

## **DISSERTATIONS AND THESES ON CMP**

Adams, R. L. (2005). Standards-based accountability: Improving achievement for all students through standards based mathematics instruction. *Dissertation Abstracts International*, 66(6) (ProQuest ID No. 932378841)

ABSTRACT: The purpose of this study was to conduct evaluation research on the professional development intervention implemented to address the effectiveness of standards-based instruction in improving the mathematic achievement of all student subgroups in Yolo County schools. The question addressed in this study was "Does standards-based instruction in mathematics, coupled with professional development on the standards-based content of California State Board of Education-approved text books, lead to increases in student achievement and high school graduation rates for all subgroups in Yolo County schools?"

The Yolo County Office of Education (YCOE) university partnership designed the professional development intervention for teachers delivering math at grade levels 5th through algebra I. Twelve teachers (treatment group) participated in 40-hour institutes; follow-up sessions, and data gathering to measure the effectiveness of the training and support. Ten teachers (control group) recruited as 2005 institute participants simultaneously gathered like data.

Twelve schools participated in the study. The teacher index ranges from 0.00 teachers trained in standards-based mathematics instruction to 0.50 with a mean of 0.19 indicating that the schools hadn't implemented school-wide professional development.

There was a significant difference between the treatment group scores on the post-survey and the control group scores ( $p = .011$ ) (effect size  $> 1.0$ ). The treatment group results indicate that the treatment group's beliefs on standards based instruction shifted significantly into the high-reform range after the intervention.

Curriculum calibration indicates that the use of the textbook as the main teaching resource did not ensure that the instruction was on grade-level over 75% of the time. The control group used the textbook as the main teaching resource 30% of the time compared to 55% by the treatment group, yet taught on grade-level more often than the treatment group.

The implications of this program evaluation point to continued organizational improvement through reducing gaps in: content knowledge, motivation, and organization support. Based on the research cited, and the practical implications from the intervention piloted in the Yolo County schools, the county partnership must continue to build systems of support that embrace standards-based mathematic instruction.

Bay, J. M. (1999). Middle school mathematics curriculum implementation: The dynamics of change as teachers introduce and use standards-based curricula. *Dissertation Abstracts International*, 60(12). (ProQuest ID No. 730586091)

ABSTRACT: Two case studies of school districts were developed to study the district-level constraints and considerations during adoption of standards-based middle school mathematics curricula. In addition, the nature of implementation within classrooms was described through six teacher case studies. The two school districts were in their third year of full implementation of a curricula, with one school district implementing the Connected Mathematics Project and the other MATH. Data collected included interviews, surveys, and classroom observations. Factors influencing teacher decision-making and district-level decision-making were analyzed. Several themes emerged related to the district-level issues of implementation. First, teacher leadership and/or participation in the professional development and district decision-making throughout the implementation had an impact on the nature of the teachers' perceptions of the need for change. Those who were involved in professional development or provided leadership in the district had a stronger commitment to the implementation. Teacher turnover constrained the level of implementation in the classroom and the level of interaction among teachers. Perceptions of parents, expectations for students, and state/national assessments were important considerations as districts selected and implemented their curriculum.

Successful implementation of standards-based curriculum in the classroom appeared to be related to several factors. First, the extent to which teachers were involved in the process of implementation. Including choosing the curriculum and participating in professional development, influenced the degree to which their classrooms were aligned with recommendations from the curricula and the NCTM Standards(1989, 1991, 1995). Collaborative relationships that were developed during the selection and first year of implementation continued to function productively in the third year of implementation, which happened to be the first year the districts were not participating in any externally-sponsored professional development. All teachers were concerned with the level of skill development that students needed beyond what was provided in the curriculum and made adjustments accordingly.

Bennett, C. J. (2007). A curriculum project of vocabulary development in the Connected Math

program Moving Straight Ahead. Unpublished master's thesis. State University of New York College at Brockport.

Bledsoe, A. M. (2002). Implementing the Connected Mathematics Project: The interaction between student rational number understanding and classroom mathematical practices. *Dissertation Abstracts International*, 63(12). (ProQuest ID No. 765115471)

ABSTRACT: The Research Advisory Council (RAC, 1991) of the National Council of Teachers of Mathematics (NCTM) called for research on the effects of Standards-based (NCTM, 1989, 1991, 2000) curricula. Following a qualitative design, this dissertation study provides insight into what it means to know and do mathematics in one seventh-grade classroom in which one such curriculum was implemented. More specifically, this study provides a thick description of the teaching and learning of rational number concepts in a classroom where the Bits and Pieces I unit (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1997) from the Connected Mathematics Project (CMP) was used. Through the lens of the Emergent Perspective (Cobb & Yackel, 1996), this study investigates the relationship between students' initial and developing understandings and the evolving classroom mathematical practices. Results indicate that students' rational number understandings and the teacher's proactive role contributed to the establishment of the classroom mathematical practices. These mathematical practices serve to document the development of the collective understandings as the students engaged in activities from Bits and Pieces I (Lappan et al., 1997). Findings suggest that students did make significant growth in their rational number understandings as a consequence of engaging in these activities and participating in these mathematical practices. In particular, results indicate that participation in conceptually-based mathematical practices provided greater opportunities for students' to advance in their rational number understandings than participation in those that were procedurally-based. In fact, participation in procedurally-based mathematical practices actually constrained some students' advance in their rational number understandings.

Bray, M. S. (2005). Achievement of eighth grade students in mathematics after completing three years of the Connected Mathematics Project. *Dissertation Abstracts International*, 66(11). (ProQuest ID No. 1031063341)

ABSTRACT: The purpose of this study was to examine the three-year effect of the Connected Mathematics Project (CMP) on the mathematics achievement of middle school students in a southeastern Tennessee public school district. This was accomplished by (1) comparing the mathematics achievement of eighth graders who have completed three years of CMP with their mathematics achievement after completing one and two years of CMP ; (2) comparing the achievement of male and female students during the same period of time; and (3) comparing the mathematics achievement of historically underrepresented students after completing one, two, and three years of CMP.

In order to provide for a richer analysis of the CMP experience, the overall design employed quantitative and qualitative methodologies. The quantitative section of the study examined the mathematical achievement of almost 2,900 of the 2001-2002 eighth graders, over 3,000 of the 2000-2001 seventh graders, and over 3,100 1999-2000 sixth graders as evidenced by their Tennessee Comprehensive Assessment Program (TCAP) test scores. The qualitative segment of the study explored the experiences of the textbook adoption committee members, teachers, administrators, and parents.

Using the Tennessee Comprehensive Assessment Program mathematics total battery test score as the dependent variable, there was no significant difference between the mathematics achievement of students completing one or two years of CMP . However, there was a significant difference in the mathematics achievement between students completing three years of CMP when compared to their mathematics scores after one and two years. There was also a significant difference between male and female students after completing one and two years of CMP but no significant difference was detected after the completion of three years. Though there was a significant difference revealed in the achievement between African Americans and Non African Americans after completing one, two, and three years of CMP the gap closed slightly after completing three years. Overall, CMP students performed better on the state achievement assessment the longer they were being instructed using the standards based curriculum.

Castro, A. M. (2006). Planning for mathematics instruction: A study of the teacher guide as a resource. *Dissertation Abstracts International*, 67(10). (ProQuest ID No. 1251814391)

ABSTRACT: Planning is an important, and often underappreciated, phase of teaching, during which teachers make decisions and draw upon a variety of resources, such as curriculum materials, that shape students' opportunities to learn. The teacher guide (TG) is a particularly important curricular resource because it is designed to assist teachers in making decisions that affect these opportunities. Prior research has established that teachers' use of curriculum materials is affected by a range of factors, such as state level policies, knowledge of mathematics, and the nature and

may play in mediating the influence of these and other factors on teachers' decisions and actions during planning and instruction. Accordingly, this study examines how four experienced 6th grade teachers use the TG from Connected Mathematics Project (CMP) as a resource in making planning and enactment decisions, and factors associated with patterns of TG use.

Using interpretive case study methodology, the author examined teachers' use of the CMP TG in planning for and implementing an entire unit. In addition to observing their implementation of the unit, teachers were interviewed prior to and immediately following each observation to understand how they used the TG to plan for and enact different mathematical tasks. The author then developed case studies of teachers' use of the TG in implementing the unit.

Through cross-case analysis, the author found that teachers seemed to draw largely from their personal resources when making planning and enactment decisions related to mathematical tasks, and not particularly from the TG. For example, when faced with certain planning and instructional challenges, such as anticipating how students would work on a task or students struggling with the content, teachers tended to rely on their particular conceptions of mathematics teaching to address these challenges. Despite the fact that the TG provided suggestions for teachers as to how address such challenges, it was not extensively used as a resource by the teachers in this study, in their planning and enactment of classroom lessons. Based on these and other findings the author identifies important questions and potential implications for curriculum developers, teacher educators, and researchers.

Celedon, S. (1998). An analysis of a teacher's and students' language use to negotiate meaning in an ESL/mathematics classroom. *Dissertation Abstracts International*, 69(9). (ProQuest ID No.732855961)

ABSTRACT: The research reviewed indicates a paucity of studies addressing issues regarding language as used by linguistically diverse students and its role in mathematics problem solving, especially at the secondary level. The purpose of this qualitative study was threefold: (1) to describe how English as a second language (ESL) students and their teacher used language (Spanish and English) to negotiate mathematical meaning in an ESL/Mathematics classroom, (2) to explore problem-solving strategies used by ESL students and examine how these connect, or not, to those presented by their teacher, and (3) to generate a theory about the use of language to teach mathematics to ESL students. Research was conducted in a self-contained ESL/Mathematics classroom at the middle school level (6th-8th grade). The study included participant observations, in-depth interviews with a representative sample of nine students and the teacher, and written documents.

Analysis of the data collected throughout a nineteen-week period indicated that Spanish was the language used by most ESL students to express themselves when they needed to elaborate on their responses orally or in written form as they engaged in a curriculum, the Connected Mathematics Project(CMP), that promoted higher order thinking skills. From the teacher-student discourse samples, it was evident that using Spanish created more opportunities for students to participate in discussions where an explanation of their responses was needed. Furthermore, these students felt comfortable expressing themselves in their first language when explaining their problem-solving strategies during think-aloud protocols. Overall, the accuracy of these nine students improved by one or two word problems (out of five) in the Spanish version. These results indicate the importance of making both languages accessible to students during mathematics problem solving. While I am not advocating that Spanish be used as the only language of instruction, I am suggesting that students' sociocultural and linguistic experiences be used to make the mathematical connections between the everyday use of English and the language that is specific to mathematics.

Studying how ESL students used language when engaged in mathematical problem solving provides educators insight as to how they can help students make connections between their existing everyday language and the mathematical language necessary for problem solving. In addition, the self-findings provide both ESL and mathematics teachers with detailed information regarding the variety of problem-solving strategies used by ESL students.

Collins, A. M. (2002). What happens to student learning in mathematics when a multi faceted, long-term professional development model to support standards-based curricula is implemented in an environment of high stakes testing? *Dissertation Abstracts International*, 65(2). (ProQuest ID No. 765336031)

ABSTRACT: Assessment and accountability have created a high-stakes environment for districts, schools, teachers, and students. Assessment is driving most educational decisions. In Massachusetts's graduation is contingent upon passing the mathematics and English language arts subtests of the Massachusetts Comprehensive Assessment System (MCAS). Teachers in schools where 30% or more students fail MCAS are required to take a mathematics proficiency test. Middle schools not exhibiting improvement in their mathematics scores are identified as under-performing and are subject to interventions by the Department of Education. Not surprisingly, students in

have been declared under-performing. It is within this environment of high-stakes testing and as repercussions that this study was undertaken.

In an effort to change the unsuccessful experiences of many urban students, the Noyce Foundation and Raytheon Company made a commitment to funding a long-term professional development intervention. This study investigates the impact of that sustained professional development program in one urban district. The professional development was designed to support the implementation of The Connected Mathematics Project ( CMP ) and to assess its impact on student learning. This dissertation presents a quantitative comparison between student scores on two standardized tests in schools whose teachers availed themselves of all available professional development surrounding the implementation process for CMP with schools whose teachers chose only to participate in contractually mandated district professional development.

Results indicate that students in schools whose teachers received sustained professional development designed to meet the needs of the participating teachers performed significantly higher on both the MCAS and a nationally formed achievement test, Terra Nova, than did those students whose teachers had not participated in consistent professional development. Evidence is included to document the positive impact on student achievement as a result of changing teacher practice and beliefs through mentoring and coaching in teachers' own classrooms.

Covington Clarkson, L. M. (2001). The effects of the Connected Mathematics Project on middle school mathematics achievement. *Dissertation Abstracts International*, 61(12).

(ProQuest ID No. 727079071)

ABSTRACT: The purpose of this study was to examine the three-year effect of the Connected Mathematics Project (CMP) on the mathematics achievement of middle school students in an urban school district. This was accomplished by (1) comparing the mathematics achievement of eighth graders who have completed three years of CMP with the achievement of eighth graders who have completed three-years of a traditional curriculum; (2) comparing the interaction and communication patterns in the two types of classrooms; and (3) comparing the mathematics achievement of historically underrepresented students in both curricula. In order to provide for a richer analysis of the CMP experience, the overall design employed quantitative and qualitative methodologies. The quantitative section of the study examined the mathematical achievement of 700 of the 1999-2000 eighth graders as evidenced by their State Basic Standards Test(BST) scores. The qualitative segment of the study explored the experiences of the primary participants, the teacher and the students. Using the State Basic Standards Test as the dependent variable, there was no significant difference between the mathematics achievement of CMP students and that of traditional students after three years of the respective curricula. The achievement gap between CMP Caucasian students and CMP African American students was smaller than the achievement gap between these groups in the traditional curricula. The classroom interaction and communication patterns were very different. CMP classrooms provided more opportunities to learn mathematics than traditional classes. Moreover, CMP students demonstrated algebraic reasoning skills at the same level as the traditional students and demonstrated conceptual understanding through the use of multiple strategies at a higher level than traditional students. Overall, CMP students had a higher level of satisfaction and more positive experiences in their mathematics classes than did traditional students.

Danielson, C. (2005). Walking a straight line: Introductory discourse on linearity in classrooms and curriculum. *Dissertation Abstracts International*, 67(2). (ProQuest ID No.

1095417771)

ABSTRACT: The current curricular reform in US mathematics education has changed many aspects of classroom teaching. Commonly, discussions about this curricular reform presume an unproblematic relationship between textbooks and classroom instruction. This study contributes to the understanding of the relationship between one published reform curriculum, Connected Mathematics (CMP) (Lappan, Fey, Fitzgerald, Friel & Phillips, 2001) and classroom instruction. The study characterizes teaching and learning in terms of communication patterns---discourse ---and analyzes the discourse of CMP, of a traditional US curriculum, Mathematics, Structure and Method (Dolciani, Sorgenfrey & Graham, 1992), and of two teachers in urban classrooms---focusing on the introductory lessons on linear relationships in each case. Results include full descriptions of the introductory discourse on linearity in the textbooks and changes that the CMP textbook discourse undergoes as the curriculum is implemented in these two classrooms.

De Groot, C. (2000). Three female voices: The transition to high school mathematics from a reform middle school mathematics program. *Dissertation Abstracts International*, 61(4).

(ProQuest ID No. 731933601)

ABSTRACT: In this ethnographic study, the transition experiences and coping mechanisms of three female students

field testing of the Connected Mathematics Project (1990-1995), a middle school curriculum closely reflecting recommendations of the National Council of Teachers of Mathematics. The participants of the study were in the same mathematics class during their grade 8 experience, but went to different high schools.

Two interviews were conducted toward the end of their grade 9 experience and six interviews were conducted during their grade 10 experience. Middle school mathematics teachers and high school mathematics teachers were interviewed as well as one parent. One observation of each of their tenth grade mathematics classes was conducted. The reported characteristics of transition in this study focus mainly on changes or discontinuities in the learning of mathematics. Data were analyzed by coding processes and presented in narratives and Qualitative Schematics of Dimensions of Transition in Learning Mathematics Thematic interpretations are given with respect to coping mechanisms that were revealed.

One of the major findings of this study is that early in grade 9 these three students related their learning of mathematics in high school closer to their (traditional) elementary experience, which was termed as regular mathematics, than to their reform middle school experience, which was more constructivist in design. In grade 10 they seemed to connect more with their middle school experience, for example, while doing proofs and related this to "explaining your thinking." Another major finding was that these three students experienced a gradual individualization during this transition together with increased in-class competition among students, particularly for attention from the teacher. In high school, they appeared to cope with this lack of student-to-student discourse by forming out of-class support networks.

Suggestions for future research are made regarding the transition discontinuity from learning in a reform environment to learning in a traditional environment, as well as the need to investigate how transitional standards-based curricula, steeped in problem solving, supports students' development of mathematical proof.

Durkin, N. M. (2005). Using Connected Math program: Its impact on the Delaware State Testing scores of 8th-grade students at Milford Middle School. *Dissertation Abstracts International*, 66(4). (ProQuest ID No. 913516241)

ABSTRACT: This study was designed to investigate the impact of the Connected Math Project curriculum on the student achievement of eighth grade students participating in the Delaware State Testing Program from 1998-2004. The study included an investigation of overall student achievement of students participating in the Connected Math Project as well as specific subgroup populations such as the Black and Special Education students.

The investigation revealed that overall student performance and subgroup population performance has increased since the first administration of the Delaware State Testing Program in 1998. A pair wise comparison probability for all test years indicates the increase in mean math scale scores was significant. However, additional pair wise comparison probabilities indicate the percentages of students meeting the state math standard are significant for comparison of test year 2000 with 2003 only. This indicates that although student mean math scale scores are increasing the percentage of students meeting the standard has not increased significantly. Student scores may be approaching the standard but not meeting or exceeding the standard. Pair wise comparison probabilities for the subgroup populations Black and Special Educational so indicate a significant increase in the mean math scale scores but not a significant increase in the percentage of students meeting the standard.

Fauth, T. (2007). *Using the Connected Math Project to improve seventh grade math scores at Wapato Middle School*. Unpublished master's thesis, Heritage University, Toppenish, WA.

Folsom, M. L. (2002). Empowering girls in math: The influence of curriculum on Female beliefs about mathematics. *Masters Abstracts International*, 41 (2). (ProQuest ID No. 766367131)

ABSTRACT: This qualitative inquiry examines the belief systems of female students in a sixth grade mathematics classroom and explores how a middle school math curriculum influences these beliefs. Specifically, this inquiry focuses on two of four internal beliefs posited by Gilah C. Leder: confidence and usefulness of mathematics. The design of this inquiry is loosely based on the research tradition of ethnography. Data collection consisted of classroom observations, teacher surveys, standardized test scores, and student questionnaires. The inquiry found that the math curriculum had some influence on the girls' overall attitude towards and enjoyment of math classes. Despite confusing explanations with overly complicated language and editing errors, the girls' enjoyed working through the math curriculum's small group activities and experiments. The inquiry found that the Connected Mathematics Project curriculum connected with the sixth grade girls.

Genz, R. (2006). *Determining high school students' geometric understanding using Van*

*Hiele Levels: is there a difference between standards-based curriculum students and non-standards-based curriculum students?* Unpublished master's thesis, Brigham Young University, Provo.

ABSTRACT: Research has found that students are not adequately prepared to understand the concepts of geometry, as they are presented in a high school geometry course (e.g. Burger and Shaughnessy (1986), Usiskin (1982), van Hiele (1986)). Curricula based on the National Council of Teachers of Mathematics (NCTM) Standards (1989, 2000) have been developed and introduced into the middle grades to improve learning and concept development in mathematics. Research done by Rey, Reys, Lappan and Holliday (2003) showed that Standards-based curricula improve students' mathematical understanding and performance on standardized math exams. Using van Hiele levels, this study examines 20 ninth-grade students' levels of geometric understanding at the beginning of their high school geometry course. Ten of the students had been taught mathematics using a Standards-based curriculum, the Connected Mathematics Project (CMP), during grades 6, 7, and 8, and the remaining 10 students had been taught from a traditional curriculum in grades 6, 7, and 8. Students with a Connected Mathematics project background tended to show higher levels of geometric understanding than the students with a more traditional curriculum (NONcmp) background. Three distinctions of students' geometric understanding were identified among students within a given van Hiele level, one of which was the students' use of language. The use of precise versus imprecise language in students' explanations and reasoning is a major distinguishing factor between different levels of geometric understanding among the students in this study. Another distinction among students' geometric understanding is the ability to clearly verbalize an infinite variety of shapes versus not being able to verbalize an infinite variety of shapes. The third distinction identified among students' geometric understanding is that of understanding the necessary properties of specific shapes versus understanding only a couple of necessary properties for specific shapes.

Goodman, E. (2004). Connected Mathematics Project: A constructivist view of mathematics education in the middle grades. *Masters Abstracts International*, 43(2). (ProQuest ID No. 813809801)

ABSTRACT: For decades, education critics have been debating what and how mathematics should be taught. The following Master's thesis examines a new mathematics curriculum, Connected Math Project, geared to teach mathematics from a constructivist approach. It examines whether or not the students are able to reflect knowledge or understanding of mathematical concepts as well as their ability to learn from group motivated investigation. It also looks at the view and beliefs of mathematics teachers towards a constructivist program. This thesis is founded on the notion that public school educators must introduce a mathematics curriculum that enables all children to increase their problem solving skills and abilities with regards to mathematics.

Grunow, J. E. (1998). Using concept maps in a professional development program to assess and enhance teachers' understanding of rational numbers. *Dissertation Abstracts International*, 60(3) (ProQuest ID No. 734420161)

ABSTRACT: This professional-development institute was designed to look at a little researched component, adult learning in a specific content area. Rational-number understanding was the domain addressed. Teachers were selected to participate in a two-week institute and were supported the following year with on-line mentoring. Assessment of teacher rational-number knowledge was done using concept maps, tools chosen because of their congruence with the domain. Concept maps, as an alternative assessment measure, had potential to satisfy another need, authentic assessment of the professional-development experience.

The study investigated three questions: (1) Will middle-school teachers' understanding of rational number, as reflected on concept maps, be enhanced as a result of participation in a professional-development institute designed specifically to develop understanding of a domain? (2) Will middle-school teachers' understanding of interrelationships among concepts and awareness of contexts that facilitate construction of conceptual knowledge, as assessed through concept maps, be increased as a result of participation designed with a focus on reform curricula, authentic pedagogy, and learner cognitions to facilitate decision-making? (3) Will middle-school teachers communicate knowledge growth through well-elaborated graphic displays using concept maps?

The research design used was both qualitative and quantitative. Participants designed pre institute concept maps of rational-number understanding. Following instruction, participants designed post institute concept maps to reflect their learning. Quantitative analysis of the concept maps was achieved by scoring participant maps against an expert criterion map and a convergence score was used. Qualitative analysis of the maps was done using holistic techniques to determine overall proficiency.

The Wilcoxon Signed-Ranks Test was used to analyze the data obtained from scoring the concept maps. Three areas were examined: (a) knowledge of concepts and terminology; (b) knowledge of conceptual relationships; and (c) ability to communicate through concept maps. Results of scoring in all areas yielded significant gains.

It was concluded that teacher knowledge of a content domain can be enhanced significantly in a professional-development experience designed to concentrate on such growth, that teachers can become aware of contexts that facilitate development of content knowledge, and that concept maps can be valid, reliable measures.

Hallagan, J. E. (2003). Teachers' models of student responses to middle school algebraic tasks. *Dissertation Abstracts International*, 64(2). (ProQuest ID No. 765247341)

ABSTRACT: Often, the difficulties of students to make the cognitive leap from arithmetic to algebra are related to instructional strategies. The way teachers make sense of their practice, in turn, informs pre-service and in-service algebraic instruction. Algebraic instruction is also of current interest due to recent national initiatives calling for all students to learn high school algebra.

The purpose of this study was to describe middle school mathematics teachers' models or interpretations of students' responses to middle school algebraic tasks. The research questions focused on the nature of the teachers' developing ideas and interpretations of student responses from selected algebraic tasks involving the distributive property and equivalent expressions. The core research questions were: (a) What information do middle school mathematics teachers acquire about their students' algebraic thinking? and (b) How do middle school mathematics teachers interpret their students' algebraic thinking? A models and modeling framework guided the study's design. Model-eliciting activities were used to perturb and at the same time reveal their thinking. These activities consisted of asking the teachers to create a "Ways of Thinking" sheet based upon students' responses to the selected algebraic tasks, and to select, analyze and interpret samples of student work. Five teachers participated from two middle schools. Data collection included classroom observation, artifact collection from the model-eliciting activities, semi-structured interviews, and team discussions.

Two sets of findings emerged from this study. First, I concluded that the models and modeling perspective is indeed an effective methodology to elicit teachers' models of their students' algebraic thinking. Second, I found the following five aspects are central to teachers' models of student responses to tasks with equivalent expressions and the distributive property. Teachers recognized that students: (a) tended to conjoin expressions, (b) desired a numerical answer, and (c) had difficulty writing algebraic generalizations. In addition, teachers identified that (d) visual representations were highly useful as instructional tools. And finally, (e) the teachers in this study needed more experience in analyzing and interpreting student work. The findings from this study revealed consistent information across the Ways of Thinking sheets, library of student work, individual and team interviews, and classroom observations.

Herbel-Eisenmann, B. A. (2000). How discourse structures norms: A tale of two middle school mathematics classrooms. *Dissertation Abstracts International*, 62(1). (ProQuest ID No. 727910361)

ABSTRACT: My experiences as a student and a teacher of mathematics have led me to pursue the topic of this dissertation--discourse patterns and norms in two "reform-oriented" mathematics classrooms. The two 8th grade classrooms that form the focus of this dissertation were using the Connected Mathematics Project, an NSF-funded curriculum project. I was intrigued by the teachers and their teaching because I noticed the students seemed to have similar understandings, but each classroom felt different to me as a participant-observer.

These classrooms offered a context that allowed me to study differences in the context of similarity. The teachers had many attributes in common (detailed in Chapter 5): similar academic backgrounds and professional development activities, same certification, same school, same curriculum and similar enthusiasm for it, same heterogeneous group of students, similar student-understandings, etc. However, the teaching in the two classrooms was different. Drawing from the sociolinguistics and mathematics education literatures, I describe the social and sociomathematical norms of the two classrooms in terms of the classroom discourse which they were embedded in and carried by. I also interpret student understandings whenever possible throughout the thesis, taking a social constructivist perspective. In the year prior to commencing my dissertation study (1997-1998), I completed classroom observations and student interviews as part of my practicum work and research assistantship, which were used to form preliminary hypothesis about student understandings and the classroom environment. The data used for this dissertation was collected over the next two years (1998-2000). During the first, I observed and audio-and video-taped students on a weekly basis. In addition, students were interviewed about their algebraic understandings and their classroom experience. The second year, one of the classrooms was observed to trace the formation of the norms in the classroom. The teachers took part in four extensive interviews, in which they were asked about influencing experiences related to their teaching and the norms in their classroom (in terms of the expectations, rights and roles of themselves and their students).

The ideas I investigate in this dissertation include how social and sociomathematical norms are embedded in and carried by the classroom discourse in each classroom (Chapters 6 and 7). I also discuss aspects in the teachers' professional lives that influenced the ways they think about and work to establish and maintain the norms in their

different, which has allowed me to locate differences in: the overall structure of teacher talk, the positioning of the teacher with respect to the locus of authority, the way each teacher draws from potential other knowledge sources in the classroom (i.e. students and the textbook), and the way each teacher draws attention to the common knowledge constructed in the classroom.

Hoffmann, A. J. (2004). Middle school mathematics students' motivations for participating in whole-class discussions: Their beliefs, goals, and involvement. *Dissertation Abstracts International*, 65(9). (ProQuest ID No. 795927881)

ABSTRACT: Whole-class discussions in mathematics classrooms are considered to foster active sense-making and intellectual autonomy among students. Through participating in these discussions, students have the opportunity to develop skills of mathematical communication, reasoning, and justification. However, middle school students may resist participating in whole-class discussions if they perceive social consequences resulting from this activity.

Research on mathematics classroom discourse typically focuses on the role of the teacher in discourse, examining student variables as outcomes to measure the effectiveness of the teachers' strategies. Alternatively, in this study, students' beliefs and goals are examined for how they influence students' participation in classroom discourse rather than as outcomes.

I assessed beliefs and goals of 15 target students from two seventh grade mathematics classrooms through one-on-one interviews and a Likert-scale survey instrument. Students' talk in interviews was analyzed through the use of a framework that included imperative verbs to capture idealized states, repetition to capture emphasis, and connections to affect to capture relative importance to the student. This framework allowed for a more rigorous analysis of students' beliefs in contrast to reporting any and all of their responses to interview questions.

Students' involvement in classroom discourse was described based on an analyses of videotaped classroom discussions about four investigation problems from the Connected Mathematics Project Standards-based mathematics curriculum.

Results from this study indicate that students' involvement in classroom discussions is influenced by their social goals and epistemological beliefs. Students who believed they learned mathematics through a process of negotiation and associated a low level of risk with participating in discussion were more likely to extend their participation during an interaction, critique the thinking of their classmates, and talk about mathematics at a high level of explicit meaning. There were also differences in students' involvement between the target students based on their classrooms.

This study illustrates how adolescence intersects with the mathematics reform movement by taking into account students' perspectives. Future research investigating how beliefs and goals relate to students' involvement in discussions may explain how a classroom of students together supports the development of effective classroom discussions.

Hughes, E. K. (2006). Lesson planning as a vehicle for developing pre-service secondary teachers' capacity to focus on students' mathematical thinking. *Dissertation Abstracts International*, 68(1). (ProQuest ID No. 1288646801)

ABSTRACT: This study investigated the extent to and ways in which attention to students' mathematical thinking was evident in the written lesson plans or lesson planning process of ten pre-service secondary mathematics teachers at various points during their teacher education program: prior to and immediately after participation in a course (the Teaching Lab) that emphasized students' mathematical thinking as a key element of planning, during teachers' first semester of their field experience as they planned lessons in their actual practice of teaching, and near the end of the first semester of their field experience as they planned lessons on demand and for university assignments.

With respect to learning from the Teaching Lab, the study shows that the teachers demonstrated significant growth on pre to post course measures in their ability to attend to students' thinking when planning a lesson on demand and for a university assignment. Furthermore, teachers continued to be able to apply these ideas when planning on demand and for university assignments several months later. When investigating whether or not teachers would apply the ideas they had learned when planning in their own practice, the study suggests three findings. First, teachers' attention to students' thinking when planning lessons that used tasks with a high level of cognitive demand was not significantly different from their planning for a lesson on demand or the lesson plan they produced for the Teaching Lab assignment.

Furthermore, teachers were more likely to attend to students' thinking when planning a lesson that used a high-level task compared to a lesson that used a low-level task. Second, for some teachers, written lesson plans significantly under-represented their attention to students' thinking in their planning process. Finally, the study suggests that support from the mentor teacher and/or university supervisor may be an important factor in determining whether or not the teacher applies their knowledge of attention to student's thinking to their planning in practice.

Hull, L. S. H. (2000). Teachers' mathematical understanding of proportionality: Links to curriculum, professional development, and support. *Dissertation Abstracts International*, 62(2). (ProQuest ID No. 727942411)

ABSTRACT: The Proportional Relationship Study was designed to investigate whether using a standards-based middle school mathematics curriculum, together with professional development and follow up support, can lead to increased teacher content knowledge and pedagogical content knowledge of proportionality. From the literature, it is clear that what teachers do in the classroom affects what students learn, and that what teachers know affects their actions in the classroom. Teachers need strong personal content knowledge and pedagogical content knowledge in order to teach mathematics well; therefore, the question is an important one.

Seven sites participated in a statewide implementation effort during 1996-1999 that included Connected Mathematics Project (CMP) curriculum professional development experiences for teachers plus additional district and/or campus support. As part of this study, the Proportional Reasoning Exercise (PRE) was given to seventh-grade teachers three times: before CMP professional development, after a year of teaching with CMP materials, and again after a second year of teaching with the materials. Teacher responses were coded for correctness and for problem-solving strategy; group responses were compared for all three PREs. In addition, group and individual interviews were conducted with CMP teachers.

Data from the three PREs anti group and individual interviews of seventh-grade teachers showed growth in performance and understanding of proportional relationships over the two-year period. Analysis of each of the PRE problems revealed an increase in the percent of teachers who correctly answered the problems and a tendency toward using more sophisticated proportional relationship strategies. However, choice of strategy appeared to depend on the context of the problem. Participants also tended over time to record multiple and more diverse strategies, increase the depth and detail of their written explanations, and include units along with numbers.

Interviews after the first year confirmed that experienced teachers placed in a new situation, with new curriculum and expectations of using new instructional approaches, often revert to "novice" status, concerned primarily with survival (Borko & Livingston, 1989). However, individual interviews conducted after the second year showed that teachers were then ready to focus on student understanding of mathematics and were themselves learning new and important mathematics.

Johanning, D. I. (2005) Learning to use fractions after learning about fractions: A study of middle school students developing fraction literacy. *Dissertation Abstracts International*, 66(4). (ProQuest ID No. 913515271)

ABSTRACT: There is a large body of literature, both empirical and theoretical, that focuses on what is involved in learning fractions when fractions are the focus or goal of instruction. However, there is very little research that explores how students learn to use what they have learned about fractions outside instruction on fractions. The specific goal of this research was to explore how middle school students learned to use fraction knowledge, the fraction concepts and skills studied in formal curriculum units, in mathematical instructional settings where fractions were not the main focus of study, but rather supported the development of other mathematical content.

This study is sociocultural in nature. It is guided by a practice account of literacy (Scribner and Cole, 1981) and Barton's (1994) ecological approach to literacy. Studying literacy involves studying the practices that people engage in as they use knowledge for specific purposes in specific contexts of use. This research describes the practices that grade six and seven students engaged in when they had to use what they learned about fractions to make sense of mathematical contexts such as area and perimeter, decimal operations, probability, similarity, and ratio. In order to understand how the practices students engaged in when learning to use fractions differed from the practices students engaged in when learning about fractions, data collection and analysis focused on identifying and then comparing these two types of practices.

Data collection for this dissertation spanned approximately one and one-half school years. In the fall of 2002 and winter of 2003 I collected data during the two units where one class of sixth-grade students learned about fractions. In the spring of 2003 I began to collect data during three units where these sixth-grade students were using fractions as part of learning about area and perimeter, decimal operations, and probability. Data collection continued into seventh grade as I followed a subset of these sixth-grade students into their seventh-grade year. Data was collected during two seventh grade units where fractions were used in the context of similarity and ratio. Data collection ended in December of 2003. The data collected included field notes, video recordings of whole class discussions, video-recording the small-group interactions of one group of four focus students, interviews with the four focus students, and copies of their written work.

The study's results revealed that students did not simply take the concepts and skills learned in the fractions units and use them. Understanding how to use fractions was tied to understanding situations in which they can be used. Students had to take into account both mathematical and situational contexts when making choices about how to use fractions. This led students to raise questions regarding what was appropriate when using fractions in these

had regarding the use of fractions were not only different from the conversations they had when learning about fractions, but potentially may not have occurred when learning about fractions directly. It is argued that providing students the opportunity to use fraction knowledge is critical to the development of fraction literacy.

Kasmer, L. (2008). The role of prediction in the teaching and learning of algebra. Doctoral Dissertation, Western Michigan University. *Dissertation Abstract international*69(3). (UMI No. 3303469)

ABSTRACT: Research has shown that including prediction questions within reading and science instruction has been advantageous for students, yet minimal research existed regarding the use of such questions within mathematics instruction. In order to extend and build on our knowledge about the effects of prediction in mathematics instruction, this study explored the impact of this paradigm in the teaching and learning of algebra. Specifically, this study probed whether utilizing prediction questions provided students opportunities for engaging in mathematical thinking, retrieving prior knowledge, and discussing related mathematical ideas, could increase such students' conceptual understanding and mathematical reasoning in the content area of algebra.

To address the research questions, a longitudinal quasi-experimental study was conducted to explore to what extent and in what ways prediction questions could help students develop mathematical reasoning and conceptual understanding. In this research, instruction and learning for two groups of students were examined whereby prediction questions were infused within the treatment class, while the control group received instruction devoid of such prediction questions. Both groups were taught by the same teacher and curriculum, with no initial significant differences between these two groups. During the course of one school year within this treatment group, the teacher employed prediction questions at the launch of each lesson and then revisited the student predictions at the closure of the lesson. A total of 1,178 unit assessment responses and 494 responses to Mathematical Reflections were examined, along with videotaped sessions from both classes to explore out-come based differences between the two groups. In addition, 491 prediction responses from the treatment class were coded for levels of reasoning and characteristics of prediction responses.

The overall results suggest prediction is a relevant and valid construct with respect to enhanced conceptual understanding and mathematical reasoning. The treatment class outperformed the control class on a number of measures. The benefits from a teacher's perspective were also identified. Prediction questions became a catalyst for classroom discussions, increased student engagement, and an informal assessment tool for the teacher. Through this study, benefits for instruction, professional development, and curriculum design in relation to prediction became apparent.

Katwibun, D. (2004). Middle school students' mathematical dispositions in a problem-based classroom. *Dissertation Abstracts International*, 65(5). (ProQuest ID No. 766026571)

ABSTRACT: The purpose of this study was to describe middle school students' mathematical dispositions in a problem-based learning [PBL] classroom. Eight volunteer students from one 6th grade mathematics classroom participated in this study. The curriculum used was the Connected Mathematics Project [CMP]. The main sources for data collection were classroom observations, the Attitudes and Beliefs questionnaire, teacher interviews, and student interviews. The CMP class routine consisted of four phases: Warm-up, Launch, Explore, and Summarize. The teacher in this study had her students investigate mathematics problems within cooperative small groups and share their ideas in large group discussions. The teacher acted as a facilitator and encouraged her students to try new ideas without fear of making mistakes. The findings revealed that almost all of the students in this study demonstrated positive mathematical dispositions. They volunteered and shared their ideas, both in small cooperative group investigations and in large group discussions. They believed mathematics was about "learning new ideas" and mathematics was "life" because it was everywhere in their lives. They also mentioned the usefulness of numbers, measurement, and geometry in their daily lives. All eight participants liked hands-on activities and working on a mathematics project. Most of them agreed that they liked mathematics because it was fun and interactive. Most also saw themselves as good at mathematics. All of them agreed that mathematics was useful, and that one's mathematics ability could be increased by effort. They also believed that there were no gender differences in mathematics, even though in their class, they realized that boys outperformed girls. Most of the students agreed that they could solve time-consuming mathematics problems and that it was important to understand mathematical concepts. None of them had negative feelings about group work; they learned from each other.

Finally, an analysis of the participants' mathematical dispositions was discussed. Based on the Taxonomy of Educational Objects: Affective Domains by Krathwohl, Bloom, and Masia (1964), the participants were categorized into three disposition levels: Level 1: "receiving;" Level 2: "responding;" and Level 3: "valuing." Half of the participants demonstrated dispositions at the high level (Level 3: "valuing") because of their willingness to pursue and/or seek to do mathematics outside the classroom. Three of them were in mathematics disposition Level 2.3: "satisfaction in response" because they usually participated in the class activities. They were satisfied and enjoyed doing mathematics. One of them demonstrated mathematical disposition Level 2: "Willingness to practice"

because she listened to the whole class and group discussions without sharing any ideas or asking for help when she needed it.

Keiser, J. M. (1997). The development of students' understanding of angle in a non-directive learning environment. *Dissertation Abstracts International*, 58(8). (ProQuest ID No. 736600251)

ABSTRACT: Curriculum reform in mathematics shows that geometry is becoming an important part of the middle grades curriculum. This dissertation study looks at the geometry learning of sixth-grade students who were using a newly-drafted unit, Shapes and Designs, from a reformed middle grades curriculum, the Connected Mathematics Project (CMP).

The research focuses on students' understandings of angle concepts. The research questions are as follows: What understandings of angle concepts are revealed by sixth-grade students during their geometry investigations? Which concepts are particularly difficult (easy) for students to grasp? What are some of the misconceptions they hold? How well-connected are their ideas and what are the gaps in their thinking concerning the angle concepts that are presented?

A CMP pilot-testing school in Michigan was chosen as the site for in-class observations since the teachers had been teaching with CMP materials for two years. Two mathematics classrooms were observed daily during the duration of the Shapes and Designs instruction which lasted 5 weeks during the winter of 1995-96. The researcher observed and audio-taped all classroom discourse and collected samples of students' work. Data were transcribed and analyzed for important themes in the students' understandings. Results revealed that students' understandings of angle concepts are disconnected and fragile. Students tend to focus on one of three aspects--the angle's vertex, its rays, or its interior region. These unbalanced concept images often exclude many angles from being considered as angles, and can also interfere with other understandings such as angle size. However, these understandings are a very natural part of development given three different influences--the mathematical community's construction of the angle concept throughout history, the students' everyday experiences and language, and the instructional approach--all of which were highly influential factors in the students' development of the angle concept.

Kendrick, D. G. (2004). High school algebra teachers' beliefs and attitudes about the mathematics reform movement and high-stakes testing: Implications for staff development. *Dissertation Abstracts International*, 65(7) (ProQuest ID No. 775169461)

ABSTRACT: This study attempts to define urban teacher quality, understand teacher learning, and gauge the success of efforts to develop urban teacher competencies in implementing mathematics education reform in high school algebra classrooms. The Professional Standards for Teaching Mathematics (NCTM, 1991) includes two underlying premises of mathematics education reform: that teachers are the primary facilitators of change, and that teachers need adequate support to make changes. The study focuses on: (a) the extent to which reform-oriented practices are being implemented in high school algebra classrooms; (b) the relationship between teacher preparation and reform-oriented practices; and (c) the effects of teacher beliefs, school-level environment, and staff development on the mathematics education reform practices in high school algebra classrooms. The research includes examination of the responses of high school algebra teachers on a self-administered survey as well as the responses of high school algebra teachers and mathematics chairpersons in one-on-one interviews. The subjects were asked about their beliefs, actions, and needs as related to the NCTM Standards.

Kersaint, G. (1998). Preservice elementary teachers' ability to generalize functional relationships: The impact of two versions of a mathematics content course. *Dissertation Abstracts International*, 59(5). (ProQuest ID No. 1251814391)

ABSTRACT: This study investigated the impact of two versions of a mathematics content course designed for preservice elementary teachers on their growth in algebraic understanding. One section of the course was presented a traditional approach using instructor developed or compiled materials. Another section of the course was presented a function-based approach using algebra materials developed for middle school students by the Connected Mathematics Project (CMP). Specifically, this study examined the influence these materials had on preservice teachers' ability to generalize problem situations, to represent them symbolically, and to use their representation to solve related problems. Achievement gains and obstacles experienced by the students were also analyzed.

Data collection for this study included self-reported background data, instructor and student journals, written pre-and post-assessments, interviews, and observations. Qualitative and quantitative data analysis methods were used to analyze the data. Sfard's (1991) model of conceptual development was used as a lens by which to examine, describe, and interpret the students' conceptual understandings.

Achievement gains on the post-assessment were not statistically significant. Students from both classes performed similarly. Responses from the students in both sections of this course were characterized at the

interiorization and condensation phases of Sfard's model. In spite of this, results from the study show differences in the kinds of understandings developed by the students. The section using the CMP materials focused on developing students' conceptual understanding of algebra. While the other section of the course focused on developing students' procedural understanding of algebra. In addition to developing conceptual understandings, students using the CMP algebra units reported that they learned an alternate method for introducing and teaching algebra.

King, D. A. (2007). *A study to ascertain the effects of the Connected Mathematics Project on student achievement in the Buffalo public schools*. Unpublished master's thesis, State University of New York at Buffalo.

Krebs, A. S. (1999). Students' algebraic understanding: A study of middle grades students' ability to symbolically generalize functions. *Dissertation Abstracts International*, 60(6). (ProQuest ID No. 733526481)

ABSTRACT: The publication of the National Council of Teachers of Mathematics' Curriculum and Evaluation Standards in 1989 was pivotal in mathematics reform. The National Science Foundation funded several curriculum projects to address the vision described in the Standards. After these materials were developed and implemented in classrooms, questions arose surrounding students' learning and understanding. This study investigates students' learning in a reform curriculum. Specifically, "What do eighth grade students know about writing symbolic generalizations from patterns which can be represented with functions, after three years in the Connected Mathematics Project curriculum?"

The content, the curriculum, the data, and the site chosen define the study. Initially, the study surrounded students' algebraic understanding, but I focused it to investigate students' ability to symbolically generalize functions. Although this selection is a particular slice of algebra it represents a significant piece of the discipline.

I selected the Connected Mathematics Project (CMP) as the curriculum. I supported the authors' philosophy that the teaching and learning of algebra is an ongoing activity woven through the entire curriculum, rather than being parceled into a single grade level.

The data surrounded the solutions of four performance tasks, completed by five pairs of students. These tasks were posed for students to investigate linear, quadratic, and exponential situations. I collected and analyzed students' written responses, video recordings of the pairs' work, and follow-up interviews. The fourth choice determined the site. I invited Heartland Middle School, a pilot site of the CMP to participate in this study. I approached a successful teacher, Evelyn Howard, who allowed her students to participate. Together, we selected ten students who were typical students in her classroom to participate in this study.

In conclusion, I present two major findings of this study surrounding students' understanding of algebra. First, students who had three years in the Connected Mathematics Project curriculum demonstrated deep understanding of a significant piece of algebra. And second, teachers can learn much more about students' understanding in algebra by drawing on multiple sources of evidence, and not relying solely on students' written work.

Lewis, R. M. (2002). Mathematics for all? The cultural relevance of connected mathematics. *Masters Abstracts International*, 41(2). (ProQuest ID No. 766358581)

ABSTRACT: Studies have shown that White students consistently achieve higher than students of color. Recent calls for mathematics reforms have made many suggestions for narrowing this gap. One local school district adopted a standards-based mathematics program, Connected Mathematics, for the middle school level. Using theory from Freire, Giroux, Dewey, Tate, and Ladson-Billings, a framework for a culturally relevant curriculum was constructed. This inquiry project identifies the characteristics of a culturally relevant curriculum, examines why a culturally relevant curriculum is important in mathematics, and assesses Connected Mathematics for its cultural relevance based on the framework. Connected Mathematics was found to adequately support two of the five components of a culturally relevant curriculum.

Lubienski, S. T. (1996). Mathematics for all? Examining issues of class in mathematics teaching and learning. Unpublished doctoral dissertation, Michigan State University, East Lansing, MI.

Mathis, E. (2004). A comparison of two NSF funded middle school mathematics curricula in Delaware's Appoquinimink and Caesar Rodney school districts. *Dissertation Abstracts International*, 65(1). (ProQuest ID No. 765270181)

ABSTRACT: This evaluation compares two NSF funded middle school curricula, Math in Context and the Connected Math Project as measured by student achievement on the mathematics portion of the Delaware State Testing Program. The two groups consisted of 7th grade students from the Caesar Rodney and Appoquinimink School Districts who were not classified as receiving special education services nor services for learning English as a second language. The students took the 5th grade math portion of the DSTP in the Spring of 2000 and the 7th grade math portion of the DSTP in the Spring of 2002. The evaluation involved 295 students from the Appoquinimink School District and 291 students from the Caesar Rodney School District.

The findings of the study indicate that the use of different curricula in the Caesar and Appoquinimink School Districts, CMP and MIC, respectively, did not equivocate to a significant difference in math achievement as measured by the math portion of the DSTP. Descriptive data did show that CMP students outperformed MIC students in terms of increasing their scale scores, but again this difference was not significant. It is important to note that the factors of gender and ethnicity did not contribute to any statistically significant differences between the groups.

Meiler, J. (2006). Does a problem-centered curriculum foster positive or negative changes in students' attitude and learning in mathematics? A case study of three sixth grade students. *Masters Abstracts International*, 45(3). (ProQuest ID No. 1251814661)

ABSTRACT: This case study walks you through the educational lives of three students in sixth grade as they journey through learning by "doing" in a newly implemented, problem-centered math curriculum, Connected Math Project. The purpose of this study was to investigate how the learning strategies provided by Connected Math Project impacts students' attitudes and learning in mathematics. The overall confidence in personal mathematical ability, in how good they perceived themselves to be, in math, demonstrated an increase in positive responses over the last year for the case study students. Because of the increase in positive responses over the last year, the achievement level for the students also increased. These gains were impacted by the highly motivating problem-centered curriculum, Connected Math Project.

Newton, J. (2008). *Discourse analysis as a tool to investigate the relationship between the written and enacted curricula: the case of fraction multiplication in a middle school standards-based curriculum*. Unpublished doctoral dissertation, Michigan State University, East Lansing.

ABSTRACT: In the 1990s, the National Science Foundation (NSF) funded the development of curricula based on the approach to mathematics proposed in Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989). Controversy over the effectiveness of these curricula and the soundness of the standards on which they were based, often labeled the "math wars," prompted a plethora of evaluative and comparative curricular studies. Critics of these studies called for mathematics education researchers to document the implementation of these curricula (e.g., National Research Council, 2004; Senk & Thompson, 2003) because "one cannot say that a curriculum is or is not associated with a learning outcome unless one can be reasonably certain that it was implemented as intended by the curriculum developers" (Stein, Remillard, & Smith, 2007, p. 337).

Curriculum researchers have used a variety of methods for documenting curricular implementation, including table-of-content implementation records, teacher and student textbook use diaries, teacher and student interviews, and classroom observations. These methods record teacher and student beliefs, extent of content coverage, in-class and out-of-class textbook use, and classroom participation structures, but do little to compare the mathematics presented in the written curriculum (the student and teacher textbooks) and the way in which this mathematics plays out in the enacted curriculum (that which happens in classrooms).

In order to compare the mathematical features in the written and enacted curricula, I utilized Sfard's Commognition framework (most recently and fully described in *Thinking as Communicating: Human Development, the Growth of discourses, and Mathematizing* published in 2008). That is, I compared the mathematical words, visual mediators, endorsed narratives, and mathematical routines in the written and enacted curricula. Each of these mathematical features provided a different perspective on the mathematics present in the curricula. The written curriculum in this study was represented by Investigation 3 (Multiplying with Fractions) included in *Bits and Pieces II: Using Fraction Operations in Connected Mathematics 2* (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2006). Videotapes of this same Investigation recorded in a sixth grade classroom in a small, rural town in the Midwest were used as the enacted curricula for this case.

The study revealed many similarities and differences between the written and enacted curricula; however, most prominent were the findings regarding objectification in the curricula. Sfard defines objectification as "a process in which a noun begins to be used as if it signifies an extra discursive, self-sustained entity (object), independent of human agency" (Sfard, 2008, p. 412). She proposes that objectifying is an important process for students' discursive development and that it serves them particularly well in the study of advanced mathematics.

Both objectification itself and the opportunities present for objectification were more prevalent in the written curriculum than in the enacted curriculum.

O'Clair, K. K. (2005). Impact on student achievement: Going to scale with a middle school math initiative. *Dissertation Abstracts International*, 66(5), 1585 (ProQuest Id No. 921030071)

ABSTRACT: To measure the impact of a middle school math initiative on student achievement, a survey research design was used to categorize the levels of implementation by 7th -grade math teachers. The survey targeted the teachers' participation in 4 key components of the middle school math initiative, based on an expanded model of the theory of action of standards-based reform by Elmore & Rothman (1999): district-led professional development, school walkthroughs, site-based team planning, and use of standards-based Connected Mathematics program. In a western urban school district, 18 of the 21 contacted teachers from 2002-2003 completed and returned their self-administered surveys; 26 of 33 from 2003-2004. The Year 1 teacher sample represented 29% of the total teacher population and their 1,259 students were 24% of the total student population. The Year 2 teacher sample represented 39% of the teachers and their 1,765 students were 33% of the total student population. The scale scores of these students from 18 schools were the dependent variable for analyses of variance. The independent variables were the year and the level of implementation that was determined by weighting the results from the teacher survey against a rubric of implementation created by the researcher.

The major findings showed statistically significant differences by years and by levels of implementation. The 7th -grade student math scale scores of the statewide standards-based assessment positively improved and the strength of the effect was small. Using a 2-way ANOVA to compare the 4 groups of high and low implementation in both years, there was a statistically significant difference between the students' scores who experienced higher versus lower levels of implementation in their 7th grade math classes. The students of the higher implementation group of teachers, who had less teaching experience but attended more professional development and had more team planning, had higher math scale scores.

The research results conclude that there was a statistically significant small improvement. Recommendations for further research suggest investigation of the quality of instructional delivery, not only the quantity of CMP units. More involvement with instructional leaders on-site could support scheduling efforts for grade-level planning and more walkthroughs.

Post, R. A. (2004). Generation of mathematical knowledge through teacher practice: Study of a novice elementary teacher. *Dissertation Abstracts International*, 65(12). (ProQuest ID No. 845705381)

ABSTRACT: Research on teachers' knowledge has shown that elementary teachers often lack the deep, flexible, and conceptual mathematical understandings necessary for reform efforts in mathematics education to be realized in classroom practice. In order to meet the complex demands of developing are form-oriented teacher practice, a considerable amount of teacher learning must take place through participation in the activity of teacher practice.

Using case study methods, this research analyzed the practice of one 1st-year elementary teacher as she implemented a reform-based curriculum program (Connected Mathematic Project) and participated in the school, classroom, and reform (i.e., curriculum materials and professional development) communities of practice. Data were collected from observations of three units of instruction, professional development sessions, concept maps, and interviews with the case study teacher and members of the school community. Analysis revealed the key role curriculum materials played in the generation of mathematical knowledge. The classroom and reform communities acted as catalysts in the teacher's participatory practices, which generated expanded, connected , and unresolved mathematical knowledge.

Pradere, S. (2007). Effective staff development connected to increased student achievement. *Dissertation Abstracts International*, 68 (3). (ProQuest ID No. 1310415901)

ABSTRACT: School districts expend considerable resources to establish effective staff development opportunities that lead to increased student achievement. This research project focused on the development, implementation, and evaluation of a school based staff development project built around four distinct instructional elements: teacher instructional practices, student engagement, stating the objective, and developing a literacy rich environment. Specifically, the study addressed the following research questions: (1) Did teachers' instructional practices change as a result of participating in the professional development program? (2) If teachers adopted the new instructional practices, did the changes have an impact on student performance as calculated on the Measures of Academic Progress (MAP) assessment? The study was established within a mixed methodology design in which changes in teacher performance were measured using qualitative research methods including survey, interview, and classroom observation data sets. To measure changes in student performance. traditional univariate and multivariate statistical

the researcher: (1) facilitated the design of the staff development model; (2) provided or facilitated foundation staff development on four key instructional elements to both teachers and administrators; (3) provided guidance to administrators on gathering key data; (4) provided support to teacher leaders and administrators on methods for coaching teachers adopting new practices; (5) observed teachers utilizing skills in practice; (6) gathered both perception and observation data related to teacher implementation of four key elements; (7) gathered and processed student academic performance data; and (8) studied the results measuring the impact of staff development on both teacher practices and student performance. The results of the study verified: (1) that teachers adopted or maintained teacher skill levels related to key instructional practices; (2) students' actual mean growth rates on MAP assessment exceeded projected mean growth rates in reading and language but not mathematics; and (3) students whose teachers exceeded proficient skill levels in instructional practices and student engagement demonstrated higher performance levels in reading and language on the MAP assessment than those students whose teachers met or approached desired skill levels in those two areas.

Richards, K. T. (2004). Communications in mathematics. *Masters Abstracts International*, 43(2). (ProQuest ID No. 813818281)

ABSTRACT: The mathematics classroom is evolving to include more writing and discourse as a means of deepening student understanding of mathematical concepts. Traditionally, math has been taught as a set of procedures that when you plug in the right numbers in to the right equations, you get the right answers. My research in a middle school setting using the Connected Math Project curriculum required students to think more deeply and reflect on their math knowledge to write and discuss mathematical concepts with their classmates. In the process the students were more engaged, took more ownership, and constructed knowledge themselves. Through student observations, samples of writing work, Socratic Seminars, and student surveys and interviews, I discovered most students enjoy and value both writing and discourse. They see themselves as benefiting from both, writing and discourse, gaining better understanding and clarity of thought. Teachers are also able to assess their students understanding more accurately.

Rickard, A. (1993). Teachers' use of a problem-solving oriented sixth-grade mathematics unit: Two case studies. *Dissertation Abstracts International*, 54 (10), (ProQuest Id No. 745239291)

ABSTRACT: Problem solving is a central issue in current reform initiatives in mathematics education. However, while curriculum developers design problem-solving oriented curricula to help move reforms into K-12 mathematics classrooms, little is known about how teachers actually use problem-solving oriented mathematics curricula to teach.

This study investigates how two sixth-grade mathematics teachers used a problem-solving oriented unit on perimeter and area. A four-dimensional framework is developed and employed to explore how each teacher's knowledge, views, and beliefs shaped her use of the unit. Using data collected through interviews, classroom observations, conversations with teachers and their students, samples of students' work, teachers' lesson plans, and the unit on perimeter and area, two case studies are presented to portray how each teacher used the unit in her classroom.

This study shows that each teacher's use of the unit was consistent with her underlying views and beliefs, and with some aspects of the intentions of the curriculum developers who designed the unit. However, other aspects of the teachers' use of the unit varied from the intentions of the curriculum developers. This study shows further that each teacher's use of the unit was shaped by interplay between her own views, beliefs, and knowledge, and the unit. Therefore, both the perimeter and area unit and the teachers shaped the teaching which occurred in their classrooms.

This study suggests that while problem-solving oriented curriculum can play a role in shaping mathematics teaching, the views, beliefs, and knowledge of teachers should be addressed in curriculum. This study also points to issues for future research that are connected to teachers' use of problem-solving oriented curricula.

Schneider, C. L. (2000). Connected Mathematics and the Texas Assessment of Academic Skills. *Dissertation Abstracts International*, 62 (2). (ProQuest ID No. 727941391)

ABSTRACT: This study determined if the use of Connected Mathematics (CMP), a middle school curriculum based on the reform standards called for by the National Council of Teachers of Mathematics in 1989, impacted student performance measured by the state mandated Texas Assessment of Academic Skills (TAAS) test. Did Texas campuses involved in the CMP pilot from 1997 to 1999 have different TAAS results compared to similar Texas campuses that did not use CMP?

In this study campuses were not randomly selected to use the curriculum. CMP and non-CMP campuses were matched using a regression analysis of the significant variables predicting 1996 pre-CMP TAAS rates. Campus level TARS passing rates and student Texas Learning Index (TLI) scores were analyzed using mixed model methodology. There were 48 campuses represented in the campus level analysis and 19,501 students from 32 of

was identified from teachers' reporting that at least one-third of the total possible curriculum at every grade and year during the pilot was taught. The data were partitioned into cohorts; Cohort 1 represented observations from sixth, seventh, and eighth grades, from 1996-97 to 1998-99. Cohort 2 included data from sixth and seventh grades, 1997-98 to 1998-99. Cohort 3 had data for sixth grade, 1998-99.

For the analyses on TAAS percent passing and student TLI for all campuses and cohorts combined there is no difference between CMP and non-CMP campuses. When disaggregating the analyses by cohort, there is no difference between CMP and non-CMP campuses for either type of data for any individual cohort using all campuses. For the high use subset of campuses with all cohorts combined there is no difference between CMP and non-CMP campuses for either TAAS passing rates or student TLI scores. For the high use subset of campuses and students disaggregated by cohort, differences may be found, but they are not consistent. Research in this study indicates that the use of the CMP curriculum does not make a difference on TAAS passing rates or student level TLI scores.

Seifer, M. D. (2005). *Collaborating with colleagues to improve student learning using the Connected Mathematics Project*. Unpublished master's thesis, Bank Street College of Education, New York, NY.

Star, J. R. (2001). Re-conceptualizing procedural knowledge: Innovation and flexibility in equation solving. *Dissertation Abstracts International*, 62(10). (ProQuest ID No. 726024271)

ABSTRACT: The studies described in this thesis explore the development of students' knowledge of mathematical procedures. Students' tendency to develop rote knowledge of procedures has been widely commented on and is generally attributed to a lack of connection to principled knowledge. I postulate an alternative endpoint for the development of procedural knowledge, one that Ryle (1949) called an "intelligent performance" and Skemp (1976) described as "relational." Students demonstrate this capacity when they are able to flexibly use mathematical procedures, especially when they choose to deviate from established solving patterns on particular problems for greater efficiency. The purposes of these studies were (a) to demonstrate that students could develop the ability to execute mathematical procedures "intelligently," and (b) to explore the instructional conditions that facilitate the emergence of this outcome. In three studies, students with no prior knowledge of formal linear equation solving techniques were taught the basic transformations of this domain. After instruction, students engaged in problem-solving sessions in two conditions. In the treatment group, students completed "alternative ordering tasks," where they were asked to re-solve previously completed problems but using a different ordering of steps. When the treatment group engaged in such tasks, the control group instead solved structurally isomorphic equations. In Study 1, 10 students worked individually with the experimenter for 4, 30-minute problem-solving sessions. Eight of the 10 students became very successful solvers of linear equations, discovering sub-goal knowledge and also developing an efficient and consistently used solving heuristic. In Study 2, 36 students engaged in 4 one-hour individual problem-solving sessions. The treatment group students became more innovative and more flexible solvers. Study 3 replicated Study 2 using a classroom rather than an individualized learning environment; similar results were obtained.

These results suggest that alternative ordering tasks may help to support the development of flexible knowledge of procedures. Flexibility is an advantage for acquiring more advanced knowledge and also for solving specific problems most efficiently. With training on considering alternative solutions, students can be assisted in avoiding rote learning of procedures and in developing a rich understanding of why procedures work.

Stevens, B. B. A. (2005). The development of pedagogical content knowledge of a mathematics teaching intern: The role of collaboration, curriculum, and classroom context.

*Dissertation Abstracts International*, 67(9). (ProQuest ID No. 1212777591)

ABSTRACT: In this study I examined the role of collaboration, curriculum, and the classroom context in the development of pedagogical content knowledge of a mathematics teaching intern. Additionally, I investigated the nature of the collaborative process between the teaching intern and his mentor teacher as they collaborated on action (during structured planning time) and in action (while students were present). The teaching internship resided in a seventh-grade mathematics classroom during the teaching of a probability unit from a standards-based curriculum, Connected Mathematics Project.

Using existing research, a conceptual framework was developed and multiple data sources (audio taped collaborations, observations of the intern's teaching practices, semi structured interviews, and a mathematics pedagogy assessment) were analyzed in order to understand the teaching intern's development of knowledge of instructional strategies, knowledge of student understandings, curricular knowledge, and conceptions of purpose for

Results identified numerous dilemmas related to planning and implementing instruction. Although the teaching intern developed pedagogical content knowledge, he often experienced difficulty accessing it while teaching. Through collaboration, curriculum, and the classroom context, the teaching intern learned to incorporate his pedagogical content knowledge in instruction. Analysis revealed that as he gained new knowledge he was able to shift his focus from content to the use of instructional strategies for teaching and learning. The curriculum was the primary focus of collaboration and initiated the intern's examination of the learning-to-teach process.

Collaboration on action and collaboration in action proved to be essential elements in the development of pedagogical content knowledge.

Theule-Lubienski, S. A. (1996). *Mathematics for all?: Examining issues of class in mathematics teaching and learning. Dissertation Abstracts International, 58(1)*. (ProQuest ID No. 739654911)

ABSTRACT: Diversity and equity are popular topics in the mathematics education community today, particularly amidst current reforms intended to "empower all students." Still, little attention is given to socio-economic diversity in relation to mathematics teaching and learning.

In this study, a researcher-teacher explores the ways in which a curriculum and pedagogy aligned with current, mathematics education reforms played out with a socio-economically diverse group of seventh-grade students. Interviews, surveys, teaching journal entries, and daily audio recordings were used to document students' experiences across the 1993-94 school year. Qualitative analyses compared the lower-and higher-SES students' experiences with the whole-class discussions and contextualized, open-ended mathematics problems. The analyses revealed that while the higher-SES students tended to have confidence in their abilities to make sense of the mathematical discussions and problems, the lower-SES students often said they were "confused" by conflicting ideas in the discussions and the open nature of the problems--they desired more specific direction from the teacher and texts. Additionally, while the higher-SES students seemed to approach the problems and discussions with an eye toward the larger, abstract, mathematical ideas, the lower-SES students more often became "stuck" in the contexts of the problems.

The study examines critical links between the current mathematics reforms and literatures on social class, which suggest there might be a mismatch between the culture of lower-SES students and the culture of the mathematics classroom advocated by current reformers. "Cultural confusion" is proposed as an explanation for the struggles the lower-and working-class students faced in the reformed mathematics classroom. The study suggests that a classroom in which taking initiative in solving problems, analyzing and discussing ideas, and abstracting mathematical ideas from contextualized problems, might be more aligned with middle-class students' preferred ways of communicating, thinking and learning.

Dilemmas involved in educating lower-and working-class students are discussed. This study contributes to our understanding of both possibilities and hazards inherent in constructivist-inspired pedagogies and curricula intended to "empower all students," in both mathematics and other fields.

Triantos, L. M. (2005). *The aftermath of implementing a standards based curriculum in a K-8 district: Is there a correlation between hands-on instruction and math scores?* Unpublished master's thesis, Rowan University, Glassboro, NJ.

Van Dyke, C. L. (2001). *The shape of things to come: Mathematics reform in the middle school. Masters Abstracts International, 40(2)*. (ProQuest ID No. 727357331)

ABSTRACT: In this thesis I investigate the implementation of the Connected Mathematics Project (CMP) at Gallup Middle School in the Holbrook School District. I analyze my experiences and observations at Gallup Middle School during the 2000-2001 school year in the broad context of mathematics education reform. My observations reveal difficulties with implementing CMP. I describe several factors contributing to these problems. It is my goal to strengthen investigation-oriented mathematics by illuminating its weaknesses. I believe CMP fosters a greater understanding of mathematics among students. This understanding creates the foundation for a mathematical perspective on the world. The development of a mathematical perspective is crucial to the economic well-being of our students and, in turn, our country.

Waite, R.D. (2000). *A study of the effects of everyday mathematics on student achievement of third-, fourth-, and fifth-grade students in a large north Texas urban school district. Dissertation Abstracts International, 61(10)*. (ProQuest ID No. 1251814391)

ABSTRACT: Data were examined in this study from student records in a large North Texas urban school district who were taught with two different mathematics curricula to determine whether or not they had different effects on

mathematic standards, written by the National Council of Teachers of Mathematics. The other mathematics curriculum was district-approved, using a textbook from a large publisher, with a more traditional approach.

The students selected for the experimental group came from six schools that had implemented the Everyday Mathematics curriculum for the 1998-99 school year. An experimental group was formed from these students. Twelve schools with similar socioeconomic ratios, ethnic makeup and 1998 Iowa Test of Basic Skills mathematics score profiles were selected. A control group was formed from this population of students that was similar to the experimental group with the exception of having been taught using the district-approved mathematics curriculum.

These two groups were very similar in socioeconomic, ethnic, gender, and grade level makeup. Most importantly, the experimental group and control group were almost identical (there was no statistically significant difference) in their 1998 Iowa Test of Basic Skills mathematics scores, a gauge used to demonstrate that prior mathematics ability was equal going into the 1998-99 school year.

In the statistical analysis, almost all comparisons showed that the experimental group taught with the Everyday Mathematics curriculum had higher scores on the 1999 Texas Assessment of Academic Skills mathematics test. When compared to children with similar mathematics ability at the beginning of the 1998-99 school year, the students in this study who were taught using Everyday Mathematics showed greater achievement gains than students in classes that used the district-approved curriculum.

Wasman, D. G. (2000). An investigation of algebraic reasoning of seventh-and eighth-grade students who have studied from the Connected Mathematics Project curriculum.

*Dissertation Abstracts International*, 61(9). (ProQuest ID No. 727777811)

ABSTRACT: This study investigated algebraic reasoning of seventh and eighth graders' who have studied from the Connected Mathematics Project (CMP) materials. Algebraic reasoning was defined as the process of thinking logically about and applying algebraic concepts as described by NCTM's expectations for grades six through eight students described in the Patterns, Functions, and Algebra Standard outlined in the Principles and Standards for School Mathematics. The seventh and eighth graders represented 75% of the students at their grade level because the other 25% were enrolled in accelerated courses that did not use CMP. In order to document the extent and nature of the use of CMP, all sixth, seventh and eighth grade teachers completed a survey followed by researcher-conducted classroom observations. The Iowa Algebra Aptitude Test (IAAT) was administered to 100-seventh graders and 73-eighth graders. Five-seventh graders and six-eighth graders were randomly selected for individual interviews consisting of a series of twelve algebra tasks.

Students' performance on the IAAT and interview tasks demonstrated the well-developed nature of their understanding and use of algebraic ideas and strategies. Students demonstrated flexibility in their thinking and ability to describe linear relationships in a variety of representations. Students described rate of change arithmetically, algebraically, and/or geometrically in different situations. Students approached problems in a sense-making way, choosing a variety of different strategies (informal and formal) all of which led to correct solutions and reflected strong conceptual understanding of algebraic ideas. Eighth graders were more likely to use symbolic algebra methods to solve problems than the seventh graders, reflecting a natural development of more symbolic strategies. Context played an important role with regard to students' ability to interpret and symbolize mathematical ideas. Students were more likely to represent situations symbolically when they were embedded in a context-rich setting. Some students had difficulty translating from a recursive pattern to an explicit formula and interpreting a graph as a relationship between independent and dependent variables. These same weaknesses have been noted in other research studies indicating that these ideas may require more time or maturity to develop, regardless of the particular curriculum used.

Wanko, J. J. (2000). Going public: The development of a teacher educator's pedagogical content knowledge. *Dissertation Abstracts International*, 62(1). (ProQuest ID

No. 727910571)

ABSTRACT: When Lee Shulman and his colleagues introduced pedagogical content knowledge (PCK) to the education lexicon in the 1980s, they gave teachers and teacher educators some technical language that could be used for talking about the knowledge needed for work that they do in classrooms, thereby helping to establish teaching as a profession. Since that time, the PCK of classroom teachers has been studied and documented across various content areas. But the PCK of teacher educators has remained a largely unexamined area of research, especially in the providing experiences in helping preservice teachers develop their own PCK. This study examines this issue more fully. Specifically, "Can pedagogical content knowledge be a useful framework for a teacher educator in designing and teaching a mathematics content course for preservice teachers and if so in what ways?"

In this study, I use my own teaching and classroom of prospective elementary teachers as the site for investigation. I examine the ways in which my own PCK as a teacher educator influenced and was influenced by my

work with students. Data for the study are provided by my teaching journal, lesson and units plans, student work, and audiotapes of class proceedings.

In conclusion, I present three major findings of this study. First, this study highlights and problematizes Shulman's notion of representation that is used in defining pedagogical content knowledge. In mathematics there are mathematical and empirical representations--classifications which do not map easily onto Shulman's use of representation. This study exposes some of those inherent distinctions and seeks to make Shulman's work more applicable to the field of mathematics. Second, this study describes the importance of task design--a process that is particularly essential in teaching mathematics--and finds that Shulman's notions of PCK and the pedagogical reasoning and action cycle miss or obscure its significance. And third, this study introduces the notion of shared reflection to Shulman's model for pedagogical reasoning and action when it is applied to teacher education. It also finds that the act of going public with one's ideas through shared reflection can be a useful tool for teacher educators in the development of their pedagogical content knowledge.

Wilt, B. J. (2007) Preservice teachers to inservice teachers: Teaching for social justice.

*Dissertation Abstracts International*, 68 (10). (ProQuest ID No. 1251814391)

ABSTRACT: The purpose of this research project was to explore how preservice teachers, who are now currently inservice teachers, who took an undergraduate secondary education course with a focus on teaching for social justice, currently, make sense of what it means to teach for social justice. The participants in this study took the same secondary education course for preservice teachers which focused on critical consciousness raising experiences in order to promote teaching for social justice in classrooms. My participants took this course when they were working on their undergraduate degrees in education. This course was the one course in the education program that brought together students in each of the content specific discipline areas of the program--mathematics, science, social studies, language and literacy, and world languages (Bullock, 2004). The course was taken the semester prior to student teaching and occurred during the first 10 weeks of the semester followed by a five-week practicum (Bullock, 2004). In order to conduct my research project I solicited sixteen secondary education teachers, who were previously enrolled in the same undergraduate teacher education program (mentioned above) at a major university in the Mid-Atlantic region of the United States to volunteer to participate in this study. The inservice teachers all took the same secondary education course as preservice teachers which focused on teaching for social justice.

There were many factors that influenced the participant's perspectives about teaching for social justice as well as the degree to which they taught for social justice. All these factors--the undergraduate course rooted in critical consciousness raising experiences, sociocultural structures, political structures, contextual influences, hidden curriculum, teaching stance, teaching praxis--connected to power, privilege, and oppression through issues such as race, ethnicity, class, culture, sexual preference, language, ability, etc.

Both participants self-admittedly teach for social justice, however, the degree to which this takes place varies depending on their respective perspectives on what it means to teach for social justice. Jim does not teach for social justice and is less inclined to trouble and challenge dominant perspectives because he is uncomfortable with difference. He also does not understand the sociocultural mechanisms that reproduce hegemony and is part of the complicit process rather than part of the solution. Neil teaches for social justice to a certain degree and is more inclined to trouble and challenge the status quo and hegemonic mechanisms. However, he does this by teaching for the other (Kumashiro, 2002) and teaching about the other (Kumashiro, 2002) but does not teach in a manner that is critical of privileging and othering (Kumashiro, 2002).

This study suggests that more research is needed in order to explore and understand how teachers who have an awareness of teaching for social justice actually teach for social justice. This exploration and understanding needs to look at the broad scope of the influences on teachers and how these influences impact teaching for social justice. In addition, teacher education programs must emotionally and structurally embrace curricula rooted in social justice in order to promote teaching for social justice in away that preservice teachers can also embrace and incorporate in to their teaching praxis. If preservice teachers are to do this they need to understand approaches like education for the Other, education about the Other, education that is critical of privileging and Othering, and education that changes students and society (Kumashiro, 2002) in order to teach for social justice.

Wu, Z. (2004). The study of middle school teacher's understanding and use of mathematical representation in relation to teachers' zone of proximal development in teaching fractions and algebraic functions. *Dissertation Abstracts International*, 65(7). (ProQuest ID No. 775173261)

ABSTRACT: This study examined teachers' learning and understanding of mathematical representation through the Middle School Mathematics Project (MSMP) professional development, investigated teachers' use of mathematics representations in teaching fractions and algebraic functions, and addressed patterns of teachers' changes in learning and using representation corresponding to Teachers' Zone of Proximal Development (TZPD). Using a qualitative research design, data were collected over a 2-year period, from eleven participating 6th and 7th grade mathematics

teachers from four school districts in Texas in a research-designed professional development workshop that focused on helping teachers understand and use of mathematical representations. Teachers were given two questionnaires and had lessons videotaped before and after the workshop, a survey before the workshop, and learning and discussion videotapes during the workshop. In addition, ten teachers were interviewed to find out the patterns of their changes in learning and using mathematics representations. The results show that all teachers have levels of TZPD which can move to a higher level with the help of capable others. Teachers' knowledge growth is measurable and follows a sequential order of TZPD. Teachers will make transitions once they grasp the specific content and strategies in mathematics representation. The patterns of teacher change depend on their learning and use of mathematics representations and their beliefs about them. This study advocates teachers using mathematics representations as a tool in making connections between concrete and abstract understanding. Teachers should understand and be able to develop multiple representations to facilitate students' conceptual understanding without relying on any one particular representation. They must focus on the conceptual developmental transformation from one representation to another. They should also understand their students' appropriate development levels in mathematical representations. The findings suggest that TZPD can be used as an approach in professional development to design programs for effecting teacher changes. Professional developers should provide teachers with opportunities to interact with peers and reflect on their teaching. More importantly, teachers' differences in beliefs and backgrounds must be considered when designing professional development. In addition, professional development should focus on roles and strategies of representations, with ongoing and sustained support for teachers as they integrate representation strategies into their daily teaching.

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