Of the boys' eighteen interactions, eleven (61%) were considered positive, six (33%) were neutral and one (5%) was negative.

In the second lesson, the girls had forty-five total interactions with the teacher while the boys had forty-three. Of the girl's forty-five, twenty-five (56%) were positive, seventeen (38%) were neutral and three (7%) were negative. Of the boy's forty-three interactions, thirty-two (74%) were positive, nine (21%) were neutral and two (5%) were negative.

Figure 4.1

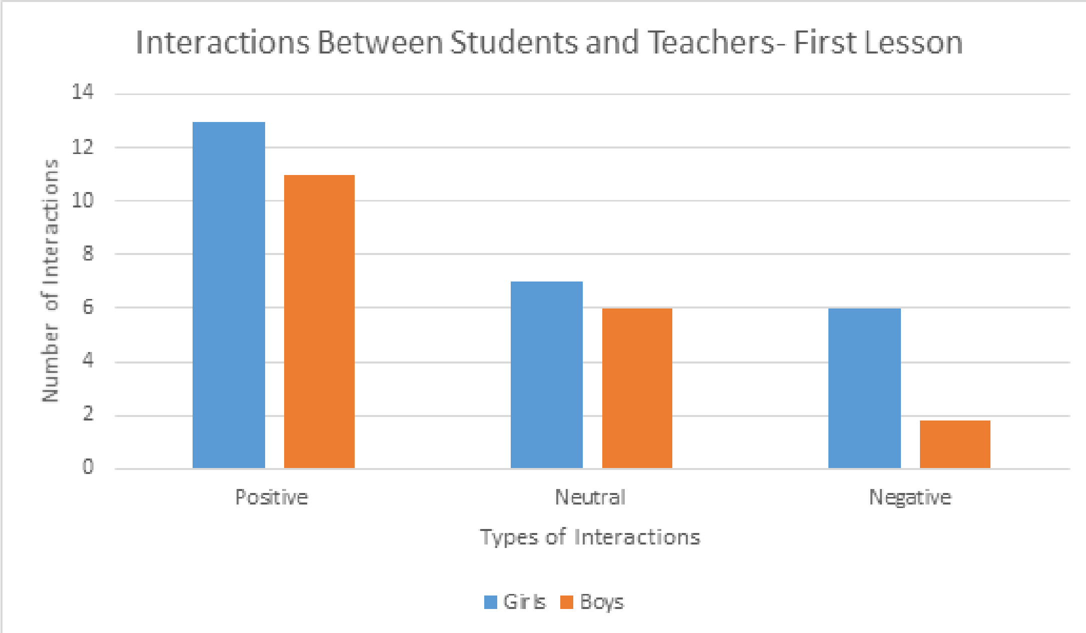


Figure 4.1. Figure 4.1 shows that number of interactions between students and the teacher in the measuring distances lesson. There is no consistent pattern.

Figure 4.2

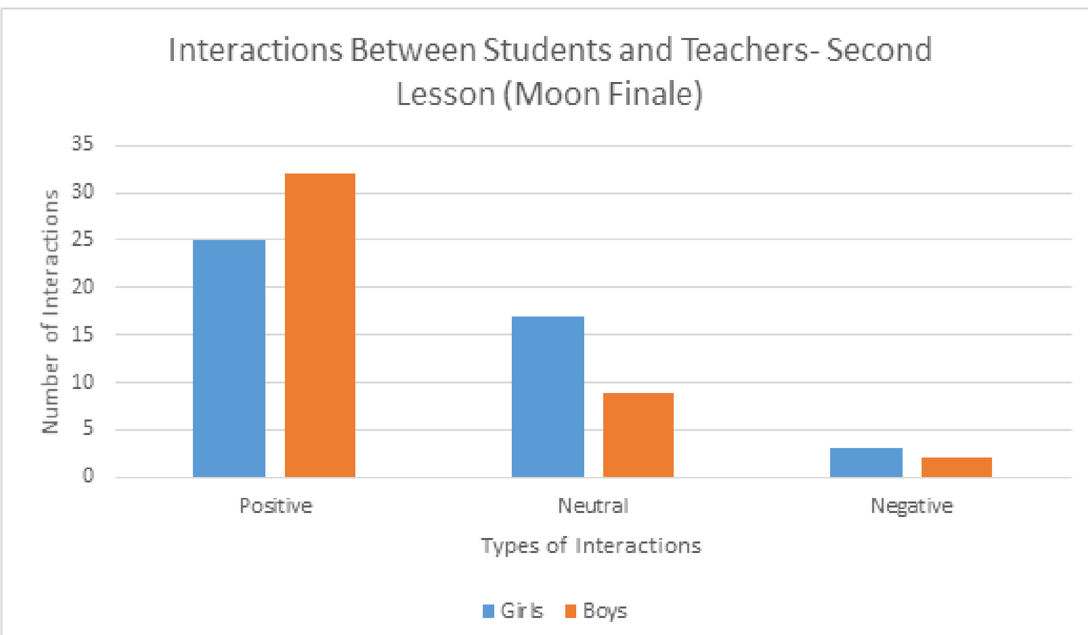


Figure 4.2. Figure 4.2 shows the number of interactions between students and teachers in the second lesson- Moon Finale. The figure show how there is no consistent pattern between teacher and student interaction.

Summary. In the first lesson the girls had more interactions with the teacher, but they had a higher number of positive interactions, but also a higher number of negative interactions. In the second lesson, the total number of interactions was much closer, but the boys continued to have a higher number of positive interactions. However in the case of the second lesson, both the boys and the girls experienced a similar number of negative interactions.

Time Spent

Time spent was only compared in the second lesson. In the first lesson, “Measuring Distances”, students were receiving help upon request and not in groups; they were working as individuals. The interactions were short were classified by number rather than time spent. In the second lesson, “Moon Finale”, students were working in groups making moon phases around a light source. The groups were divided up by gender, thus a girls group and a boys group. Time was measured from the moment the teacher approached the group to the time the teacher left. The teacher spent seven minutes and eight seconds with the boys group and six minutes and six seconds with the girls group, resulting in fairly equal amounts of time with each group.

Teacher Initiated Interaction

Teacher initiated interactions were defined as occasions when the teacher sought out a person or group with which to check in or when two groups were both asking for assistance, it was who the teacher chose to help first. The first lesson started with the students moving around the room taking measurement, but after the measurements were taken the students returned to their desks to work on the questions. The teacher sits at the front of the room and the students approach her. After a few minutes of students approaching, the teacher calls two boys up to her to get some help, an example of an unsolicited help request. The students return to working. The teacher walks around and sits next to a group of boys. The teacher was seated next to a boy and is pointing to his paper. What she is saying is impossible to hear, but she is pointing to his paper. When he starts to write, she scans the room looking at the other students. While working, the teacher visited boys three times to give them unsolicited help on their papers, but only visited one girl for the same kind of help. In the second lesson, the teacher gave no unsolicited help in the beginning of the lesson, which was teacher directed questions. However, when students were working in two groups (one boy and one girl group), the teacher consistently went to help the boys group first after each directive was given. Although some of this may have been following a pattern, there were at least two opportunities to change the pattern. The first was when the group activity began, the teacher could have visited the girls first and the second is when students were released to do individual work. During this second time, even though a female student asked to be checked first, the teacher lingered with the boys group for an additional minute before heading over to check the girl.

Student Generated Discourse

Student generated discourse was defined as interactions caught on camera between students without the teacher present. The only data available was from the second lesson as students were grouped by gender and close to the camera. In addition, the teacher was moving from group to group affording students several minutes of down time to talk out of ear shot. Both groups engaged in off task behaviors, but the tone in each group was different. In the boys group off task behavior was neutral to the project, examples: dancing, singing, pretending to eat the project, and joking about space related topics (blowing up planets, blowing up the solar system). The boys did not have any incidents in which they gave up on the problem or spoke negatively about the project.

In contrast, the girls had a few examples of this. After starting the project on task, silent and serious (no smiling), things changed at the point when they began to struggle. The bulk of the comments were made by two of the six girls, labeled Natalie and Quinn. All recorded comments reflect conversations after the teacher had left the group. Natalie had her first negative comment right after the project began, by indicating to the rest of the group that the sticks holding the moon and Earth were sucker sticks.

> Natalie: Do you guys realize we are using sucker sticks?
>
> Quinn: Eww.

Many girls made noises to indicate that they were disgusted by the thought. When the group began to try their moon phases, Natalie said she'd "stopped trying." The rest of the girls stopped as well. When the boys had someone succeed, the girls began to work again. Natalie said, "I don't know," referring to the problem she was to be solving, "I give up." Quinn, who had also been showing signs of frustration, but had completed the problem with the help of the teacher announced that she wanted to go home. Other girls agreed but the number was difficult to discern because of the camera angle. Quinn said, "Why do we have to have education? I am not going to use this." Natalie said, "Yeah. I'm not going to use this. It's not like I am going to become an astronaut." This led to a discussion between the groups of girls about what careers they might have, which included photography to working at McDonalds.

Quinn: What time is it? I want to go home.

Natalie: Me too.

Quinn: I just want to get an A and go home.

Natalie: I just want to go home.

Quinn: Why do we have to go to education? We are never going to use it.

Natalie: Yeah.   I am not going to use this.

Quinn: I am not going to be an astronaut. I'm going to be an (inaudible). (Looks at the camera and holds up moon model.) I am not going to do this.

Jen: Yeah.

Natalie: (Looks strait in the camera.) I'm gonna be a photographer. So HA!

Jen laughs.

Natalie (to Ana): I said I am going to be a photographer, so ha.

Ana laughs.

Quinn: I like your idea. I'm gonna be a photographer too.

Natalie: I'm going to be the *Times Magazine* editor.

Quinn: I want to photographer animals.

Ana: (Looks in the camera, concerned.): She's looking!

Quinn: I want to photograph-al animals. (Looks at the camera.) I want to photograph-al animals. (Laughs.)

Natalie: I want to photograph different countries.

Girls are all talking at once.

Jen: (Looks at the camera and points to self.) Going to be my first job!

Someone is talking about working hard.

Quinn: (Leans in to look at the camera.) I work real hard and I work at McDonalds. HA!

Natalie: (singing) I work hard at McDonalds! Making chic- making chicken

(Continues to sing, but becomes in audible.)

Quinn: (singing along with Natalie) Making chicken, fried chicken!

Natalie continues to sing.

Of the six girls, only two did not participate in the negativity at all, and focused completely on their project. Jen participated in some negativity joking about wanting to work at McDonalds and she as well as one Ana watched and listened to Natalie and Quinn. Out of the four off task girls, only Ana seemed concerned about their behavior, often looking into the camera with a worried expression.

Discussion

Summary

This project sought to determine how classroom discourse could affect male and female students differently. After the pre and post data was compared between the male and female students, it seems possible that something different had happened to cause female students to drop in score as opposed to improve. Not only did the female students do poorly compared to the males, but their data contrasted data from previous years in which females made gains in all areas. (See Table 2.)   While an exact explanation cannot be determined, an investigation seemed warranted leading me to investigate my own teaching practices and how that affected the discourse in my classroom.

Teacher and Student Summary. The primary focus of this study was on interactions between teachers and students, but the study also included student to student interactions. Within the areas of teacher and student interactions, there were three areas that gave little or no support to the claim that girls were receiving a different standard of attention or instruction. The first area was time spent. Time spent with groups in the second lesson remained fairly equal at seven minutes and eight seconds for boys and six minutes and six seconds for girls. Even if the times were adjusted as percentages to make a prediction to which a whole class would result, it would result in a roughly equal percentage. The second area is total number of interactions. Although in the first lesson the interactions were disparate, twenty-six for girls and eighteen for boys, the second lesson counters any trend, forty-five for girls and forty-three for boys. This data does not lead to consistent trend favoring boys over girls. Finally, the third area is types of interactions. Negative interactions showed only as a slight indicator of favorable behavior towards boys. Comparisons between the two lessons showed that in lesson one, while girls had more negative interactions (23% compared to 5% for boys), in the second lesson, the numbers were much closer to balance with girls having slightly more negative interactions compared to boys (7% compared to 5%). This discrepancy led to no clear conclusion that negatives consistently favored boys. Showing slightly more of a trend was positive interactions. In lesson one, girls had only 50% positive interactions while boys had 60%, and in lesson two boys remained the same at 61% while girls rose to a much closer 56%. Again the numbers do not have a clear bias toward the boys gaining more positive attention and less negative attention.

One area of teacher and student interaction that is much clearer, is that of unsolicited teacher attention. In lesson one, boys had three examples of unsolicited visits by the teacher compared to girls who only had one. In addition, the teacher showed preferential treatment of the boys group in the second lesson, checking in on their group more often and making the girls group wait while the boys received assistance. This data is supported by research that shows that student cognitive learning is affected by classroom discourse. Because of the slight male favored bias, female students may have felt unsupported by the microculture of the classroom and not felt that trying was worth their time. Which may have led to female student showing negative growth on the posttest as they had created a cultural model that this was not worth their time.

Student to Student Interaction. While student-to-student interaction provides less quantifiable data than teacher to student interaction, it does provide a very clear difference between the boys and girls groups. During the second lesson, Moon Finale, the girls group showed that two out of the six girls had little interest in completing the project once it became difficult, two were in the middle, sometimes participating in the negativity, sometimes not and two were completely immune to it, choosing instead to focus on completing their project. The two girls with the strongest reactions toward the project could have created a negative discourse that affected the rest of the group, indicating to other girls, as they mentioned during the lesson, that this material was of no use to them and they were unlikely to understand it even if they tried. Compared to boys group, which had no negative discourse, the girls group had a more negative tone. The two girls who engaged most in the negativity, could have been affecting the group of girls as a whole. Although they may not have seen themselves as “bullying”, their dominance of the group could be seen as a form of relational bullying. The girls were powerful, and dominant in the group. Even though at least one of the six girls felt that their behavior was unacceptable (by looking into the camera with a worried look) she did not stand up against them. This would follow the pattern of a student who felt there would be some consequence for not going along. In addition, the two girls most negative girls began the unit (in Measuring Distances) working hard and participating. By the end (Moon Finale Lesson) they were purposefully attacking the lesson. If they were able to spread their negativity through this bullying, other girls may have felt that it was socially unacceptable to try and this may account for why female students lost ground as opposed to simply staying the same- which would be more likely if they didn't learn anything from the unit.

Limitations

The major limitation in this research project is the limitation of the technology used in the classroom. Although two cameras were set up in the classroom, there were still areas of the classroom that were unable to be seen on the video. This led to occasions in which interactions could be overheard, but could not be seen. I decided to eliminate the interactions in which I could not see both the persons involved as well as hear what they were saying. I did this for two reasons: (1) I could not be absolutely sure if the persons involved were male or female; and (2) I could not be sure that I had counted an interaction twice as it may have been recorded by the other camera.

In addition to the technology, another limitation was a low number of students. Only thirty-seven students returned their paper work so that their data could be evaluated.

This compares to eighty-seven students the previous years. With such low number of students participating, one or two students can dramatically sway the results in one direction or another.

Implications for Future Research

It is clear from this research that there is a difference in discourse between male and female students in this classroom. While both males and females did made significant gains in several areas, these gains were not as powerful as the ones found in previous research. The limited scope of the research makes it difficult to make clear conclusions, but there is a discrepancy between the female students' and the male students' attitude toward the science engagement, which is showcased in the interactions between the girls group in the second lesson, and the boys group. Further research will help to answer more questions, was it simply coincidence that the two negative girls were so difficult in class? Was it the class itself that caused the girls to be so negative? How much was their behavior influencing that of other students? In addition, the microculture of the classroom could be improved by some of the best practices mentioned in the Literature Review. While both lessons were inquiry based (Measuring Distances- asking How do I measure distances in the sky? and Moon Finale- asking Why do we have moon phases?), there was no evidence to suggest that the students were asked to justify their answers, which was a key component in improving student cognition. A more longitudinal study, combined with interviews with the students, could provide insight into the whether this is an isolated incident or the start of a trend.

Another area to consider is the material itself. Perhaps discourse is not wholly to blame. Recent research of English university students suggests that women do not have as much interest in physics; they believe it to be more difficult and they believe that it has as much less career value (Veloo, Nor, & Khalid, 2015). Perhaps because the material was so based in physics, the female students were less interested in working through it. This could have explained why the girls were so hostile toward the lunar modeling and why they felt that it had no value for their future. It also is supported in the girls' own statements that this would not help them in their future careers. Retesting the students after study of a different field of science may offer more insight.

The middle school years are very influential for student careers determination, with many students determining if STEM careers are worth pursuing (Wyss, 2013.) The conceptions and misconceptions that students create at this time guide their decisions for what careers in which they believe they will be successful. The data found in this paper caused me to reflect on my own teaching practice and make changes to how I address my female students and the culture I create in the classroom. Further, as this is an action research project, my evaluation of myself caused me to want to share my findings with my peers so that we can all grow as instructors.

Conclusion

Every teacher wants their students to grow and be challenged through the material that is taught. When students fail to grow, teachers must look to themselves to determine why that is. This action research project sought to determine why female students would have negative growth in astronomy compared to male positive growth. Due to the limited nature of the data and the low number of students participating, a clear consensus cannot be made, however there was evidence that the teacher exhibits some bias toward male students in the classroom. This bias was shown by disproportionate number of times the teacher approaches male students for unsolicited help as well as the number of times that the teacher approached the male group to check in before checking on the female group. In addition, a small gap was found favoring males in the area of positive interactions with the teacher. This subtle bias could have created the hostility that two female students felt toward science and toward the astronomy project which appeared to be permeating the other girls in the group. It could also be that these girls were carrying a bias created by previous discourse they created from previous science experiences either at school or at home and this bias was not altered by their current science class. The girls themselves could have contributed to a negative discourse affecting female students' scores in the post test.

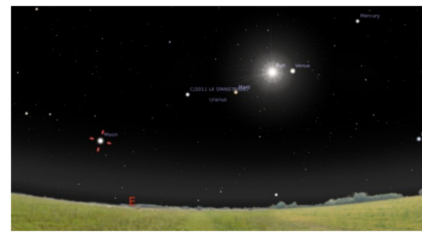
It is always difficult to come to finite conclusions when working with children. Their mercurial temperament often makes it difficult to determine true cause and effect relationships. In this case, the data suggests that student growth may be affected by classroom discourse. More research in this field is needed to determine how this discourse is consistently created and how students are reacting to it in a variety of science concepts.   The study shows that there is a difference in how discourse is being created between male and female students.

Appendix A

Student work sheet from the first video, ("Measuring Distances). This worksheet is adapted from REAL Lesson 2.

Name____Date_____________________

How to measure distances in the sky!!



Part I

1. How do you think people measure distances in the sky?

Today we're going to try measuring an object on the wall from several different locations in the room. You and your partner will begin working at an open station on the side of the classroom and then move to consecutive stations as groups finish.

2. What technique do you think we could use to measure how "big" the object is, using only our body?

When we do an experiment, it's important to control all of our variables. For the purpose of this activity, let's control the way we measure the object.

Record your data at each station along the way in your lab. For the purpose of this lab, use only whole number measurements, or 0.5 increments. For example, you can say the object is 0.5 thumbs wide, or 1 thumb wide, but not 1.7 thumbs.

➔ Each person needs to measure the distance, not just one per group.

MY DATA:

Station	# of thumbs
1	
2	
3	
4	
5	
6	

MY PARTNER'S DATA:

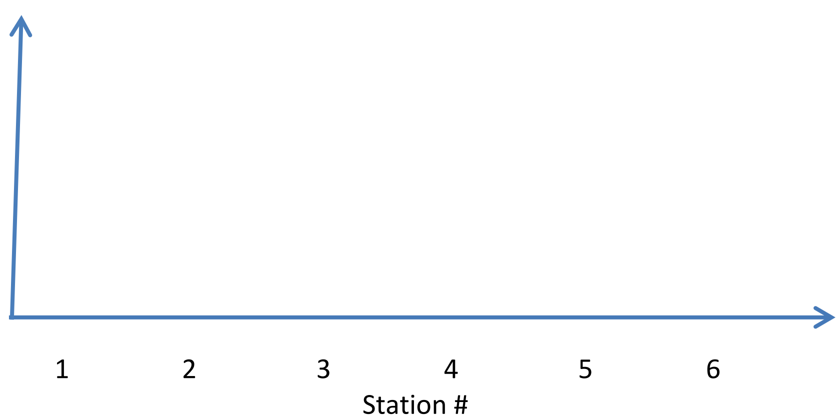
Station	# of thumbs
1	
2	
3	
4	
5	
6	

3. Make an observation about <u>your</u> data, as you moved from one station to another. (Is there a pattern?)

4. Make an inference: Why did your data change?

Displaying our data: Time to Graph!!

5. Make a line graph to show your data and your partner's. Include the following in your line graph: title, labels, units, and a KEY. You will need to use a different color for each person's data.



6. How does your data compare to your partner's? Was it similar or really different? (Explain, USING DATA!)

7. Now find another group. Ask them for their data and record it below.

Name____________________________

Station	# of thumbs
1	
2	
3	
4	
5	
6	

Name__________________________

Station	# of thumbs
1	
2	
3	
4	
5	
6	

8. Now go back to your graph from above, and add two more lines: one for each person's data from question #8. Make sure each line is in a different color.

Look at the data you've collected. You should now have your own data, your partner's and data from two other people in class.

9. Is the data consistent? Are the data concentrated in one or two areas? Are there any outliers?

10. What could make someone's data different than yours? (Think about how you held your thumb to collect your data. Did everyone else hold it the same way??)

11. What can we do to get more accurate data?

PART II. Grab a measuring tape! It's time to do some measuring!!

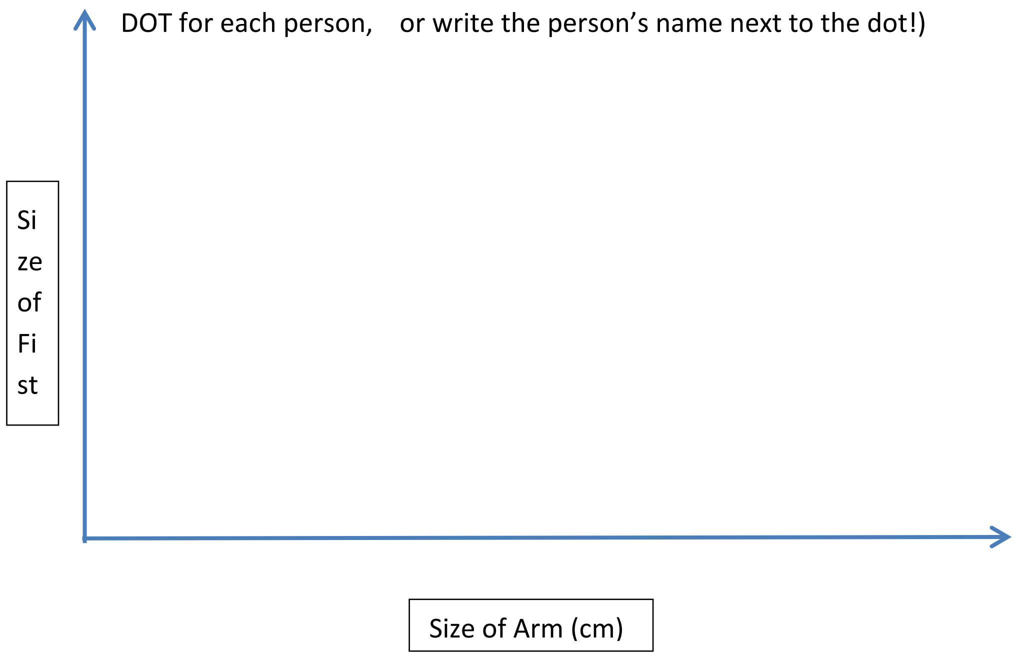
12. With a partner, measure the width of your fist and length of your arm in cm.

Fist________________ Arm_____________

13. Fill in the chart with your info, then find 4 other people and get their info too!

Name	Fist	Arm

14. Use the table in #14 to make a LINE PLOT below: (don't forget to use a different color DOT for each person, or write the person's name next to the dot!)



15. Describe the graph. (Is it a straight line?)

16. Choose three people's information (fist and arm) and add it to the table below.

Fist	Arm	Ratio

17. Now find the ratio for each person's data you chose and fill it in the table above. (You can write this as a decimal. (Need help?? FIST divided by ARM = RATIO)

18. Compare the ratio of Fist to Arm from the table in #18 and use the graph for extra help. What can we say about the ratio of a students' fist width and arm length?

Part III. *You're gonna need to stand up for this part!*

19. Hold your arms out in front of you and make a fist. Placing one fist over the next, how many fists will it take to make a complete circle around you?

20. How does your number compare with your partner and two others?

21. How many degrees are in a circle?

22. Find the number of degrees (on average) for a fist. (Need help? If there are _______degrees in a circle and I could fit _______fists in a circle… divide ☺ you should get a whole number.

23. How can knowing the number of degrees a fist makes help us describe where objects are in the sky?

24. How can we use this information to determine how high an object is in the sky?

References

Anderson, D., Nelson, J., Peterson, J., Richardson, M., Webb, N., & Young, E. (2011). Using dialogue journals to strengthen the student-teacher relationship: A comparative case study. *College Student Journal, 45*(2), 269-287.

Atlas, R.S., & Pepler, D.J. (1998). Observations of bullying in the classroom. *The Journal of Educational Research, 92*(2), 88-99.

Chaudhry, N., & Arif, M. (2012). Teachers' nonverbal behavior and its impact on student achievement. *International Education Studies, 5*(4), 54-64.

Crafter, S. (2012). Parental cultural models and resources for understanding mathematical achievement in culturally diverse school settings. *Education Studies in Mathematics,81*(1), 31-41.

Duschl, R. A., & Osborne, J. (2002). Supporting and promoting argumentation discourse in science education. *Studies in Science Education, 38*(1), 39-72.

Enyedy, N., & Goldburg, J. (2004). Inquiry to Interaction: How local adaptations of curricula shape classroom communities. *Journal of Research in Science Teaching, 41*(9), 905- 935.

Gee, J. (2001). Reading as situated language: A sociocognitive perspective. *Journal of Adolescent & Adult Literacy, 44*(8), 714-725.

Gough, S., & Scott, W. (2000). Exploring the purposes of qualitative data coding in educational enquiry: Insights from recent research. *Educational Studies*, *26*(3), 339-354.

Hall, C., & Sampson, V. (2009). Inquiry, argumentation, and the phases of the moon: Helping students learn important concepts and practices. *Science Scope*, (April/May), 16-21.

Neuliep, J.W. (2012) *Intercultural communication: A contextual approach.* Thousand Oaks, California: Sage Publications

Piccolo, D., Harbaugh, A., Carter, T., Capraro, M., & Capraro R. (2008). Quality of instruction: Examining discourse in middle school mathematics instruction. *Journal of Advanced Academics, 19*(3), 376-410, 552-554.

Pollack, E. (2013). Why are there so few women in science? *The New York Times.* http://www.nytimes.com/2013/10/06/magazine/why-are-there-still-so-few-women-in-science.html

Ryan, A., Shim, S., & Makara, K. (2013). Changes in academic adjustment and relational self-worth across the transition to middle school. *Journal of Youth and Adolescence, 42*(9), 1372-84.

Smart, J., & Marshall, J. (2015). Interactions between classroom discourse, teacher questioning, and student cognitive engagement in middle school science. *Journal of Science Teacher Education, 24*(2), 249-267.

Squire, K.D., MaKinster, J.G., Barnett, M., Luehmann, A.L., & Barab, S.L. (2002). Designed curriculum and local culture: Acknowledging the primacy of classroom culture. *Science Education, 87*(4), 468-489.

Stone, J.C., & Veth, E.S. (2008). Rethinking the new literatures of childhood: Cultural models of gender in popular websites. *Journal of Language and Literacy Education, 4*(2), 21-39.

Veloo, A., Nor, R., & Khalid, R. (2015). Attitude towards physics and additional mathematics towards physics achievement. *International Education Studies, 8*(3), 35-43.

Voyer, D., Voyer, S., & Bryden, P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin*, *117*(2), 250-270.

Wilhelm, J. (2009). Gender differences in lunar-related scientific and mathematical understandings. *International Journal of Science Education, 31*(15), 2105-2122.

Wilhelm, J., Cole, M., Pardee, R., and Cameron, S. (2015). Mathematical classroom discourse in three middle level science classrooms. In Bartell, T. G., Bieda, K. N., Putnam, R. T., Bradfield, K., & Dominguez, H. (Eds.). *Proceedings of the 35th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, (p. 11.62). East Lansing, MI: Michigan State University: PME.

Wyss, V. (2013). Developing videos to better inform middle school students about STEM career options. *TechTrends, 57*(2), 54-62.

Zangori, L., Forbes, C., & Biggers, M. (2013). Fostering student sense making in elementary science learning environments: Elementary teachers' use of science curriculum materials to promote explanation construction. *Journal of Research in Science Teaching, 50*(8), 989-1017.

Vita

Lauren Schwartz Moorhead has earned her undergraduate degree in Middle Education from the University of Kentucky. Currently she teaches eighth grade science.