

Using Sociotransformative Constructivism to Create Multicultural and Gender Inclusive Classrooms: An Intervention Project for Teacher Professional Development¹
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Abstract

Maxima was an intervention project that focused on assisting teachers to establish more inquiry-based, gender inclusive, and culturally relevant learning environments. We grounded the project by using sociotransformative constructivism as a theoretical framework to steer the implementation of three guiding concepts for professional development. These guiding concepts were: (1) Being Responsive and Theoretically Explicit; (2) Providing On-going and On-site Support; and (3) Reflexive Approaches to Collaboration. Our analysis of multiple data sets gathered during the first year of the project indicated that most of the teachers responded positively to the proposed guiding concepts and significantly changed their teaching practice.

Laying Down Invisible Boundaries

Those of us who are committed to exploring more effective ways to strengthen university/schools professional development partnerships face many challenges (Johnston, Brosnan, Cramer, Dove, 2000). As teacher educators/researchers, we are aware that university faculty members are often perceived as spending most of their time in an “ivory tower” (Lortie, 1975; Zeichner, 1996; Loucks-Horsley, Hewson, Love, & Stiles, 1998; Johnson, Peters, & Williams, 1999). Even those of us who appreciate the reasons why some teachers and school administrators may have this perception are not exempted from the need to develop the kind of professional trust that can lead to having open and constructive dialogues with teachers about their (our) everyday teaching practice. Therefore, this paper is about our efforts as teacher

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educators/researchers to build transformative relationships with public schools through a two-year project, and what we learned as a part of that process. Our study, Maxima, was a professional development and research project that focused on improving the academic participation of culturally diverse girls in science, mathematics and technology from economically impoverished schools in the Southwest Borderlands of the United States. To this end, our study was an *intervention* project; that is, we sought to impact teachers' practices through research-based insights and innovative approaches to teaching and learning. Furthermore, we sought to evaluate the outcomes of such intervention through the analysis of multiple data sets. Hence, the research questions at the center of this study were:

1. How did the participants respond to this intervention project and its approach to professional development?
2. How did the professional development experiences in Maxima impact the teachers' classroom practices in terms of being student-centered, gender inclusive and multicultural?

Our project expands on what other teacher educators and researchers have suggested for the establishment of effective teacher professional development. For instance, we are in agreement with Loucks-Horsley, Hewson, Loves and Stiles (1998) description of *professional development experiences* as a more inclusive term that allows for teachers' voices and needs to be considered. This and other key terms used in the paper will be explained next. This is followed by a description of the intervention/research design we implemented, and how teachers responded to these approaches to professional development. Based on the analysis of multiple data sets, we also provide evidence of how our intervention study impacted the teachers' classroom practices. While our intervention was very productive at multiple levels, we did encounter some challenges or barriers that require further study. We hope that insights gathered

from this intervention study will assist other teacher educators and school district officials in their professional development efforts.

Calls for Standard-Based Teacher Education Reform and their Accompanying Silences

In recent years, a wave of calls for standards-based reform has swept the country. Politicians, interest groups, professional organizations, educational leaders, and even teachers' unions are calling for standards-based reform (e.g., American Federation of Teachers, 2000; National Science Foundation, 1996; American Association for the Advancement of Science, 1989). Two major driving factors in the calls for reform are the need to prepare teachers to meet the needs of diverse learners and to build stronger university-school partnerships (Loucks-Horsley, et al, 1998; National Research Council, 1996; National Science Foundation, 1996; Holmes Group, 1995). However, these new calls for reform have accompanying silences that threaten their implementation and long-lasting impact. For instance, one important aspect missing from the reform rhetoric is specific suggestions for meeting the challenges, tensions, and risks associated with working with teachers to implement the sweeping changes being proposed (Rodriguez & Kitchen, 2005; Rodriguez, 2004, 1997). Our study begins to address some of the silences in the education and teacher education reform literature by highlighting insights gathered from the first phase of Maxima, a longitudinal professional development research project.

In terms of developing university and school partnerships, many studies have focused on describing the tensions and challenges associated with establishing professional development schools (Dickens, 2000; Johnston, Brosnan, Cramer, & Dove, 2000). However, within the literature on building school-university partnerships, there is little research on the strategies for

and impact of professional development experiences that focus on gender inclusive, inquiry-based and multicultural practice. Though in many instances teaching all children and teaching for diversity are advocated within these partnerships, this body of research usually expects teachers to tackle teaching for diversity and understanding without examples and guidance on how to meet the demands of working with students from economically impoverished, diverse, and urban-schools. One case in point is the popular book, *Designing Professional Development for Teachers of Science and Mathematics* (Loucks-Horsley, Hewson, Loves and Stiles, 1998). After a review of the literature on teacher professional development, these teacher educators argue that the following “seven principles” represent an improvement in professional development approaches over the last 25 years. Effective Professional Development Experiences:

1. Are driven by a well-defined image of effective classroom learning and teaching.
2. Provide opportunities for teachers to build their knowledge and skills.
3. Use or model with teachers the strategies they will use with their students.
4. Build a learning community.
5. Support teachers to serve in leadership roles.
6. Provide links to other parts of the education system.
7. Continuously assess themselves and make improvements to ensure positive impact on teacher effectiveness, student learning, leadership, and the school community (p. 36).

We believe that even though these principles reflect an attempt by Loucks-Horsley and her colleagues to assist teachers to learn to teach for understanding, they fall short when it comes to making specific connections between teaching for understanding and teaching for diversity.

The research and pedagogical design of Maxima was developed in order to bridge this gap in the literature. We make teaching for diversity a central driving concept throughout the

implementation of the project, and we sought to assist teachers in implementing such practices within the specific cultural contexts of their classrooms. Therefore, we expand on Loucks-Horsley et al's (1998) principles² and use five additional *guiding concepts* in our collaborative work with teachers: 1. Being responsive and theoretically explicit; 2. Providing on-going and on-site support; 3. Facilitating reflexive approaches to collaboration; 4. Providing opportunities for enhanced communication among university and school faculty; and 5. Utilizing assessment strategies that are on going, responsive, and are derived from research methodologies that move beyond end of program evaluations.

For this manuscript, we will only report on the first three guiding concepts, and they are defined as follows:

1. Being Responsive and Theoretically Explicit: Professional development experiences (PDE) that promote multicultural understanding are responsive to teacher needs while explicitly acknowledging the theoretical underpinnings of the facilitators of the experiences. School and university agendas are shared and merged to create meaningful PDE's that include the modeling and naming of curricular and pedagogical practices that align with the theoretical orientation of the project, in this case, sTc.
2. On-going and On-site Support: Professional development experiences that promote multicultural understanding provide on-going and on-site professional support including modeling sTc activities, making resources and equipment readily available, and supporting sTc activities in the teachers' classrooms.

² We have decided to use the words "guiding concepts" instead of "principles," due to the totalizing and constraining connotations the word "principle" invokes for us.

3. Reflexive Approaches to Collaboration: Professional development experiences that promote multicultural understanding provide reflexive³ approaches to collaboration, building a community of learners that includes teachers, student teachers, university professors, and graduate students that provides continuous opportunity for professional dialogue across and within school contexts.

These additional guiding concepts are informed by sociotransformative constructivism, so this framework and its connection to multicultural and gender education need to be explained before discussing how we enacted our guiding concepts within the Maxima Project.

Sociotransformative Constructivism

The conceptual glue that is informing our work with teachers and that is helping us address the gaps identified above is *sociotransformative constructivism* (sTc). This is a theoretical orientation to teaching and learning which affirms that knowledge is socially constructed and mediated by cultural, historical, and institutional contexts (Rodriguez, 2002, 1998). However, this orientation goes beyond this affirmation by creating praxis with the participants to collaboratively deconstruct the structures of power that sustain the ruling education hegemony. sTc is an orientation that draws from multicultural education (as a theory of social justice) and social constructivism (as a theory of learning). For us, it makes good sense that if we wish teachers to learn to teach for diversity and for understanding, we must use a theoretical framework that merges multicultural education tenets with a sociocultural theory of learning. In our work, learning to teach for diversity means learning to use more gender inclusive and socially relevant teaching strategies; learning to teach for understanding involves learning to implement more critically engaging, inquiry-based, and intellectually meaningful strategies.

³ Using the STC framework, reflexivity is more complex than reflection. Being reflexive explicitly acknowledges how one's cultural positions, privileges and ideological underpinnings come to inform one's actions and reactions to

Therefore, through sTc, learning to teach for diversity and for understanding can be accomplished by enacting four interconnected components: The *dialogic conversation*, *authentic activity*, *meta-cognition*, and *reflexivity*. Due to space constraints, these terms will only be explained briefly below.⁴

According to Bakhtin (1986; 1981), the dialogic conversation involves engaging in a deeper kind of exchange through which the goal is to understand not just what is being said, but the reasons (emotional tone, ideological and conceptual positions) the speaker may have to choose to say what he or she says in that particular context. Thus, developing trust amongst the project participants was paramount to establishing a productive exchange of ideas and a fruitful community of practice.

Authentic activity involves hands-on, minds-on activities that are also socio-culturally relevant and tied to the everyday life of the learner. This implies that it was not enough for us to highlight the importance of more gender-inclusive curriculum in—for example—space exploration. We also needed to model how this curriculum could be enacted, by engaging teachers in authentic activities and providing support for them to implement this curriculum in their own classroom contexts. The third element of sTc is metacognition. This term is defined as the “knowledge, awareness, and control of one’s own learning” (Baird 1990, cited in Gunstone, 1994). As such, teachers and students should be encouraged to ask questions about the purpose for and the reasoning behind certain activities. In this way, the learner could become more reflective about his/her preferred learning patterns and how they interact in preventing or assisting her/him how to learn new concepts.

the issues being considered or curriculum being taught.

⁴ For more details on sTc, the reader is encouraged to see Rodriguez, (2005, 2002; 1998). These manuscripts also include more examples of how sTc was applied in elementary, high school and college-level classroom settings.

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 it is 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.

How is sTc more specifically connected to gender inclusive and multicultural education, and how did we use these theoretical frameworks to inform our work?

Connecting Multicultural and Gender Inclusive Education to sTc

Given the multiple definitions that are associated with multicultural and gender inclusive education (Bennett, 2003; Sleeter and Grant, 1993), it is important to explicitly define what these terms mean to us and in our work with teachers. The basic premise of multicultural and gender inclusive education is that all learners at any grade level must be provided with equitable opportunities for academic success. It is not enough to simply encourage all learners to celebrate and study the contributions of men and women from various ethnic backgrounds.

Multiculturalism requires that it be made a driving principle in the development and implementation of policies, curriculum, and assessment. The end result is not only providing equitable opportunities for access, but also opportunities for equitable outcomes. In addition, multiculturalism seeks to provide learners with opportunities for empowerment. This is particularly important in science education because a very small percentage of our scientists come from traditionally underserved backgrounds (i.e. Latinos or Hispanics, African American, Native American or First Nations, and/or female students).

Though we argue that issues of gender equity rightly fall within our definition of multicultural education, gender is usually not discussed in integrated ways within much of the multicultural literature (Zozakiewicz, 1999). Therefore, throughout this project, we emphasized the use of the term multicultural and gender inclusive education. By gender inclusive we mean the development and implementation of curriculum, instructional practices and learning environments that provide equal access and outcomes to girls, particularly within content areas where women are underrepresented, such as, science, math, engineering and technology.

We draw on our own experiences and the literature (Sadker & Sadker, 1994; Clewell, Anderson & Thorpe, 1992; Rodriguez, 2002) to model and encourage teachers to implement a variety of practices that are demonstrative of multicultural and gender inclusion and that are congruent with the inquiry-based and social constructivist orientations that guided Maxima.

Some of these key approaches modeled during Maxima included:

- Develop teaching situations that are relevant, authentic and meaningful for girls as well as boys.
- Monitor groups for equity in terms of participation and use of resources.
- Use non-sexist and inclusive language, and resources.
- Display images of men and women in career roles from various ethnic backgrounds and investigations into why these scientists pursued careers in science, mathematics, engineering and/or technology.
- Encourage collaborative learning and avoid competitive environments.
- Provide opportunities to critically reflect on the impact of gender and cultural practices on our daily lives and society.
- Explore who makes decision about what is defined as science or research worth doing. Who benefits or not from established definitions and research trends in the sciences?

The elements of sTc explained earlier facilitate the implementation of these challenging approaches to teaching. In short, sTc can be perceived as the bridge that leads to empowerment by connecting multicultural and gender inclusive education (a theory of social justice) with social constructivism (a theory of learning). We define empowerment as the voice that individuals use to enact their rights and responsibilities; whereas, equity is the social and

institutional process by which individuals can attain empowerment. Therefore, though equity can be mandated by law, only empowerment can be facilitated. It is up to the individuals and/or groups of individuals ultimately to enact their own voices.

Using these insights, we have taken steps through Maxima to begin to address the multicultural education silences that exist within the teacher education literature. Although there has been an increase in the scholarship on what multicultural teacher education should include over the last decade, there is still a large gap regarding specific strategies for implementing multicultural and gender education in university and school contexts (Martin, 1995). For example, the literature that speaks to multicultural teacher education practices most often concentrates upon a single course within a teacher education program (Ahlquist, 1991; Sleeter, 1996). Though these studies offer rich insights into how pre-service teachers respond to multicultural courses, they do not discuss how such understandings are translated into practices for diversity within the field (Martin, 1995; Sleeter, 1996). In addition, when one looks to the literature on multicultural education and student teaching, the silences remain undisturbed. According to Grant and Zozakiewicz (1995), for example, most of the literature on the stakeholders in the student teaching experience--student teachers, cooperating teachers and university supervisors—only superficially addresses how to include multicultural education issues within this portion of teacher education programs. More longitudinal studies, like Maxima, are needed to yield insights into how teachers translate their multicultural, gender inclusive, and social constructivist understandings into their own practices. These studies will also help us gather evidence on whether these pedagogical approaches positively impact the academic achievement and participation of traditionally underserved students in science, mathematics and technology.

Design of the Research and Professional Development Project--Some Highlights

Maxima was a three-year long professional development research project that took place in the borderlands of the U. S. Southwest and involved a partnership between university faculty, local school district faculty and pre-service teachers. The principle investigators of the project were university professors, one in science education, and the other in the student teaching program. We, as teacher educators/researchers, brought different cultural and gender positions to the study; one of us is a Latino who is bilingual in Spanish and English, and one of us is an Anglo female.

In terms of teacher participants, the project included all of the grade 4, 5, and 6 teachers (in special, regular and bilingual education) who taught math and science, from three elementary and two middle schools in a local school district. All schools had a mainly Latino/a student population (70%). The selection of elementary and middle schools was based upon the commitment of the teachers, and the regional aspect that the students in the selected elementary schools would move to the selected middle schools as part of the district feeder pattern. Of the 20 teachers involved during year one, 9 were Latinas, 1 was Latino, 1 was an African American woman and 9 were Anglo females. Throughout the first year of Maxima, a representative cohort of forty grade 4 girls, mainly Latinas, was selected from the participating elementary schools to be followed through grade 6. Each year the Maxima girls were to be placed in classrooms with Maxima teachers. In addition, 3 student teachers were recruited to be a part of Maxima during year one and were placed with 3 of the participating teachers for their student teaching experience during the spring term.

Maxima Professional Development Experiences

On-going professional development experiences were built into the Maxima Project. For example, each summer a two-week long summer institute was provided, which all teachers were expected to attend. These institutes were collaboratively designed with the participants and focused upon meeting their academic and professional needs. The first institute focused upon the integration of science and learning technologies while the second institute focused on the integration of science, math, engineering and learning technologies.

In addition to the summer institutes, the Maxima teachers and student teachers were required to participate in monthly meetings to discuss progress and concerns with colleagues. These meetings were also the place where the participating teachers presented the sTc curriculum and instruction they were implementing in their classrooms. Once a year, these monthly meetings became daylong workshops that covered content requested by the teacher participants. For example, during year one, a full-day learning technology workshop was created to address their professional and instructional needs in this area.

Data Collection and Analysis

Multiple data sets were collected throughout the entire Maxima project to assist in answering the following research questions:

1. How did the participants respond to this intervention project and its approach to professional development?
2. How did the professional development experiences in Maxima impact the teachers' classroom practices in terms of being student-centered, gender inclusive and multicultural (sTc)?

The teacher participants were interviewed 3 times during year one of Maxima, immediately after the first summer institute, at the end of the fall semester and at the end of the spring semester. Interviews included both project PI's and one teacher participant and usually lasted

between 45-60 minutes in length. Interviews included pre-determined sets of open-ended questions such as the following:

1. What are your general impressions about Maxima so far? What about Maxima has been useful or beneficial to you as a teacher?
2. Have your practices as a science or math teacher changed since becoming involved in the project and if so explain?
3. Please give some examples of activities you implemented in science and math this year that were multicultural, gender-inclusive or student-centered?
4. How did this project's Summer Institute compare to other professional development experiences you have participated in? Please explain.
5. What would you change about the summer institute or project to help it improve and why?

Beyond these kinds of questions, teacher participants could add additional information or ask questions about our work or the project during each interview. Often the interview questions would lead to dialogic conversations where together we would recollect and reflect on what we each witnessed within that particular teacher's classroom over the designated amount of time.

In addition to teacher and student teacher interviews, we interviewed focus groups of the Maxima girls at each grade level and school site at the beginning and end of each year of the project. Finally, on-going surveys, transcripts and video clips of monthly meetings, classroom activities, field notes, district documents, and various school assessment artifacts were also collected. For this paper, we concentrated on one section of analysis within the larger research project. Our interest here is in sharing the analysis of the surveys, interviews, artifacts and field notes that directly pertain to the professional development experiences provided for the teachers

during year one of Maxima and the impact these experiences had on their practices with their students.

Using an ethnographic approach to data analysis (Lincoln & Guba, 1985; Spradley, 1979), all interviews, surveys, videotapes, transcripts and field notes were read several times by members of the research team. After coding these data sets, prominent categories surfaced across the data. The research team determined the strength and validity of the categories 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), we were able to draw relevant insights about the impact Maxima had on the teachers and researchers' efforts to learn to teach for diversity and understanding during year one and deduce which guiding concepts seemed to be having the most positive impact on the project participants. Though science and math are the content areas for this project, we believe our findings reveal insights that will prove beneficial to the larger professional development and reform literature within and beyond math and science.

Findings

As mentioned earlier, in this manuscript we will discuss only three of the guiding concepts implemented in this intervention project. Analysis of multiple data sets indicate that the participants found the implementation of the project's guiding concepts useful in various ways. To facilitate discussion, the categories emerging from our qualitative analysis are organized into two sets—one set of three categories for each research question as indicated in Figure 1. Even though these categories cut across guiding concepts, we provide relevant examples using the teachers' voices and other data sources to illustrate how the teachers first responded to the

guiding concepts (Research Question #1) and how the guiding concepts implemented impacted their teaching practices (Research Question #2).

[INSERT FIGURE 1 HERE]

I. How Did the Participants Respond to this Intervention Study and Its Guiding Concepts for Professional Development?

In terms of beginning to capture the effectiveness of this project design and theoretical orientation towards professional development and multicultural school change, three major categories emerged in response to the first research question:

1. Being heard and seeing the modeling of sTc pedagogical strategies
2. Feeling supported
3. Sharing ideas and making connections

Being Heard and Seeing the Modeling of sTc Pedagogical Strategies

[Guiding Concept #1: Being Responsive and Theoretically Explicit]

One of the approaches used to implement the Guiding Concept, Being Responsive and Theoretically Explicit was the development of summer professional development institutes that were responsive to the teachers' curriculum needs and concerns. In other words, the institute's activities were based upon teachers' surveys and district and state content standards. Once the content area needs were identified, we developed and presented corresponding curriculum activities that modeled social constructivist, multicultural and gender inclusive (sTc) practices. 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 fourth grade science curriculum. After reflecting upon their requests and the science standards, we developed a problem-solving scenario where the teachers/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 are told that their spaceship was damaged and lost in space. The only way they could discern where the ship was located was to send the rover to the unknown planet they were now orbiting and hope that they could establish communication with Earth (a communications tower was also hidden in the scenario). Teachers also had to maneuver the rover using only the remote control and the television images being sent by the rover's camera. After this activity, we facilitated a discussion of how the curriculum and instruction we modeled was sTc so that teachers could connect the theoretical orientation to the practices being modeled. We also discussed how such a learning activity could be modified to meet their specific students' and context needs. This is one example of how we responded to the teachers' requests, while designing an activity that was social constructivist and made explicitly so through post reflective dialogue.

Across all the interviews, teacher participants named seeing *the modeling* of theoretically explicit sTc activities, as one of the most important parts of the project in terms of helping them to improve their teaching practices with children. Teachers often commented that they could see how these kinds of modeled activities were student-centered, and how the students would have to apply their subject-matter knowledge in relevant ways. The participating teachers also explained how activities like the Mars Rover were multicultural and gender inclusive by the way we stressed equitable control of technologies and class participation. The teachers also found useful an article that described short biographies of all of the female astronauts in the history of the NASA program. Several of them explained that they never knew that there were Latina astronauts. Two teachers explain further the importance of the *modeling of sTc activities* during the institute:

A lot of times, when you go to workshops...people teach you how to do things, but they don't implement the program ...in the same way they want you to implement it. So you don't have a model. I feel that we have a model with Dr. R and Dr. Z, because they modeled what they are asking us to do, during the institute. ...And I think that's beneficial. I learn more from a model than I do from reading a book (Lucy, SII, 11).

I was really impressed with the institute. I thought that we were going to probably have more lecture type sessions. So I was just thrilled that is was lots of hands-on activities. Stuff you can definitely come back and use in the classroom. ...I liked that they took our suggestions and created lessons. We will be teaching the solar system and electricity. So they gave us great ideas for what we can do. Especially with space, because that was an area I was unsure about. So I'm excited about trying some of these activities in the classroom (Maria, SII, 1).

In addition to naming the modeling of sTc activities as very beneficial, 70% of the participating teachers directly noted that they felt they were *being heard* within the project and that the project staff listened and responded to their needs as professionals. They claimed this was very beneficial for their professional development. Pamela and Graciela, two of the participating teachers, provide examples of how they *felt their voices and needs as teachers were being heard* and responded to within the project through the *modeling useful sTc activities*:

I found that what I marked on my paper [pre-institute survey to teachers] about things to cover that was related to my curriculum, were indeed covered in the institute. And that meant I was able to learn some things, come back and apply them. And that's what I really enjoyed. Just the application part. I was going to be able to use it (Graciela, SII, p. 1).

It [Maxima] gave us lots of ideas. The rover thing was perfect. Because we do the solar system and we were able to take that and learn about planets and then try to give them hands on experience, because we really can't go to Mars. It helped us with that and the kids liked it. So we used that idea (Pamela, I2, 23).

Feeling Supported

[Guiding Concept #2: On-going and On-site Support]

As we recruited schools and teachers to be a part of Maxima, we explained from the start how this project would be different in terms of the in-classroom and on-going support that teachers and their students would receive. These promises were met with healthy skepticism, as is evidenced by the number of times we had to meet with school teams before they agreed to make a two-year commitment to the project. This skepticism stems from, as the professional literature attests, that often, professional development opportunities are constructed in a one-time serve-all format. Seldom if ever is classroom support provided in an on-going manner after the workshops are concluded.

To implement the Guiding Concept, On-going and On-site Support, we made regular weekly on-site visits to the classrooms during math and science instruction. The research team consisted of faculty and graduate students with varying teaching experiences. Following the sTc framework, we established dialogic conversations with the teachers about their practice, and we provided support for their students to conduct authentic and culturally relevant activities by making available resources and equipment. Below, Jane discusses the category - *feeling supported* - and illustrates how the teachers were responding to this guiding concept:

I think just having professionals that you're in contact with, that you can get, if you need information on a content area, or you need materials or just additional support. I think that was very helpful. (Jane, I2, 48).

Other examples of on-going and on-site support included: monthly meetings for sharing classroom activities and discussing issues relevant to project with other teachers and project directors, delivering and setting up equipment, mentoring during the use of technology, leading learning centers with the students as their teachers lead at other centers, team-teaching, observing, and assisting as asked, and attending field trips, science fairs and other school-based activities.

Again here in response to this guiding concept, 70% of teachers explained that *feeling supported* was one of the most helpful parts of the project. While only 30% mentioned the access to science and technology equipment as beneficial within interviews, other data sources showed that 8/8 of the 4th grade teachers, 5/6 of the 5th grade and 4/7 of the 6th grade teachers used one or more pieces of the equipment provided by the grant during the first year. In fact, all of the Maxima schools had a very small budget for equipment and materials, particularly in the area of science. Therefore, the materials used during the summer institute were loaned to the teachers during the school year so that they could implement similar activities in their own classrooms. Some examples of materials and equipment available to teachers included: digital cameras, graphing calculators with classroom-based lab units (CBL2's⁵), fast plant and electricity kits, and robotic kits for constructing space rovers. To maximize use of this equipment, we placed the materials in teaching kits inside plastic crates so that teachers had all the necessary materials organized in one place to use with their students. One teacher shares how the equipment provided by the project would *support* her teaching:

Last year, when I came to fifth grade at [this] school, I had no science equipment. NONE. And by the end of the year, I had acquired a little...

⁵ The classroom based lab units (CBL2's) are hand held laboratory equipment that can be easily attached to a graphing calculator and to various probes for conducting scientific experiments and graphing data. Examples of probes include light, electricity, motion detectors and heart rate monitors.

...But with the resources [through Maxima], I see a real improvement in the way we can do science next year (Lucy, S11, 7).

Finally, Blanca shares how she *felt supported* by Maxima in different ways than those she had experienced in other professional development workshops:

I'm very proud that I was able to be a part of it [Maxima]. Because I think it's just helping me to become a better teacher. I was in awe ...of the support that we've received, and that it's going to be an on-going process. That it didn't end when the session [institute] ended. That everyone's willing to come and help us with support if we need any kind of help. That for me is really good because I've never had anything like that. As educators, I think we feel like they just hang up on us and say, "Ok, here, go at it." But here, they're willing to kind of walk us through it, if they need to. And help us, with support in any way (Blanca, I2, 35).

Sharing Ideas and Making Connections

[Guiding Concept #3: Reflexive Approaches to Collaboration]

As the facilitators of the Maxima project, we worked diligently to develop a community atmosphere amongst the different participants and project staff. We accomplished the Guiding Concept, Reflexive Approaches to Collaboration, in a variety of ways. To begin, we provided opportunities for deconstructing the university/theory image as being above teachers and school practice by moving away from false dichotomies through frequent school visits, monthly meetings, on-going conversations, building collegial and trusting relationships with the teachers as professional colleagues and facilitating relationships with teachers within and across school sites.

Based on interviews, 65% of the participating teachers shared that the opportunity to *make connections* with other professionals was valuable, while 80% noted that the opportunity to *share ideas* and see how other teachers implemented those ideas in their own classroom contexts, also proved to be important to their growth as teachers in line with project goals. Julia demonstrates how *sharing ideas* facilitated the development of collaborative relationships across school sites:

At our last [monthly] meeting, when we were here we did our presentation and I mentioned the kids did their own progress reports. You know Jane, from [another school] came to me and asked, “How do you do it? How do you do the formula? Because I haven’t done Excel yet.” So I went to my computer real quick and showed her, wrote down the formula for her and I told her MY kids did it. ... [So it’s great that she] did not feel intimidated to ask (Julia, I2, 38).

Jane discussed the same incident in her interview, explaining:

Well first of all, as far as the institute and monthly meetings go, I think it’s nice to see other teachers in your same situation and what they are trying to do. And even the other day, when Julia was saying how she used Excel... and because I knew her I pulled her aside, “Show me how to do this.” Where, if I would have met her just one time, I would never have asked her (Jane, SI, 25)

Another strategy involved holding explicit discussions of how our cultural positions frame our beliefs and teaching practices. These discussions also became an important component of building a trusting, productive and reciprocal learning community. We already mentioned that, following the sTc framework, we modeled how dialogic⁶ conversations,

⁶ Dialogic conversation can be defined as the exchange of words or ideas where the goal is not only to understand what is being said, but also why the speaker chooses to say what he or she states in that particular context.

reflexivity, metacognition and authentic activities can be implemented in the classroom.

Therefore, after each of our presentations at monthly meetings, summer institutes, and/or team teaching, we encouraged and requested reflective feedback and critiques about our teaching practices. We then took those critiques into consideration as we planned future activities for the project.

In addition to learning from the feedback of the teacher participants, we also reflected upon our practices as the facilitators of professional development when we assisted and observed in Maxima classrooms. For example, we visited one elementary school to assist in and observe the fourth grade classes launching water bottle rockets they had built as a part of their science assignments. This was an activity we introduced to the teachers during the previous summer institute, where we all participated in the activity and discussed it in terms of gender and multicultural issues. As we observed in the school setting, we noticed that some of the student-centered, gender inclusive elements were missing from the rocket launch, as they had been practiced and discussed in the institute. The following vignette discusses this in more detail:

One day, we went to help two fourth grade teachers conduct a water rocket launching. The teachers had learned how to build their own rockets and launcher during the institute, and, as part of our commitment, we were at the school to assist. It was obvious that the students had a lot of fun, and that the teachers (both Latinas) were attentive to involve the girls in all aspects of the launch. However, we felt that some opportunities for conducting the activity in more inquiry-based and social constructivist ways were missed by not having students who were waiting to launch be more involved. For example, we had discussed during the summer institute how students who were not launching rockets could be calculating the height of the rocket's flight. We also felt that the students could

have been more purposely thinking about how different variables (amount of water or pressure used, design of the fins, etc.) had an impact on their rocket's flights (Field Notes, Year I).

These field-based observations offered an opportunity for all of us to reflect upon how we could more directly make our practices with children sTc and inquiry-based. As researchers/teacher educators we learned to be even more explicit in our practices with teachers and to follow up on implementation in school contexts. In addition, after observing the partial implementation of sTc at this rocket launch, we brought this to the whole groups' attention at the monthly meeting. In fact, we created a set of reflective questions for teachers to ask before and after they implemented activities with their students to ensure it attended to the goals of sTc. We typed the questions on tag board so teachers could post them in classrooms and shared our reflections and these questions at the following monthly meeting with the whole group. Later, when visiting classrooms, we noticed that most of the teachers had posted the questions near their desks or had clipped them into the front of their weekly planners to serve as a reflective tool for planning. The reflective questions were⁷:

1. What math and/or science content knowledge do I expect the students to learn during this activity?
2. How is/was the activity multicultural, gender inclusive and social constructivist (STC)?
3. How can I assess students so that I know that 1 and 2 were met?
4. If 1, 2 and 3 were not met, how will I change this activity and/or my approach next time to ensure that they are?

Other strategies we implemented to assist teachers become a more reflexive and collaborative community of learners involved building closing reflection times into each activity at the summer institutes and monthly meetings. That is, this structured time enabled us to reflect

⁷ These questions can be found on the Maxima website, housed on the chart we created for the teachers.

upon and discuss how the activities being presented/modeled were multicultural and gender inclusive, and how these activities could be modified to fit particular grade levels and contexts.

Maria (I2, 2) explains how she found these opportunities for *sharing ideas and making connections* useful:

I'm just building up my units and stuff. . .[and] I think, just the great support we got from each other. The monthly meetings were great, because if we had any questions, maybe someone else brought it up. That we think, well gosh, am I the only one maybe this is happening to? It's neat to see how they maybe solved it, or some suggestions for what we could do.

Another teacher discusses the cross-grade level conversations that occurred with her team:

We [5th grade teachers] had a conversation with the 4th and 6th grade teachers that we might do bottle rockets each year, and then they could build on the knowledge the students had used before. So...during the institute, we were able to talk with people at different grade levels, which makes it easier to present a coordinated program (Delia, SI1, 1).

II. How Did this Intervention Study and Its Guiding Concepts Impact Teachers' Practice?

In the previous section, we discussed the categories that illustrate how the teachers responded to the guiding concepts that were the most beneficial to their professional growth. Now, in this section, we provide an analysis that shows how the guiding concepts positively impacted teachers' school practices and helped to make their science and mathematics' teaching more multicultural, gender-inclusive and social constructivist. To this end, the following three categories are examined: 1. Motivation to take a fresh look at teaching practices; 2. Affirming,

naming and raising awareness about multicultural teaching practices; and 3. Translating and converting sTc activities for specific schools contexts. Following this section, we examine several of the teachers who were less impacted by the project, and a category that emerged to explain their experiences in terms of professional development within Maxima.

Providing Inspiration and the Motivation to Take a Fresh Look at Teacher Practices

Consistently across interviews, for 60% of the teachers, it became evident that the professional development experiences in which they participated in Maxima were helping them to take a fresh and more critical look at their teaching practices [GC: Reflexive Approaches to Collaboration]⁸. A veteran teacher explains:

I have taught for almost twenty years. And it [Maxima] gave me **a fresh look** [emphasis ours] at what I should be doing. It's been awhile since I've been to classes at the university... And so, I really felt like it refreshed and brought back to my mind some things that I had known about in the past. Gave me some ideas that I hadn't thought of before. And gave me a little clearer direction on where to go. (Jane, I2, 37).

Another teacher reinforces the words above, further supporting how this project helped inspire her to make changes in her teaching practices:

For me, this year, being the first year for Maxima, I think the two weeks of training was absolutely what motivated me and what got me going. Once I got into the classroom, the fact that I could call all of you if I had any questions or I needed help in the classroom or anything. It was definitely helpful that I feel a lot better about teaching science. ...It just made me more confident (Julia, I2, 58).

⁸ Throughout this section of the findings, we will indicate the relevant Guiding Concept (GC) within the text in brackets to alert the reader to the connection between the category being discussed and the connecting GC.

Field notes, classroom artifacts and videotape data verify that during our year one school and classroom visits, many of the teachers were more enthusiastic about teaching science and math to their students, and had gained confidence as science teachers. This was evident by their willingness to try new approaches to teaching science and by integrating more learning technologies into their teaching practices, as were modeled in the summer institute. For example, Julia, the 4th grade Latina teacher quoted above, felt motivated enough to begin teaching units right out of the Maxima lesson plans and activities' binder given to the teachers during the summer institute as soon as the fall term began. She implemented activities such as fast plants and water bottle rocket launching, which were activities that she had not done before with her students.

At another school site, Delia and Maria, also 4th grade Latina teachers⁹, implemented the water bottle rocket building and launch activity and Mars rover scenario in their classrooms for the first time, again in the fall directly following the summer institute. The Mars rover and space centers were also implemented at the other two elementary school sites during the fall by all the 4th grade teachers. Analysis shows that all of the fourth grade teachers felt motivated and confident enough to implement two or more of the learning activities presented at the summer institute with their students during year one of the program, the Mars Rover centers being one example. In addition, each school site invited and involved the project investigators in the implementation of these activities, demonstrating their willingness to work with us to enhance their science teaching practices [GC: Providing on-going and on-site support].

⁹ At this same site, the 5th grade Latino teacher also implemented the bottle rocket launch, along with the 4th grade teachers, but this was not the first time he had implemented this activity with his students.

Affirming, Naming and Raising Awareness about sTc

Across data sets, 80% of the teachers were becoming more consistently aware and conscientious about teaching practices that were sTc in orientation--multicultural, gender-inclusive and inquiry-based [GC: Responsive and Theoretically Explicit]. The quotes below demonstrate, in the teachers' own words, how Maxima both affirmed their practices, as well as raised their awareness about bringing issues of diversity into the classroom more directly:

Well, a lot of the multicultural, inclusive and gender inclusive issues we talked about in the summer institute. . .brought a more conscience awareness of what I'm doing. And trying to incorporate that into my teaching. And the lessons... Just so that, I'm more aware of it. You know, where's there's an opportunity, I can find something and implement it. And make it part of my curriculum. ...So I guess that I get used to doing that, and then it becomes habit. I don't have to work so hard. Because it was hard for me., because that kept sticking in my head. How are you going to make it inclusive? How are you going to make it, gender related? So I would work at trying to get those issues in there (Cecilia, I2, 24).

Another teacher goes on to explain how in addition to the affirmations, Maxima also pushed her to a different level of awareness in terms of what multicultural education looked like in practice:

As far as teaching science and math, it [the Institute] just reinforced that yes we do need to do hands on. And it just gave me a lot more tools to use in teaching in a more hands on way. ...and reinforced again the gender inclusion. I have always felt strongly about that. And inquiry based of course. Just to make the lessons worthwhile and relevant. Multicultural is the one that I kept having to think about in different ways. I mentioned

the fruits and vegetables [Activity]¹⁰ earlier. I think I would have gone totally science during that lesson. ...And I would never have mentioned the multicultural aspect about where the fruits came from and what fruits they [the kids] are familiar with. I would have just bypassed that and gotten so excited about the science itself, that I think I would have overlooked the multicultural. And that's what I kept reminding myself of in this institute. Is that aspect of it. Because... I normally tended to save it for a one-time shot rather than putting it into everything (Delia, S11, 5).

Our field notes and classroom video data demonstrate ways in which consciousness about issues of diversity were increased due to participation in the project for year one. To begin, half of the fourth and fifth grade teachers decorated their room with new posters that displayed scientists of diverse gender and cultural backgrounds, or attended to issues of gender, such as discussing and posting a Girls' Bill of Rights¹¹, directly for the first time as teachers during the fall term. In addition, the fourth grade teachers, during the implementation of their space unit, included learning centers that exposed the students to articles about female astronauts from diverse cultural backgrounds, a resource shared during the summer institute. During our classroom visits we often found that teachers were consistently integrating the discussion of culturally diverse female scientists into their teaching practice. Several were also enacting alternative forms of student grouping, such as same gender grouping, to more closely manage gender equity in terms of equipment and roles within groups. These findings demonstrate that many of the Maxima teachers were acting upon their increased awareness of diversity issues within their particular classroom contexts [GC: Reflexive approaches to collaboration].

¹⁰ This activity involved measuring the electricity produced by a variety of fruits and vegetable native to different countries and that were part of the diet of different cultural groups represented in the teachers' classrooms.

¹¹ An example of a Girls' Bill of Rights can be found in *Rethinking Our Classrooms*, Volume 1.

Adapting and Converting sTc Activities for Specific Schools Contexts

When we asked the teachers to share the ways they had implemented sTc activities in the classrooms during year one of Maxima, we gathered the following responses. Six teachers explained that they were making the content more relevant for their students, often talking with them about their own experiences around that issue. Ten teachers shared that they were now bringing in representations of under-represented cultural groups and women into their lessons. Three teachers had begun to practice same gender grouping in science. Twelve teachers shared that they were now holding discussions with their students to help them become more sensitive to and aware of issues of multiculturalism and gender. Seventeen teachers shared that they were making their practices more sTc by doing one or more of the following: implementing authentic activities, using a variety of pedagogical strategies, being more inquiry-based, integrating learning technologies, and teaching the units they developed during the summer institute which included many of the above strategies. Again, we feel that the teachers' own voices better describe the ways in which they had begun to transform their practices to be more inquiry-based, multicultural and gender inclusive [GC: Responsive and theoretically explicit, and Reflexive approaches to collaboration]:

I brought in one of the dad's that's a nurse at the hospital, ...he's a cardiac nurse.

So when we were studying the heart, he came in and did a little talk about the heart, what he does... And then we went into the gender issue. About how he's a male and he's a nurse. And you might think he's a doctor. And he's not a woman and all that. That was a good opportunity because he was an actual person

(Cecilia, I2, 11).

Another teacher explained how she started to notice that the students themselves were taking the initiative to make their classroom more gender inclusive:

I can start by telling you after doing the gender issues with Maxima that my students picked up on that themselves. When we do any questioning or reading ... they chose a boy then a girl. They would do this to make sure there's fifty percent equality in...participation. And they'll remind each other, especially when a student is running something, "You've already called on a boy it's a girl's turn." I did some same gender grouping... That way the boys don't take over and it's a lot better. For the girls especially, if you're doing the kind of activities where you have somebody doing the note taking and so forth. Because what will end up happening every time is that the boys will expect the girls to do all the clean up. They'll [the boys] do...run all the experiments. But when you have the girls doing their own thing, they're sharing jobs that they would not normally do. And they get along better (Elizabeth, I2, 9).

Finally, a veteran middle school teacher shares how her practices became more project-based:

I'd say this was my best teaching year ever. And I'm glad to be able to say that. I think that has a lot to do with outside forces. Such as Maxima... And just doing more in-depth projects. You know, the less is more attitude. Right now we are doing our architecture unit [developed during institute] (Martha, I2, 1).

Analysis of our classroom videotapes, field notes, and observations during monthly meetings indicate that all the teachers involved were implementing one or more sTc activities within their classroom contexts. For example, Elizabeth redeveloped the Mars rover activity

demonstrated during the institute for her diverse fourth graders. She borrowed the rover kit for a week so that her students could collaboratively redesign and rebuild a rover that could complete certain tasks she had set out for her students. In this situation, groups had to work together, just like NASA scientists, to continue improving and building different components on the class rover. Overall, such examples show that year one results were positive indeed in terms of helping teachers improve their teaching practices in math and science to be more sTc.

Challenges Encountered

As it would be expected, although we were able to establish very productive professional development partnerships with most teachers, we also encountered some barriers or challenges to our efforts. Based on analysis of data, challenges encountered emerged into two general categories: 1. Challenging entrenched practices; and 2. Managing healthy tensions amongst project teachers. Due to space and the focus of this article, we will only discuss the first challenge, as it most closely pertains to the professional development results of year one of the project. The second strategy will be discussed in a future manuscript.

Challenging Teachers' Entrenched Practices – We Are Already There

While a majority of teachers in the project, (85%) described how their participation was energizing them, was increasing their awareness on issues of diversity, and was improving their science and mathematics teaching in multicultural, gender inclusive and student-centered ways, three of the teachers remained more complacent in their teaching positions. Though they participated in Maxima for the full duration, the positive impact Maxima had on their teaching practices during year one was less evident than with other teachers. When interviewing these teachers, two who were veteran teachers who had been teaching for over 20 years, one a Latino and one a Latina, and the third, an Anglo woman teaching science at the middle school level who

had been teaching for over 10 years, a category emerged across their discourse that we are calling – Entrenched Practices - We Are Already There. We identified this to be the case in two manners. First, some teachers felt that the work they were doing was already multicultural and student-centered in nature, and therefore, change was not really needed. For example, during the end of year one interview with Pedro, a Latino fifth grade teacher who was working on his PhD in the area of science and multicultural education, had this to say about how Maxima was helpful to him as a teacher:

In terms of the grant, I already do all of the things the grant is after. All of my science activities are constructivist, and I talk about issues of cultural diversity with my students all the time. So the grant for me has been more about helping the other teachers in the project change their practices, and for me to share what I have been doing with my students, showing what students of color can really do in science (Pedro, I2, 4).

Now it was quite accurate that Pedro was already a teacher leader in many of these areas, and did implement many hands-on and culturally relevant activities with his students in science and math. Due to his impressive amount of craft knowledge, we invited him during to lead a session during the summer institute to honor his expertise. Yet in visiting his classroom, we found evidence that within his cooperative grouping structures, there were students, many of them girls, that were not as engaged or participating as equally as the boys. And when facilitating activities such as the water bottle rocket launching, often his boys and he himself would dominate the handling of the equipment, more so than the girls. When bringing this to Pedro's attention during formal and informal conversations, in the hopes he might become more deeply reflective about his practices in terms of gender, and therefore see how the project might provide an opportunity to look more critically at his practices, he would instead steer the conversation in

another direction by sharing a scenario about how the girls did participate in another activity in a more equitable way and that he had been teaching for many years and was therefore aware of such issues. This conversation became a recurring one with Pedro, that we continued to facilitate as we felt it was our role to continue to help the teachers reflect on their practices more deeply based on the field notes we were gathering. What they chose to do with such conversation and data, we found in this case, we could not control.

A second example of challenging entrenched practices involves another veteran teacher that had taught so long and seen so many approaches come and go, that she was not willing to transform her entrenched practices in any significant ways at this point in her career:

...People have different ways of learning. So we end up doing both. We talk about it. But then we do the rote things... like I say, some of them just need that practice, to do it. And later on, it's going to click. [Interviewer adds— Well it sounds like you do something balanced...] I think there has to be balance. Because I feel like math has gone like a pendulum, they swing to one end when they did modern math. And then they swing to the other end. And I think you need a firm basis that goes across the board. You they need to do projects...but you need your basic facts and you need your skills (Petra, I2, 21-22).

During our classroom visits, we often observed Petra conducting engaging and well-planned lessons. She after all was a veteran teacher with a wealth of knowledge and confidence; however, in terms of meeting the goals of this project, we saw little evidence of she making her classes more gender inclusive, multicultural and/or inquiry-based. She had developed a balance of traditional and problem-based mathematics, and was going to stick to her plans at the end of her career.

Conclusion: Rethinking Professional Development for Diversity and Reform

We have argued that the principles for effective professional development experiences described by Loucks-Horsley, Hewson, Love and Stiles (1998) are an improvement over what others have suggested. However, much of the literature on professional development still does not directly address teaching for diversity. Furthermore, this literature seldom provides actual strategies to effectively travel the challenging terrain of teacher professional development.

We have begun to address these issues by conducting the Maxima Project—a three-year *intervention* project that sought to impact teachers' practice through research-based insights and innovative approaches to teaching and learning. To this end, we studied the implementation of guiding concepts that expanded upon those proposed by Loucks-Horsley et al (1998) and that focused on assisting teachers become more social constructivist, inquiry-based, gender inclusive, and multicultural teachers. In this manuscript, we discussed three of the guiding concepts the participating teachers found the most useful. These were: 1. Being Responsive and Theoretically Explicit; and 2. Providing On-going and On-site Support; 3. Using Reflexive Approaches to Collaboration.

By using sociotransformative constructivism (sTc) as a theoretical framework for merging multicultural and gender inclusive education tenets with social constructivism (Rodriguez & Kitchen, 2005; Rodriguez, 2002, 1998), we were able to maintain a focus on teaching for diversity throughout the implementation of the project. In addition to showing how the participants responded to the guiding concepts, we have offered evidence that the Maxima Project had a positive and transformative impact on most of the participating teachers' practice. However, three out of the twenty teachers involved in the project showed little or no change.

Further analysis of the multiple data sets we have collected in years two and three of the project, which include the students' voices and pre-service teachers' participation, should provide us with more insights on the impact of Maxima and its potential to inform teacher professional development research.

The findings from this study speak to the importance of making teaching for diversity a central construct in teacher professional development. While no one model can ever fit all contexts and needs, we must continue to strive to more directly address issues of equity and diversity and to provide teachers with more research-based support (strategies) so that they can meet the challenges of teaching in increasingly diverse school contexts.

References

- Ahlquist, R. (1991). Position and imposition: Power relations in a multicultural foundations class. *Journal of Negro Education*, 60(2), 158-169.
- American Association for the Advancement of Science. (1989). *Science for all Americans: A project 2061 report of literacy goals in science, mathematics, and technology*. Washington, DC: Author.
- American Federation of Teachers. (2000, April 14). Union is urging a national test for new teachers. *New York Times*, A01.
- Bakhtin, M. M. (1981). In M. Holquist (Ed.), *The dialogic imagination: Four essays by M. M. Bakhtin*. Austin: University of Texas Press.
- Bakhtin, M. M. (1986). In C. Emerson & M. Holquist (Eds.), *Speech genres and other late essays*. Austin: University of Texas Press.
- Bennett, Christine. (2003). *Comprehensive Multicultural Education: Theory and Practice*. Boston: Allyn and Bacon.
- Clewell, B., Anderson, B.T., & Thorpe, M.E. (1992). *Breaking the barriers: Helping female minority students succeed in mathematics and science*. San Francisco: Jossey-Bass.
- Cousins, J. B. & Simon, M. (1996). The nature and impact of policy-induced partnerships between research and practice communities. *Educational Evaluation and Policy Analysis*, 18(3), 199-218.
- Dickens, C. (2000). Too valuable to be rejected, too different to be embraced: A critical review of school/university collaboration. In M. Johnston, P. Brosnan, D. Cramer, and T. Dove (Eds.), *Collaborative reform and other improbable dreams*, (pp. 21-42). New York: State University of New York Press.
- Erickson, F. (1986). Qualitative methods in research or teaching. In Wittrock, M. (Ed.), *Handbook of Research on Teaching*. New York: Macmillan.
- Gomez, M. L. (1994). Teacher education reform and prospective teachers' perspectives on teaching "other people's" children. *Teaching and Teacher Education*, 10(3), 319-334.
- Goodwin, A. L. (1994). Making the transition from self to others: What do preservice teachers really think about multicultural education? *Journal of Teacher Education*, 45(2), 119-131.
- Grant, C. & Zozakiewicz, C. (1995). Student teachers, cooperating teachers, and supervisors: Interrupting the multicultural silences of student teaching. In J. Larkin, & C. Sleeter (Eds.), *Developing multicultural teacher education curricula*, (pp. 259-278). New York: State University of New York Press.

- Gunstone, R. F. (1994). The importance of specific science content in the enhancement of metacognition. In P. Fensham, R. F. Gunstone, & R. White (Eds.), *The content of science: A constructivist approach to its teaching and learning*, (pp.131-146). Bristol, PA: The Falmer Press, Taylor & Francis, Incorporated.
- Holmes Group. (1995). *Tomorrow's schools of education*. East Lansing, Michigan: Holmes Group.
- Johnson, B., Peters, J., Williams, D. (1999). Academics working with schools: Revealing the tensions. *Journal of Education for Teaching*, 25 (2), 123-133.
- Johnston, M., Brosnan, P., Cramer, D., Dove, T. (Eds.). (2000). *Collaborative reform and other improbable dreams*, (pp. 1-17). New York: State University of New York Press.
- Ladson-Billings, G. (1995). Multicultural teacher education: Research, practice and policy. In J. Banks & C. Banks (Eds.), *Handbook on Multicultural Education*, (pp. 747-759). New York: Macmillan Publishing.
- Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, California: Sage Publications.
- Lortie, D. (1975). *Schoolteacher: A sociological study*. Chicago: University of Chicago Press.
- Loucks-Horsley, S., Hewson, P., Love, N., & Stiles, K. (1998). *Designing professional development for teachers of science and mathematics*. Thousands Oaks, California: Corwin Press, Incorporated.
- Marlow, M. and Nass-Fukai, J. (1999). Collegiality, collaboration, and Kuleana: Three crucial components for sustaining effective school-university partnerships. *Education*, 121 (1), 188-195.
- Martin, R. (Ed.). (1995). *Practicing what we teach - Confronting diversity in teacher education*. New York: SUNY Press.
- National Research Council. (1996). *National Science Education Standards*. Washington: National Academy Press.
- National Science Foundation. (1996). *Indicators of science and mathematics education 1995*. Arlington: Author.
- Nieto, S. (1996). *Affirming diversity: The sociopolitical context of multicultural education*. White Plains, NY: Longman.

- Rodriguez, A. J. & Kitchen, R. (2005). *Preparing prospective mathematics and science teachers to teach for diversity: Promises strategies for transformative pedagogy*. New York: Lawrence Erlbaum Associates.
- Rodriguez, A. J. (2004). *Turning despondency into hope: Charting new paths to improve students' achievement and participation in science education*. Tallahassee, FL: Southeast Eisenhower Regional Consortium (SERVE).
- Rodriguez, A. J. (2002). Using sociotransformative constructivism to teach for understanding in diverse classrooms: A beginning teacher's journey. *American Educational Research Journal*, 39(4), 1017-1045.
- Rodriguez, A. J. (1998). Strategies for counterresistance: Toward sociotransformative constructivism and learning to teach science for diversity and for understanding. *Journal of Research in Science Teaching*, 36(6), 589-622.
- Rodriguez, A. J. (1997). The dangerous discourse of invisibility: A critique of the National Research Council's National Science Education Standards. *Journal of Research in Science Teaching*, 34(1), 19-37.
- Sadker, M., & Sadker, D. (1994). *Failing at fairness: How America's schools cheat girls*. New York: McMillan.
- Sleeter, C. (1996). *Multicultural education as social activism*. Albany, NY: State University of New York Press.
- Sleeter, C. & Grant, C. (1994). *Making Choices for Multicultural Education*. New York: Merrill.
- Spradley, J.P. (1979). *The ethnographic interview*. New York: Holt, Rinehart & Winston.
- Zeichner, K. M. (1996). Educating teachers for cultural diversity in the United States. In Craft, M. (Ed.), *Teacher Education in Plural Societies – An International Review*, (pp. 141-158). London: Falmer Press.
- Zozakiewicz, C. (1999). *Re-seeing the practices of my multicultural self: Examining the processes of multicultural teacher education through feminist post-structural eyes*. Unpublished Doctoral Dissertation, University of Wisconsin-Madison.

Figure 1. Organization of research findings

