Using Sociotransformative Constructivism (sTc) to Unearth Gender Identity Discourses in Upper Elementary Schools[1]

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Published in the Penn GSE Perspectives on Urban Education's Special Issue on Gender & Education. Volume 3, Issue 2. 2005. http://www.urbanedjournal.org/index.html

[1] This project was funded by the National Science Foundation (Grant #9906339). The perspectives and findings shared in this manuscript, however, were constructed by the authors alone and do not represent the position of the funding agency.

Abstract

Maxima was a two-year long professional development and research project that took place in the U.S. Southwest and involved a partnership between university and school district faculty. This intervention project was designed to positively impact the participation of diverse groups of girls in science and mathematics by assisting teachers to make their classrooms more gender-inclusive, socially relevant, and student-centered. A theoretical orientation called sociotransformative constructivism (sTc) was used to guide the project and the analysis of the data. This paper focuses on the data gathered about forty girls from different backgrounds as they were followed from grade 4 through grade 5. Using quantitative and qualitative measures, analysis demonstrated that most of the girls' interest in science and mathematics remained high. In addition, we found that the girls' gender identity awareness increased significantly from year one to year two of the project. Based on our findings, we make recommendations for how to help teachers become more aware of the covert and overt gender discourses that may take place in their classrooms. We also make recommendations for how to be more proactive in creating gender-inclusive spaces for learning science and mathematics in schools.

Introduction

The gender achievement gap in mathematics and science still exists. We have now accumulated a considerable body of research that clearly indicates that this gap may be caused by a variety of patterns found in classrooms. These patterns show that girls (a) have less exposure to science equipment than boys, (b) become less active in science and mathematics classes as they progress through grade levels, (c) and their positive attitude toward and performance in these subjects decrease as they progress through grade levels (Bae, et al., 2000; The Mendoza Commission, 2000; Kahle & Meece, 1994). Furthermore, Sadker & Sakker (1994) showed how fourth, sixth, and eighth grade girls received less attention during class discussions, less praise, and less challenging work. Although this research has been informative, it has limitations due to some authors' tendencies to homogenize girls from various socioeconomic and cultural backgrounds into one universal gender category. In addition, there is a need for more

longitudinal studies that focus on girls' classroom discourses in order to better understand how their gender identity and learning in science and mathematics classrooms are inter-tangled.

To address these gaps in the existing literature, we designed a two-year long professional development research project that took place in the borderlands of the U. S. Southwest and involved a partnership between university and local school district faculty. This intervention project, called Maxima, was designed to positively impact the attitudes and participation of diverse girls (in this case mainly Latinas and Anglos) in science and mathematics. Our goal was to assist teachers in making their mathematics and science classrooms more gender-inclusive, socially relevant, and student-centered. To this end, we used a theoretical orientation called *sociotransformative constructivism* (sTc)[2], which unites social constructivism as a theory of learning with multiculturalism as a theory of social justice (Rodriguez, 1998, 2002).

We investigated a variety of research questions, but for this manuscript we focus our discussion on the following questions: (a) In what ways does an sTc orientation impact the gender identity awareness of girls over time?; (b) in what ways does an sTc orientation impact the girls' attitudes toward and participation in science and mathematics classes over time?; and (c) what transformative insights can be gathered through conversations with girls about gender and the role gender plays in learning within their science and mathematics classroom?

Our analysis of various quantitative and qualitative data sets indicated that the project did impact the teachers' practices and the girls' attitudes and participation in science and mathematics in positive ways. In this paper, we wish to focus our discussion on some of the interesting and contradictory gender discourses that emerged during our conversations with the girls over time. We found that our in-depth conversations with the girls unearthed discourses of

[2] The "T" is kept as a capital letter here to stress the transformative component of this theoretical framework. We also wish to distinguish sTc from existing canned curriculum programs, which tend to trivialize the immense complexity of developing culturally and student-centered curriculum.

gender awareness that increased in sophistication from year one to year two of the project. Within the analysis of these discourses, it became evident that in spite of the progress being made, there were still oppressive episodes of gender play that worked directly against the goals of the project. This demonstrates that creating gender-inclusive spaces in science and mathematics is messy and complicated work that does not happen in a linear-like fashion. These findings hold powerful potential in helping educators to better understand and transform the covert discourses of gender that work to keep gender identities fixed along stereotypical lines in schools, including the lines that work to make science and mathematics fields more accessible for males.

Therefore, we begin this manuscript by situating our study within post-structural and socio-cultural theories of gender identity development. These theories move away from traditional conceptualizations and instead work to explain gender identity formation in more complicated, shifting, and context-specific ways. In addition, post-structural and socio-cultural theories suggest that learning in science and mathematics classrooms is closely linked to gender identity development (Brickhouse, 2001). Agreeing with this position, we argue that examining and listening to the discourses girls use when they describe their learning experiences in science and mathematics classrooms, as early as 4th and 5th grade, can prove fruitful in helping to further understand how to narrow the gender achievement gap.

In the methodology and findings sections of the manuscript, we provide a description of the interpretive and quantitative methods used to arrive at our conclusions. Due to space constraints, we focus our analysis on the qualitative components of our study. In closing, we utilized the insights gathered from the study to propose a set of recommendations to interrupt the

covert gender-based discourses that may take place in science and math classrooms; discourses that keep the gender gap from closing.

Identity Development, Culture and Communities of Practice

Poststructuralist studies of identity formation move away from over-simplistic notions of schools as sites of social reproduction (Davies, 2003; Weedon, 1997). Instead, these studies provide a window through which to observe "youth in the act of making the everyday problematic as they configure meaningful lives in the context of shifting social relations in and outside schools" (Smith, as cited in Proweller, 1998, p. 6). Identity is, therefore, defined here not as a unitary and static way of positioning oneself in cultural contexts. Identity is an organic system of negotiating meaning and representation in communities of practice. This implies that it is possible for us to have multiple and *shifting* identities, which in turn, enable us to function in multiple contexts and in multiple communities of practice. Like a mask that may convey different messages depending on the context and on the person wearing it, so too do we consciously or subconsciously wear our own identity(ies). Perhaps, Bakhtin explains best the important roles that social contexts and social groups play in identity formation when he states, "becoming conscious of myself, I attempt to see myself through the eyes of another person, of another representative of my social group or my class" (Bakhtin, as cited in Todorov, 1998, p. 30).

For Bakhtin and many other sociocultural theorists, the development of an individual's identity is not an individual act, nor is it the product of structural and cultural forces shaping and fitting the individual into the dominant cultural mold. It is a much more complicated process than that – one which is made even more problematic through the individual's enactment of her/his

agency. It is, in fact, through the individual's agency, voice – or "speaking consciousness" as Bakhtin (1981) describes it – that the individual seeks to accommodate into or resist against established norms within specific communities of practice. The individual's culture of course plays key roles in this process, as our learned cultural norms provide certain guideposts that help us navigate the established expectations imposed upon us by the dominant culture. The girls participating in this project (who were mainly Latinas) were exposed to established dominant institutional norms (e.g. standardized tests and curricula), established historical norms (e.g. historically, Latinos/as do not perform as well as White students on standardized tests; historically, science and mathematics were not emphasized at the participating schools), and cultural norms (e.g. boys' gender-based behavior work against the girls' developing identities in the science and mathematics classrooms). The latter aspect is explained in more detail in this study, but it needs further consideration here because in our project we sought to disrupt traditional teaching practices. By helping teachers become more aware of gender-inclusive and culturally relevant approaches to teaching science and mathematics, we hoped to impact the girls' attitudes toward and participation in these subjects—and consequently, their identity formation as legitimate participants in *all* areas of the curriculum.

Learning, Gender Identity Development, and Sociotransformative Constructivism

Identity development and learning are inextricably joined (Vygotsky, 1978). Thus, it follows that gender identity development is also influenced by, and dependent upon, the various institutional, historical, and sociocultural codes existing in the school classroom. These codes are also different for different curriculum subjects, as they tend to mirror the rituals and discourses commonly found in subject-specific communities of practice (e.g. instruction of the scientific

method in the science classroom or using algebra as a symbolic language to solve mathematics word problems). As an individual learns to function within existing discursive practices in and outside of school contexts, it is not surprising that the individual's gendered identity development exists at the intersections of agency, culture, and established codes. Learning about science and about mathematics involves a lot more than memorizing a stream of facts or performing certain skills. Brickhouse (2001), drawing from the work of social constructivists such as Jean Lave and Etienne Wenger explains this notion further, "[learning] is what is required in the process of becoming a person. Learning is not merely a matter of acquiring knowledge, it is a matter of deciding what kind of person you are and want to be and engaging in those activities that make one a part of the relevant communities" (p. 288).

Given our multiple theoretical locations, we needed a framework that could guide our interests in disrupting established teaching practices in the participating schools. At the same time, we also needed an interpretive tool to manage multiple data sources and to explore how the girls' shared meanings and gendered identities were taking shape within the contexts of the Maxima Project.

We found that sociotransformative constructivism (sTc) provided this framework by drawing from multiculturalism (Grant, 1991) and feminism (Davies, 2003; Weedon, 1997) – as theories of social justice – and from social constructivism (Gergen, 1995) as a theory of learning. The resulting intersection of these frameworks produces, in our view, sTc as a theory of praxis that goes beyond rich analyses of pervasive social issues and requires (or demands) that researchers join in with the participants in transforming existing oppressive practices (Rodriguez, 1998, 2002).

As such, sociotransformative constructivism is an orientation to teaching and learning

which affirms that knowledge is socially constructed and mediated by cultural, historical, and institutional contexts (Rodriguez, 1998). According to Rodriguez (1998), in order to provoke social change and evoke reflective action, sTc is informed by the enactment of four elements: the dialogic conversation, authentic activities, metacognition and reflexivity.

Sociotransformative constructivism draws from the work of Vygotsky (1978) in terms of his useful explanations of the complex interplay between social contexts and learning. However, we find the work of Bakhtin (1986) most helpful in advancing Vygotsky's ideas because Bakhtin describes more fully the multivoicedness of meaning construction. For Bakhtin (1981, 1986), dialogue is much more than an engaged form of conversation; it is a process by which the speaker positions himself or herself (*addressivity*) in such a way to construct context-relevant meaning with others. This involves a deeper understanding of how each individual's voice – or "speaking consciousness" (Bakhtin, 1981) – engages in conversation with others (*dialogicality*).

In this fashion, a dialogue moves beyond merely understanding what is being said to understanding the reasons a speaker chooses to state what he or she chooses to say in specific historical, institutional, and sociocultural contexts. This principle is the basis for the *dialogic conversation* in sTc, and it is very relevant here in terms of understanding the girls' perceptions of gender-based behavior in the classrooms and their own insights into what it meant to be a girl learning to function within their specific mathematics and/or science contexts. By engaging in dialogic conversations with the Maxima girls, we were, as researchers interested in transforming practice, locating a better position from which to inform teachers of the effectiveness of the Maxima Project in promoting gender-inclusive and culturally-relevant pedagogical strategies. The results of engaging in dialogic conversations with the participating girls will become more apparent in the findings and discussion section of this manuscript.

The other three elements of sTc – authentic activity, metacognition, and reflexivity – will be explained briefly due to space limitations (the reader is encouraged to see Rodriguez, 1998, 2002 for details). Authentic activity involves hands-on, minds-on activities that are also socio-culturally relevant and tied to the everyday life of the learner. In addition, these learning activities are authentic as they connect to what practitioners in the specified communities of practice would do, such as scientists conducting experiments.

Metacognition involves having a critical knowledge and conscious awareness of your own learning, and working to have some control over that learning. As such, teachers and students should be encouraged to ask questions about the purpose and the reasoning behind activities.

The final element, reflexivity, involves becoming critically aware of how one's own cultural background, socioeconomic status, belief systems, values, education, and skills influence what we consider to be important to learn. Through reflexivity, one becomes more aware of how issues of power determine who has access to education and to better opportunities in life and the role each one of us plays in maintaining or disrupting the status quo. It is from these theoretical places that we enact our work in partnership with teachers and the diverse children they serve.[3] A more detailed example of how sTc was used during the summer institute—and later by the participating teachers in their own classrooms—is discussed in the Findings and Discussion Section.

Methodology

Design of the Research and Professional Development Project

[3] Each one of the elements and their applications in different school contexts are explained in more detail in Rodriguez (1998, 2002). The use of sTc in teacher education courses is discussed further in Rodriguez & Kitchen (2005) and Rodriguez (1998).

Maxima was designed to help teachers create sTc practices – or multicultural, gender-inclusive, and social constructivist practices – within their science and math classrooms, with the hope that more girls of diverse cultural backgrounds would develop positive feelings about participating in these fields. This project explored a variety of research questions. However, for this paper we focus our discussion on the following questions that emerged due to our initial analysis of the data from the participating Maxima girls: (a) In what ways does an sTc orientation impact the gender identity awareness of girls over time?; (b) in what ways does an sTc orientation impact the girls' attitudes toward and participation in science and mathematics classes over time?; and (c) what transformative insights can be gathered through conversations with girls about gender and the role gender plays in learning within their science and mathematics classroom?

Research Sites and Participants

Maxima included all of the grade 4 and 5 teachers (in special, regular, and bilingual education) who taught math and science, from three elementary schools located in the Southwestern United States. These teachers were actively recruited based upon the commitment to becoming more gender-inclusive and more competent math and science teachers for all of their students, but particularly their girls. Since this design was based on an "all school approach," all the grade 4 and 5 teachers at each school had to commit to the project for two years. The teachers participated in summer institutes and monthly meetings during each year of the two-year project. They also were provided access to innovative science, mathematics, and learning technology equipment as part of our on-going and on-site support in their classrooms. After recruiting in several districts, the teachers at three elementary schools agreed to participate. All schools chosen had a mainly Latino/a student population (80-90%). The selection of the elementary schools was based upon the commitment of the teachers to stay with the project over

the two-year period in order to follow the participating girls from grade 4 to grade 5. Of the 25 teachers involved, 13 were Latinas, 2 were Latinos, 1 was an African American woman, 2 were White males, and 7 were White females.

During the first year of Maxima, a representative cohort of forty grade 4 girls, mainly Latinas (69% Latina, 29% White, and 2% of Middle Eastern origin), was selected from the participating elementary schools to be followed through grade 5. Each year the participating girls were placed in classrooms with Maxima teachers. This representative cohort included high, middle, and low achieving girls in math and science. In addition, both bilingual and monolingual girls were included, as well as two girls identified as having special needs. In terms of socioeconomic status, the schools ranged from 70-80% eligibility for free and reduced lunch.[4] Another factor used for selection was the girl's parents' commitment to keep their daughters at the same school for two years.

Maxima Professional Development Experiences

On-going professional development experiences were built into the project. Each summer a two-week long summer institute was collaboratively designed with the participants and focused upon meeting their professional development needs. Central to these institutes was the modeling of sociotransformative constructivist (sTc) teaching practices that aligned with state and national content standards. In addition, the Maxima teachers participated in monthly meetings to discuss progress and concerns with colleagues. These meetings were also the place where the participating teachers made presentations about the sTc activities they were

[4] In terms of retention, the project lost three girls from year one to two due to relocation: one White, one Latina, and one of Middle Eastern origin. In addition, an additional White female student joined in the last year.

implementing in their classrooms. Once a year, these monthly meetings became daylong workshops that covered content requested by the teacher participants.

Two unique aspects of this intervention project are its longitudinal design and the *on-going, on-site, and responsive* support the research team offered. This meant that professional development opportunities expanded beyond summer institutes and monthly meetings. Research staff visited classrooms regularly to provide support in terms of delivering equipment and materials, assisting with instruction, modeling activities with students, participating in planning sessions, and sometimes team teaching with the teachers. This allowed us to have on-going access to the Maxima girls in order to develop more personal relationships with them. Since we followed the progress of the same group of girls at each of the schools from grade 4 to 5, we were better able to assess whether sTc had an impact on the girls' attitudes toward science and mathematics.

Data Collection

Multiple data sets were collected throughout the entire Maxima project. For this paper, we are concentrating only on the data gathered on the girls' attitudes towards and participation in science and math classes. This data set involved both qualitative and quantitative data including focus groups interviews, classroom artifacts, Draw-A-Scientist Tests (Chambers, 1983), classroom observations, on-going informal conversations, and field notes.

Three focus group interviews were completed with the girls in total. Two interviews were held during year one of the project, the first in February and the second in May. The first interview included a discussion of the Draw-A-Scientist Test (DAST)

that the girls completed in January of the same year. We held this interview directly after the tests were completed to gather baseline data. The final focus group interview was conducted at the end of year two in May, soon after the second DAST. In the first and last focus group interviews, questions about the DAST were discussed to gather a richer understanding about what the picture of the scientist represented to the girls (due to space limitations the results of the DAST are presented on the Maxima website at http://edweb.sdsu.edu/maxima). Focus group interviews also included a variety of open-ended questions designed to capture the attitudes and perceptions of the girls towards science and mathematics, the manner in which their teachers taught within these content areas, and their career goals and participation patterns during science and math classes. The data analyzed involved the same set of girls across school sites. If any girls moved or relocated from year one to year two, their interview data was deleted in the final analysis to keep the sample intact from the beginning to the end of the project.

Data Analysis

An ethnographic approach was employed that produced contextual information needed to make reliable inferences. Using a constant comparison and interpretive approach (Lincoln & Guba, 1985; Spradley, 1979), all interview transcripts, DAST, classroom artifacts, and field notes were read several times by members of the research team. As themes surfaced, the research team determined their strength and validity by triangulating emerging claims across various data sets. Since multiple data sources, multiple schools sites, and at least two members of the research team reviewed all data (Erickson, 1986; Wolcott, 1985), we were able to draw relevant insights

on the impact of the project on the girls' attitudes and participation in science and mathematics, as well as their conceptualizations of who scientists were and what they did as part of their jobs.

The girls' responses to questions pertaining to their interest in science and math for year one and two were tabulated in percentages, with changes over time included. Also, student responses to what they found most engaging about their teachers' classroom practices in science and math, and their future career goals were analyzed for frequency patterns from year one to year two.

Findings and Discussion

A modified version of the DAST (Chambers, 1983) was administered twice to all the Maxima girls, once in grade 4 and at the end of grade 5. Findings from the first test (grade 4) indicated that the girls held strong stereotyped images of scientists and science related-work. These results were consistent with those previously reported in the literature (Chambers, 1983). During year one, the majority of the girls drew White male scientists with wild hair wearing lab coats, glasses, and surrounded by stereotypical symbols of research (e.g. flasks, test tubes, etc.) and symbols of knowledge (e.g. books, filing cabinets, etc). The results of the second test (at the end of grade 5) indicated a statistically significant drop in the number of stereotypes held by the Maxima girls about scientists and their work ($t = 2.681$; $p = 0.012$). A more detailed analysis of the quantitative aspects of this study will be presented in a separate paper, but it is important to note here that the girls' drawings of scientists were used as a heuristic to stimulate discussion during interviews and to probe more deeply into the girls' attitudes toward science and their emerging identities in the science and math classrooms.

In fact, Table 1 and Table 2 indicate that the majority of the girls involved maintained a high interest in science (81% in grade 4 and 84% in grade 5) and mathematics (76% in grade 4

and 75% in grade 5). The number of girls who were not sure whether they liked[5] science or mathematics dropped in science from 19% to 9%, and in math from 24% to 19%.

Table 1 - Maxima Girls' Changes in Attitudes Toward Science from Grade 4 to Grade 5

	Like	Dislike[6]	Not Sure
Grade 4 (n=37)	81% (30)	0	19% (7)
Grade 5 (n=32)[7]	84% (27)	6% (2)	9% (3)

Table 2 - Maxima Girls' Changes in Attitudes Toward Mathematics from Grade 4 to Grade 5

	Like	Dislike	Not Sure
Grade 4 (n=37)	76% (28)	0	24% (9)
Grade 5 (n=32)[8]	75% (24)	6% (2)	19% (6)

In addition, the majority of the girls involved named sociotransformative constructivist (sTc) activities carried out by their teachers as the most engaging. Most of these inquiry-based, gender-inclusive, and socially relevant lessons were part of the curriculum and activities modeled during the teachers' summer institutes and/or monthly meetings. The following quotes provide a general sample of the girls' typical responses:

> I also liked science when we did the [water bottle] rockets.
>
> I like it best when my teacher uses hands-on projects. I don't like it when she talks too much.

[5] The word, "like" was used because it was part of the shared discourse amongst the girls to describe their attitudes and participation in a subject. Similarly, The terms "like" and "dislike" were used during the interviews because they represent the discourse commonly used by elementary students in reference to school subjects.

[7] Note: The number of girls is different from grades 4 to 5 because of some girls moved to a different school or did not complete a component of pre and post DAST.

[8] See footnote 7.

My favorite activity this year was working with the Mars rover. [9]

The Mars rover activity provides a good example of what we mean by supporting the teachers to implement sociotransformative constructivist activities. For example, a number of teachers were interested in concentrating on the study of the solar system and space exploration, a major section of the grade five science curriculum. They indicated that they needed to improve their content knowledge in this area and that they had no idea of how to make this topic socially and culturally relevant for the students. After reflecting upon their requests and the science standards, we developed a *problem-solving scenario* where the teachers (and later their students) had to discern what planet a model size rover had landed on based upon the images the remote control rover sent via a wireless camera. To this end, we built a planet scenario (in this case based on the key features of Mars) and hid the scenario behind large curtains. As part of the problem-solving activity, the teachers/students were told that their spaceship was damaged (due to solar flares) and lost in space. The only way they could discern where they were was to send the remote control rover to the unknown planet they were now orbiting in hope that they could establish communication with Earth (a communications tower was also hidden in the scenario). Since the participants could not actually see the rover in the scenario, they had to maneuver the rover using only the remote control and the television images being sent to their "spaceship" by the rover's camera. After this activity, we facilitated dialogic conversations on how the curriculum and instruction we modeled was an example of authentic science (doing work similar to that of NASA scientists), how the activity was inquiry-based (by allowing student to apply what they knew to solve a realistic scenario), how the activity was collaborative, and student-centered (by allowing students to work in groups—some of them in same gender-groupings—to

[9] See project website for video clips of classroom activities: http://edweb.sdsu.edu/maxima.

solve the given scenario together), how the activity was multicultural and gender-inclusive (part of this activity included a learning center at which the participants read and discussed the contributions of women and other underrepresented groups to space exploration. For example, the teachers/students were given an article that described short biographies of all of the female astronauts in the history of the NASA program). These kinds of deeper discussions (dialogic conversations) with the students (and the teachers when we modeled the activities during the summer institutes) enabled the participants to also be more reflexive. In other words, on several occasions we heard teachers and students make comments such as, "I never knew there were Latina astronauts." This provided multiple opportunities to reflect and discuss why the contributions of female astronauts and other underrepresented groups were not made readily apparent in their prescribed textbooks and/or other school resources.

The fact that the girls named a variety of sTc activities and/or lessons that were previously prepared by the teachers during the summer institutes indicate that these types of activities can assist in keeping girls' interest in science and mathematics high. These findings are promising in terms of countering the current trend – that is, the tendency for girls to lose interest in science and mathematics as they progress through their academic preparation (Bae, et al., 2000; The Mendoza Commission, 2000). We argue that if culturally diverse girls' interest in science and mathematics is maintained through the implementation of socially relevant, gender-inclusive, inquiry-based, and empowering (sTc) activities, they would be more inclined to pursue science, mathematics, and/or technology-related careers in the future.

Growth in Gender Identity Awareness

The participating girls also demonstrated a significant increase in *gender identity awareness* based on their responses during the interviews conducted in grade 5 as compared to grade 4. Overall, by year two, the girls used a more sophisticated gender-oriented discourse to explain their perceptions of gender-based dynamics in the classroom. In year one, most of the girls discussed classroom participation with little or no mention of the gender dynamics involved and instead explained patterns in terms of individual behaviors or intelligence. For instance, in grade 4, most girls tended to mention the names of the students who frequently participated in science and mathematics classes according to – as they put it – how "smart" they were. Other students tended to explain that these "smart" students participated more because "they didn't want bad grades." Only a small group of the participating girls were beginning to notice differences in gender-based behaviors between the boys and girls during mathematics and science activities. Even then, explicit mention of gendered behavior was not directly named. For example, one of the grade four girls after listing the names of two boys and two girls she felt participated the most in class – explained:

> I think Luis and David participate in math especially because they're geniuses in math (laugh). They are always acting all bad. They're racing, and everything, and they get done, they're all, 'Oh, I beat you Luis,' and stuff like that.

Though this student is beginning to analyze these boys' behaviors, she is not at this point indicating that their behavior might be gender-based. The tendency to explain behavior based on gender is observed more directly by year two of the project, when a majority of the girls include gender analysis of classroom interactions.

During year one, there were only several occasions when a few girls began to use gender to understand student interactions in the science and mathematics classrooms. For example, one of the fourth grade girls from a different school started to notice that the boys tended "to mess around" more in class. "[The teacher] tries to explain and they are not listening." Another girl, also in fourth grade, tried to provide some gender insights into the boys' behavior:

> The boys are just goofing around. Maybe because, boys, I don't know, they're more jumpy and stuff. And they're more into sports, so that makes them more like active and all. It's like I'm in sports, but I can hold in my hyper.

Here, one of the girls is beginning to identify possible reasons for the boys' behavior, as attached to boys being athletic and more out of control – the "boys will be boys" idea.

This level of sophistication in explaining the gender dynamics in the classroom, which was only apparent amongst a few of the girls during year one interviews, increased significantly by the end of grade 5. This became more apparent when we observed that many of the Maxima teachers commonly used competition in their science and mathematics classes. We were puzzled by this approach because we also observed, during our numerous visits to their classrooms, that most teachers had incorporated more gender-inclusive practices in their teaching as a result of their participation in this project. We noticed many instances in which the teachers were purposely attempting to include all students in classroom discussions. In fact, the teachers would often implement same-gender groupings during mathematics and science activities, and they commented on how well this approach worked in their classrooms. In addition, it became a common practice to explore the contributions of women and peoples from under-represented ethnic groups to the topic under study (especially in science). The teachers attributed all of these

changes to their participation in the Maxima Project, because it helped them to become more consciously aware of gender issues and how to address them within their teaching practices.

In any case, competition, as a pedagogical strategy, was not one of the activities we encouraged or modeled during the summer institutes or monthly meetings. Nevertheless, this approach was so widely used by the participating teachers that we decided that it could be used as analytical tool to explore more deeply the gender dynamics in the classrooms. This methodological decision proved to be quite fruitful because during our last interviews with the grade 5 girls, we were able to identify more significant aspects of the girls' growth in gender identity awareness.

From this analysis, we found that teachers tended to use more competition games in mathematics than they did in science and that *all* of the girls liked competitive games. This is in contrast to the literature on gender-inclusive teaching that recommends moving away from competition in the classroom (Chu Clewell & Ginorio, 1996; Kahle, 1996). Even the girls who said that they were nervous or worried during competitive games in science and math still enjoyed these kinds of activities. Marlene[10], a fourth grade girl, describes her feelings during a competitive mathematics game as follows, "My heart races 'cause I'm afraid I'll get it wrong." What the girls did not find useful – and that demonstrated growth in their awareness of gender differences – was the way the boys acted during competition.

By year two, grade five, there was a significant increase in the gender identity awareness of the girls in the project, as was evidenced by how often issues of gender were raised by students during our focus group interviews. Based on our analysis of these interviews, we organized the girls' perceptions of gender dynamics in their classrooms into the following

[10] The names of all participants used in this manuscript are pseudonyms so that the participating teachers and students' privacy is protected.

categories (using their own voices): “As if games were for a big prize;” “Mean criticism;” and “Acting bad.” The girls also showed an increased sense of gender identity awareness by utilizing a sophisticated discourse for explaining the boys’ gender-based behavior. We organized these responses into the following categories: “Sports culture-based behavior;” “Being favored by male teachers;” and “Being all that.” Each theme is discussed below, supported by quotes from the interviewees and by our field notes.

Girls’ Perceptions of Boys’ Gender-Based Behavior

As if games were for a big prize

All of the girls from the three different elementary schools commented that the boys took competition too seriously. Isabel, a fifth grade girl, provides a good example of the girls’ views as follows:

> I like [competition] . . .but sometimes you don’t want to answer because the boys take it very, very personal, like if you get it wrong like sometimes Steven, he gets like very upset. It’s like [the boys] think they’re gonna win like a car or something. They take it so seriously that’s why you don’t want to answer because if you get it wrong, you’re like embarrassed to get it wrong. [Boys] just complain way too much.

It seems that even though the girls enjoyed competitive games in science and mathematics some of them felt silenced by the boys’ competitive behavior. During the interviews, the girls displayed a mixture of shock and amusement as they supported each other with nods, laughter, and headshakes while recounting their perceptions of the boys’ behavior during in-class competitions.

In addition to having a silencing effect on some of the girls who did not mind the competitive games in mathematics and science, the boys exerted their dominance over the direction and nature of the classroom interactions by engaging in the following behaviors.

Mean criticism

Most of the girls mentioned that the boys would use "mean criticism" to punish the girls for failing to respond correctly during competitive games. Maria stated that "When [the boys] are with their friends and they get the wrong answer on the board, they're like 'Oh, you tried your best," but when we, the girls, get it wrong, [they say] 'Oh, you suck, you're dumb, you don't know how to do math,' and they tell you all this stuff." Some of the girls mentioned that some boys are encouraging and do not get so upset with them or each other. However, sometimes the boys "acted bad."

Acting bad

According to the girls, some boys would get so upset about losing during a competitive game that they would carry their anger outside of the classroom setting. Lurdez explained that "Our class gets a little too competitive with the guys when they lose they get mad at each other, and they won't be friends for the whole day – they even tell on each other.

In another school, the girls recounted an incident in which the boys began to harass another boy because he did badly during a competitive game. The girls explained that some boys would call him "a penis," "dumb," and "gay" outside of the classroom. According to the girls, this particular boy was also "picked on" the playground because he ran "slow." We asked the girls how they felt about this behavior and whether they intervened on the boy's behalf. They explained that the boys would tease them in return and ask them, "What? You want to date him?" Here the girls are beginning to analyze and interrupt gender identity in terms of how

femininity and masculinity are played out in performances of gender. The girls are recognizing what is considered appropriate (normal) behaviors for being a "boy" versus a "girl". The boys in this case were ostracizing this boy for demonstrating more "feminine" traits and, as such, began to police his performance of maleness. In addition, the boys were pushing the girls to acknowledge and agree with identifying his behavior as inappropriate (abnormal) for a boy, by using humiliation, "What? You want to date him?" to silence their attempts at using their agency to disrupt gender/sexual discrimination.

These types of gender dynamics demonstrate that boys and girls are engaged in more sophisticated gender-based discourses than we may be aware of or even have access to as adults. These interactions, inside and outside of the classroom, also had a significant impact on the girls' gender identity formation and point to the importance of teachers (and researchers) taking more direct steps in interrupting the entrenchment of negative behaviors that can work to perpetuate gender identity norms in schools. We argue that one place to begin these efforts is to engage in dialogic conversations with students and listen carefully to the girls themselves, exploring the insights they have for explaining their male counterparts' gender-based behavior. In addition, further dialogic conversations with boys and girls are needed about gender stereotypes and respecting multiple performances of gender. Students need to learn that multiple gender identities are to be accepted and allowed without fear of social consequences that work to fix stereotypical gender roles.

Girls' Insights into Boys' Gender-Based Behavior

In addition to sharing their perceptions about student interactions in their science and mathematics classrooms, the girls also began to share further insights into why the boys might be

behaving in the ways they were observing and critiquing. We organized these insights into three categories: sports cultural-based behavior, being favored by male teachers, and being all that.

Sports culture-based behavior

Some girls believed that the boys' competitive behavior was rooted in the traditional ways in which they were encouraged to behave in sports. Marlene puts it plainly when she states that "[The boys] are brats because they're probably so into sports that they're used to always going, 'Oh, come on you guys,' 'Oh, we're the best," and stuff like that." Angela, another fifth grade student from a different school, agreed and said that, "Because when the boys are playing sports, like they think they can beat everybody" (at this point in the interview, several girls began to talk over each other in agreement).

These responses indicate that the ways schools and parents encourage competition in sports have a significant impact on the students' gender identity formation that may work against creating productive learning environments in the science and mathematics classrooms. Are there ways that friendly and engaging competitions could be encouraged in and outside the science and mathematics classroom without these having a negative impact on the development of students' gender identity and its connection to math and science learning? This is an area worth consideration of further research.

Being favored by a male teacher

Another gender awareness theme brought forward by the girls in 5th grade emerged in one focus group where the girls felt that their teacher (a White male) tended to favor the boys during science and mathematics competitions. We did not notice this during our classroom visits, and neither did the teacher (as it was not apparent in the ethnographic interviews with him). Nevertheless, the girls articulated this position strongly, "Whenever there are contests between

girls and boys, it's always the boys who get the last question, so they always get more questions." Isabel also felt that "The boys get easier questions and they get more time."

These perceptions, along with the boys' attitude of taking the competitive games "too seriously" had a cumulative silencing effect on some of the girls. However, it did not seem to have any effect on their confidence and/or beliefs in their abilities to perform well in mathematics and science. It does, however, align with the research literature on teachers' expectations and behaviors towards boys and girls in classrooms (Sadker & Sadker, 1994). In this case, the girls' analysis points to the sex of their teacher as the reason for the gender-biased behavior. Again, such an analysis did not surface in 4th grade conversations with these same girls. Yet here we see 5th grade girls reading the gender dynamics between male teachers and male students in more sophisticated ways.

Being all that.

During the analysis of these interviews, it became evident that the girls' gender identity awareness also involved recognizing how they could be perceived as sex objects even at this early age. This is not surprising considering the bombardment of sexist messages they receive through music, T.V., and other media. While responding to the question regarding competition in the science and mathematics classroom, one of the girls responded, "Well, the boys think that they are all that. You know, they have to win. They keep screaming at us, and they make a big deal about it if they are not going to win. If they lose they get all mad." Some girls from a different focus group (and from the same school) had a more poignant way of explaining the reasons for the boys' gender-based behavior:

> A lot of boys in the classroom all they do is talk about music and girls, rapping, skateboarding, and biking, and football, and girls' butts. . .Some of the guys talk

about going to Hooters, and they show off. They're only in fifth grade and they act like that.

Here again, we witness the girls analyzing gender roles and identity of the boys in more complicated ways. They seem to understand, at even this young age, that girls' bodies can be and are objectified as sexual objects by boys/males, as is evidenced by their comments about the boys' talk of "Hooters and girls' butts." The girls shared these comments with a tone of criticism and disappointment, as if these actions by the boys were ridiculous displays of ego, thinking they are "all that." This demonstrates further evidence that the girls had begun to name and critique gender identity norms.

Conclusion and Recommendations: Improving Gender-Inclusive Practices in Science and Mathematics Classrooms

In this project, we found that as the girls developed an increased sense of gender identity awareness from grade 4 to grade 5, they also made more meaningful connections between themselves and the science and mathematics curriculum. Our results indicate that the number of stereotype indicators dropped in the girls' DAST, their level of engagement and interest in these courses remained high, and their level of sophistication to explain gender-based behaviors in the science and mathematics classroom increased.

Obviously, multiple factors influence girls' gender identity development in mathematics and science classrooms. However, we argue that the teachers' participation in Maxima played an important role in the girls' gender identity development and in their consistent interest in the fields of science and math. That is, using the sTc orientation, the teachers sought to implement the gender-inclusive and affirming pedagogical strategies modeled during the summer institutes and monthly meetings. We believe these practices helped the girls develop more sophisticated

understandings of gender identity and who could be or were scientists. The fact that the girls named sTc activities as their favorite lessons in science and math also provides further evidence upon which to make these claims.

We also found that in spite of the teachers' efforts, there were a variety of gender-based behaviors in and out of the classroom that could have detrimental effects on learning in science and mathematics classrooms if left uninterrupted. If one of the goals of the democratic and inclusive classroom is to establish a safe and productive learning environment for all students, teachers must take steps to identify and disrupt any kind of gender-based behavior that could negatively influence the academic achievement and gender identity formation of both girls and boys. To this end, we make some recommendations below, keeping in mind that the analysis presented in terms of gender identity occurred outside of the sphere of awareness of the teachers (and of the researchers). In other words, identifying negative gender-based behavior may not be easy because students tended to use covert discourses to influence one another and perpetuate gender norms. This analysis revealed the girls' perceptions of gender-based interactions that would have not been readily apparent unless these interviews had been conducted. Our on-going and long-term relationships with the girls, grounded by a certain level of trust, allowed for the unearthing of these insights through dialogic conversation. Given this, as part of our professional development and research work, we now strongly encourage teachers and researchers interested in creating gender-inclusive spaces in science classrooms to take time to hold conversations with girls in same-gender groups about the gender dynamics within their classrooms. Through our study, it became evident that some girls have interesting insights about the way gender identity formation and gender dynamics play out in their classrooms. In our case, they were also able to share ideas for how to address their concerns to make the classroom more gender-inclusive. If

such conversations are not held and analyzed, then the gender discourses that work to perpetuate negative gender conceptualizations and dynamics within in classrooms may go unnoticed and hence, uninterrupted, regardless of the teachers' and researchers' intentions.

We recognize that since we only documented the girls' perceptions, this project has limitations. We did not interview the boys, but we feel it is important to explore their perceptions on gender-based behavior as well. We are planning to use the insights gained from this study to investigate both boys and girls' growth in gender identity awareness in another longitudinal study we are presently conducting. Another limitation of this study was that no alternate forms of assessment were conducted to measure the girls' cognitive growth in science and mathematics. This issue is being addressed in our current study now that we have gathered significant data on how to establish a collaborative intervention study with teachers, and now that we have developed a variety of standard-based sTc classroom activities that made a positive impact on the girls' attitude and participation in science and mathematics.

The insights gathered from the involvement of diverse girls in this project should add to our understanding of how to assist teachers to establish more gender-inclusive, social constructivist and multicultural (sTc) learning environments for all students. In addition, we propose the following recommendations to interrupt the covert gender-based discourses that can be happening in science and math classrooms:

<u>Make the rules of classroom engagement explicit</u>

1. Be more explicit with the rules of conduct during competitive games and other science and mathematics activities. Have reasonable consequences in place for any kind of sexist or homophobic behavior and discuss these forms of discrimination directly with students.

2. Establish same-gender grouping often in the classroom and monitor the interactions within and across groups more closely. Listen for covert gender-based discourse and take direct steps to interrupt it.
3. Encourage students to focus on collaborative learning and not on winning or "getting done first."
4. Encourage students to value collaboration and teamwork as much as getting the correct answers.
5. Provide diverse gender and ethnic representations of scientists and mathematicians within curriculum across content areas.

Use competitive games as a tool to monitor growth in gender identity awareness for both boys and girls

We were originally mistaken in our approach to discourage the participating teachers from using competitive games in mathematics and science. We were making these suggestions based on what other researchers have suggested in the literature. However, in this study we found that most of the teachers in the project used competitive games anyway and girls did enjoy these types of classroom interactions. What girls did not appreciate is how some of the boys acted during the competitive games. Therefore, we are suggesting that competitive games could be used as a tool to closely monitor growth in gender identity awareness in the science and mathematics classrooms for both boys and girls. Instead of discouraging games, we are suggesting that teachers should use games to unearth and monitor the potential covert and overt discourses that may take place in their classrooms. We believe that if teachers select small groups of boys and girls and separately discuss with them the gender dynamics in the classroom on a regular basis, the teachers and the students will be in a better position to collaboratively

create a more gender-inclusive environment in the classroom, and consequently stronger identities as science and/or math learners.

Implement more authentic, gender-inclusive, multicultural, inquiry-based (sTc) learning activities in science and mathematics.

All of the students in the focus groups highlighted sTc activities as the ones where they felt they learned the most and had the "most fun." More of these activities are described on the project's website (http://edweb.sdsu.edu/maxima), and more of these activities will be posted as we complete analysis of multiple data sets. These findings indicate that teachers need to implement more integrated and multi-layered activities through which students can make meaningful connections across the curriculum and to their everyday lives. In other words, often multicultural activities are perceived as token activities having to do with only "foods and festivals" and celebrations of holidays like "Cinco de Mayo" (Mexican Independence Day) with "tacos and fajitas." The sTc activities modeled and conducted throughout the project had gender-inclusive, culturally relevant components embedded in the science and mathematics subject matter content.

In broader terms, we believe this study points to the importance of approaching the study of gender identity in more complicated ways, using post-structural and socio-cultural understandings of gender. In addition, it is vital that researchers and educators responsible for teacher professional development help teachers increase gender awareness of their own behaviors as teachers including interactions between teacher and students and students and students, as well as grouping and curricular and pedagogical choices. It has also become apparent through this study that establishing a space for structured and on-going dialogic conversations with teachers about their practices and the overt and covert discourses of their

students provide context-specific opportunities for transforming schools into more comprehensively inclusive spaces.

In closing, when one of the girls was asked what she would like her teacher to do to improve the negative gender-based behavior of the boys, she responded, “I would like Mrs. Lopez to divide the class into boys and girls so that the girls did not have to deal with all of the drama.” Perhaps listening more closely to focus groups of boys and girls separately may be the ultimate approach toward establishing a more multicultural, student-centered, and fruitful learning environment that pays as much attention to the students’ academic growth as it does their gender identity development.

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