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Maintaining the Mental Model: An Exploratory Study of Dialogic Processes on Good Teaching Practice

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Abstract

This paper presents some outcomes of an exploratory, mixed-method study that examined mental models of teaching and understanding of learning processes in 26 educators from a small suburb in the Northeastern United States. Participants, in semi-structured written interviews, were asked to rate variables contributing to their mental model of effective teaching. They were then presented with a specific educational problem and asked to provide pedagogic solutions. One finding of this exploration was that some educators did not adhere to their own described mental model of best teaching practices when faced with an educational problem. However, those who responded to the problem in concert with stated mental constructions for teaching were more likely to have engaged in daily dialogue about pedagogic practices with their colleagues. The role of self-reflection, through daily dialogue as a mediator of teacher development is discussed, along with implications for policy and practice in elementary and secondary education.

Keywords

Mental models of teaching, pedagogy

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"As is the teacher, so is the school."
-John Dewey

I.

Introduction

In the early twentieth century, John Dewey recognized the discrepancy between educational theory and practice. Highlighting the importance of teachers, he stated that the gap between our "modern theories and what is accepted in school practice, is due to the fact that the intellectual responsibility of the classroom teacher has not been sufficiently recognized" (Dewey, 1924, p. 186). Although theoretical understanding at that time appreciated the benefit of active engagement in problem solving and the contribution teacher characteristics would make toward such efforts, classroom practice nonetheless emphasized rote memorization as the primary means for knowledge acquisition. The role of the teacher was underemphasized and undervalued.

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It was not until the latter part of the twentieth century that research in cognitive psychology began to identify defining characteristics of effective teaching. Linking teacher effectiveness to expertise in general, educational researchers began to call for theories of teacher development to better understand the transition from novice to expert (Berliner, 1997, 2004; Dreyfus & Dreyfus, 1986). Most recently, educators have advocated for greater collaboration between research and education; advances in biology, cognitive science and development are beginning to inform policy and the practice of teaching and learning (Fischer, 2009). With state and national standards for assessment and accountability bearing down on pedagogic and curricular expectations, the need to understand teacher efficacy is greater than ever before. What do good teachers know and how is this transformed into a knowledge that is accessible and usable? What role does dialogue, or processing what one knows with colleagues, contribute to the development of this knowledge?

Early childhood educators are compelled to have complex understandings of child development and educational issues in order to provide rich, meaningful experiences that address cognitive, social, and emotional imperatives. This understanding is often contingent upon state-mandated, ongoing professional development for practicing elementary and secondary educators as a requirement to maintain licensure (Martinez-Beck & Zaslow, 2006; Sheridan, et al., 2009; U.S. Department of Education, 2011). Teacher development has traditionally targeted two primary systemic levels: to enhance the knowledge, skills, and practices of the individual, and to promote a professional culture that engenders growth-enhancement and self-sustenance (Sheridan et al., 2009). Promoting and sustaining an ethos of responsibility for ongoing development ideally becomes an "inside-out" process whereby educators retain responsibility to inform professional growth and development through continued study of best practices and reflective personal growth. Ideally, this process is effectively accomplished in collaboration with colleagues (Bray, et al., 2000; Semadeni, 2010; Sheridan et al., 2009). Indeed, rather than simply identifying who knows what, collaborative processes promise the potential for the *creation of new* knowledge (Brown & Campione, 1990).

This paper will examine teachers' conceptualizations of what constitutes best practice, offering theories of cognitive development and learning to elucidate possible cognitive underpinnings in the process of "just knowing" how to teach. We asked teachers to describe their mental models of teaching, in relation to both formal post-secondary education as well as informal vivo classroom experiences. We then investigated whether educators adhered to these mental constructions when faced with a challenging classroom situation. We attempted to move beyond the structure of pedagogy and into the processes of teachers' thinking.

Previous Research in Teacher Development

The call for post-graduate education for teachers continues, although the relationship between a teacher's level of education and overall classroom quality or student academic outcome has been found to be weak at best (Early, et al., 2007). Formalized teacher development traditionally takes place outside of the classroom, with limited opportunity for feedback or opportunities to engage in dialogue regarding observed practice (Pianta, 2006). Specialized training programs in which skills are practiced improve competencies of educators (Joyce & Showers, 2002); these competencies are further strengthened when opportunities for feedback are present (Fukkink & Lont, 2007). The consensus from investigators is that teachers are more likely to implement new skills with training when combined with on-the-job coaching (Ager & O'May, 2001; 2007).

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Traditional teacher development focused on workshop training and post-graduate coursework. More recently, discrete components of teacher training have been scrutinized in an effort to support No Child Left Behind Act (NCLBA) learning objectives (Tugel, 2004). Mentoring-coaching approaches to teacher training have long been emphasized as effective means of providing support and guidance for novice teachers (Cummins, 2004; Onchwari & Keengwe, 2008). Recent findings from professional development approaches for Pre-K and Head Start Programs indicate that when teachers received consultancy and mentoring in addition to workshop training (Onchwari & Keengwe, 2008; Pianta, La Paro, & Hamre, 2008), teachers improved the quality of their interactions with children (Onchwari & Keengwe, 2008; Pianta, et al., 2008). Improvements in student language arts and literacy skills were also noted within this mentoring model (Mashburn, et al. 2008).

Meaningful differences attributed to consultant effects (Downer, et al., 2009) suggest that some mentor-mentee dyads may have been more relationally attuned and/or engaged in dialogue more easily, possibly affording a more meaningful experience for the trainee. More data are needed to elucidate precisely what effective coaches and consultants should do to elicit desired competencies in practitioners (e.g., effective practice), whether these competencies include promoting self-reflection, and whether the capacity for self-reflection mediates change. One possibility is that the mentor-mentee dyads provide opportunity for dialogic processes to occur. Such dyads could provide a setting in which personally held constructions for teaching and learning are compared and contrasted until a consensus, or *public knowledge* is obtained (Scott, 2001).

Inherent in the coaching paradigm is the opportunity for self-observation and critical feedback, each conducive to personal reflection. Taken at its core, dialogic, mutually reflective processes are identified as the source of and vital for the construction of a cohesive, subjective self (Stern, et al., 1984). Evidence abounds indicating that an individual is capable of operating at a higher level of development when working in concert with a more accomplished other than when working alone (Fischer, 1993; Vygotsky, 1978). The intersubjective nature of the interplay between self and other in this socio-cultural context highlights the nexus between social exchange and subsequent personal reflection. Evidence abounds suggesting that the framework used for the development of meaning is critically dependent on interpersonal discourse. In the coaching-mentoring paradigm, structure and support is provided for higher-ordered activity and meaning-making to be jointly constructed. Ultimately, in order for individual development to occur, effortful coordination and consolidation of action, thought and feeling must take place (Mascolo & Fischer, 2004). In this manner, the primary conscious activity performed in unison serves to promote and facilitate secondary self-reflective processes (2004).

Effective models for professional development would benefit from an examination of whether self-reflection processes effect sustained cognitive change, leading to increased efficacy. Shifting focus beyond the "basics" of teacher development (e.g., pedagogical methodology; curricular design), effective teaching practices (e.g., classroom management, assessment), and into the *process* of teacher development (e.g., mediators; mechanisms of change) is scientifically relevant. The application of empirical research and inquiry to practical and applicable programs of teacher training might afford insight into effective strategies for teacher development. Current efforts by the scientific community to integrate mind, brain, and education posit that multiple lines of research within and across biology, cognitive science, human development, and education can provide knowledge that is usable; that is, practical and applicable to programs of teacher education (Fischer, 2009). Processes that mediate change are inherently difficult to capture and measure. Theories of development and learning provide

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useful information regarding how teachers think and learn, and how one can best facilitate or scaffold these processes for optimal development. We next examine how various theorists have conceptualized teaching.

Teaching

"All the greatest achievements of mind have been beyond the power of unaided individuals."
-Charles Sanders Peirce

Teaching involves two types of knowing: declarative and procedural. Declarative knowing is accessible (e.g., knowing who is the first president of the United States) whereas procedural knowing tends to be in the service of accomplishing a task, and often is not accessible (e.g., knowing how to ride a bike). Good teaching is primarily procedural (Leinhardt, et al., 1995). Consider the teacher who aids one child in a particular manner, but at the next moment interacts with another child, who is attempting the same exercise, using a different approach. No doubt the teacher has an implicit understanding of two different minds, and, drawing upon procedural knowledge, a tacit ability to provide unique interventions. Good teaching is rarely pre-contemplated; moment-to-moment dynamic interactions require immediacy: a "just knowing." Tacit understanding has been referred to as "knowing more than we can tell," (Polanyi, 1967, p. 4). The teacher who appears to seamlessly weave individualized instruction into the classroom experience is enacting these intuitive processes. Tacit knowledge is required to handle challenging situations effectively, and yet its elusive quality leaves the novice teacher wondering how and where to attain such knowledge (Leinhardt, et al., 1995; Grigorenko, Sternberg, & Strauss, 2006).

Many cognitive theorists argue that although some knowledge essential to the practice of teaching is learned via formal training, tacit knowledge is acquired primarily through personal experience (Grigorenko, Sternberg, & Strauss, 2006). These experiences might translate into common parlance: a teacher's "instinct" or "gut feeling" guides his or her actions. The teacher may not be able to articulate these "professional intuitions," as they are implicit, and therefore outside of focal awareness. Teachers generally learn this type of tacit professional knowledge informally, in context, by generating a "feel" for what to do when. Theorists postulate that although philosophical and metaphysical underpinnings of tacit knowledge might be addressed, the guiding principles are rarely explicated, and hence tacit knowledge is inaccessible (Leinhardt, Mcarthy-Young & Merriman, 1995; 2006). Implicit lay theories of the mind and learning have been referred to as "folk psychology" (Olson & Bruner, 1996). Folk psychology is thought to reflect not only innate human tendencies, but also cultural beliefs about the mind incorporated over time (Olson & Bruner, 1996). Armed with folk psychology, educators are thus directed in the activity of teaching so that learning occurs by enacting a "folk pedagogy" (Olson & Bruner, 1996, page 10).

To facilitate understanding and to describe this "just knowing," procedural knowledge, or folk psychology-folk pedagogy interface, previous investigators have utilized the concept and metaphor of a mental model (MM) (Johnson-Laird, 1983, Olson & Bruner, 1996; Strauss, 1996; Strauss, 2001). Teachers' MMs constitute a cognitive structure that organizes how they think about learning and teaching. MMs are the "nuts and bolts" of how a teacher perceives the art of teaching, the process of learning, and the educator's responsibility in this interface. For purposes pertinent to our investigation, we use MMs as a descriptive and explanatory system for understanding the development of teachers' constructions of teaching and learning.

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Investigators have noted discrepancies between in-action theories (what teachers do) versus espoused theories (what teachers purport to do) (Strauss, et al., 1998). Although teachers refer to how they teach and may indeed have a mental model for such, it has been demonstrated that in actuality this model has little to do with how they realize the actions of their profession (Strauss, 1996; Strauss & Shilony, 1994).

In order to foster the connection between implicit espoused and in-action MMs, teachers' MMs must be made explicit (Olson & Bruner, 1996; Strauss, 1996; Strauss, 1993). What is implicitly "known" is not verbalized and thus not accessible for reflection. Thinking explicitly about MMs and assumptions about processes of teaching and learning leads educators out of the "shadows of tacit knowledge," affording deliberate reflection on the process of thinking and learning (Olson & Bruner, 1996, p. 11). Teacher reflection has been long identified as the process by which we understand the progression of professional practice (Dewey, 1924; Schon, 1983). Without a reflective capacity, teachers are unable to enrich understanding and correct misconceptions of how they teach and how children learn. Teacher reflection is seen as inquiry-oriented, action-related, and personal, (Marcos, Sanchez & Tillema, 2008) the capacity of which is dependent upon experiences of the individual (Fischer & Pruyne, 2003).

In order to inform and facilitate best pedagogic practice, it is important to understand how reflective processes affect cognitive change. Karmiloff-Smith's (1992; 1994) constructivist approach to learning is a useful heuristic for understanding teacher development and mechanisms of change. The acquisition of usable knowledge that is progressively accessible synthesizes domain-general and domain-specific theories of cognitive development (Carey & Spelke, 1994; Fodor, 1983; Karmiloff-Smith, 1992; 1994). Via the synthesis of intra- and inter-domain relationships, representational redescriptions (RR) are created, and increasingly complex abstractions are constructed (Karmiloff-Smith, 1992). Karmiloff-Smith's theory supports previous educational research in which the notion of reflection is viewed as a cyclical or recursive process involving thought and action (Korthagen, 2002).

If implicit knowledge is made progressively explicit and thus available for reflection, the MM undergoes a conceptual change, or representational redescription (RR). When this occurs, the likelihood that meaning-making and flexibility and creativity of action is enhanced (Karmiloff-Smith, 1994; Vygotsky, 1978). Assumptions can be evaluated, pedagogic skills adjusted, and teaching expertise improved (Bransford, et al., 2005). In essence, the capacity to "know" one's own mind (containing beliefs, wishes, feelings, and thoughts), to reflect upon the minds of others, to recognize that these other minds are different than one's own, and to respond in kind is essential for "good teaching" to occur. The capacity to access this type of "knowing" and apply it to given classroom situations and interpersonal relationships flexibly and creatively is what developmental and clinical psychologists refer to as *mentalizing* (Bateman & Fonagy, 2006).

Cognitive and developmental psychology offer theories of learning and development that can be of heuristic value for understanding both teacher and student development. Teachers possess MMs, or cognitive structures of how they view teaching and learning (Olson & Bruner, 1996; Strauss, 1996). Most likely, these MMs are derived from self-reflective, organizational, and integrative processes borne of intersubjective dialogic experiences (Korthagen, 2002). Developmental theory highlights the importance of and connection between social interactions and individual construction of higher-order actions, meanings, and skills (Fischer & Pruyne, 2003). Teachers' espoused MMs of how they teach most likely do not reflect what actually occurs in classroom settings (Strauss, 1996; Strauss & Shilony,

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1994). Cognitive theorists offer ideas as to how to best facilitate a connection between espoused and in-action MMs (Karmiloff-Smith, 1992).

In making MMs explicit via dialogic process, teachers enrich their understanding of teaching and learning; thus advancing pedagogic and relational expertise. Given recent national and state mandates for teacher assessment, the call to better understand process of teaching and learning becomes ever more resounding. Critical inquiry into the mediators that promote change and development of practitioners' mental models of teaching provide a means for insight into that process.

II.

The Current Study

The current investigation is a mixed-method exploration of teachers' organizing mental constructions (MMs) for teaching and learning. We sought to investigate how educators construct their mental models of teaching and learning, and whether or not they adhere to these theoretical models in actual practice. Specifically, we asked: (1) What overarching principles do teachers utilize in constructing their mental models for best practice? (2) Are educators' espoused mental models of teaching and learning reflected in their practices? (3) What role do dialogic processes play in the construction of and adherence to MMs of teaching and learning?

The current study differs from previous investigations in three distinct ways. First, in adhering to the belief that teachers and learners can and should be vital resources in formulating research methods and questions (Coch, et al., 2009; Fischer, Goswami & Geake, 2010; Maxwell, 1996), the questions and hypotheses posed in this study were drawn from the first author's experiences as an early childhood educator. Few studies are based on this unique perspective. Second, while theories of teaching and learning processes abound, few studies that investigate teachers' MMs of these processes exist. The present study attempted to gather empirical evidence to elucidate how teachers construct MMs. Third, while this study asked teachers to explain their constructions, or MMs, of teaching and learning, the focus of the study was on the *process* of their thinking, rather on the concrete examples that they articulated.

We hypothesized that teachers would report having pedagogic MMs that value the underlying processes of learning and development, but that when presented with an educational problem, their in-action models for solutions would deviate from espoused models. Specifically, we hypothesized that when confronted with increased curricular demands, teachers would deviate from the stated MM for "best-practice" and instead place emphasis on structural learning goals and objectives. We additionally hypothesized that talking about teaching practices with mentors and colleagues would mediate adherence to espoused MMs. For organizational purposes, these hypotheses are outlined according to level of professional mastery, defined in terms of teaching experience, as follows.

Teaching Experience

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The literature surrounding the role of teaching experience in teachers' subsequent expertise indicates that it takes roughly 3-5 years until a teacher is no longer surprised by what happens in the classroom (Berliner, 2004). Student scores for beginning teachers have been reported to rise every year during the first 7 years of their teaching (Lopez, 1995). The literature argues that more experienced teachers should possess a more comprehensive repertoire of teaching strategies, an ability to acknowledge the richness and complexity of individual differences in learners, and should exhibit a more flexible response pattern (Berliner, 2004). To some degree this may be true: that as teachers gain experience, they most likely become more expert. However, an alternative hypothesis is possible: not all experienced teachers are expert. It may also hold true that some novice teachers exhibit professional expertise, although in the current study, novice status was defined as an objectively quantified lack of experience. Educators in the current study were asked to identify their level of teaching experience and their self-perception of expertise. Based on these responses and a review of the literature the following criteria for parsing educators into categories were created*:

> *Novice Teachers:* those who have taught for fewer than seven years;
> *Experienced Teachers:* those who have taught for seven or more years;
> *Expert Teachers:* those who have taught for more than fifteen years and have been selected to serve as mentors to novice teachers.

Deviating from previous research models (e.g., Strauss, & Shilony, 1994) we chose to use experienced and expert classification distinctions. This was done in order to examine potential mediating processes that separate the two classifications. As a result, each of the three categories contained 8, 9, and 9 educators, respectively.

Hypotheses regarding teachers' espoused mental models of pedagogy and practice

Few researchers have attempted empirical study of teachers' models of teaching and learning processes (Strauss & Shilony, 1994); thus, guiding theory was sparse. Hence, our hypotheses are presented with a caveat. Motivations for the hypothesized models for teaching and learning are based directly on the first author's teaching and mentoring experience, as well as this author's attempts to ground assumptions in cognitive development theories (e.g, Strauss & Corbin, 1998).

- Hypothesis 1: *Novice teachers* will rely on structure to inform practice (e.g., curricular goals and objectives, instructional technique). While they deem psychological processes (e.g., theories of learning and development) to be important, novice teachers will not reflect upon these when discussing possible solutions to educational problems.
- Hypothesis 2: *Experienced teachers* will rely on implicit knowledge of each individual child to inform their practice. Although they implicate knowledge of teaching and learning processes as essential components of mental models, when generating solutions for an educational problem, they rely on structure (e.g., curricular choices, teaching strategies). Espoused mental models will deviate from in-action models.

* Administrators, Curriculum Director, Special Education and Language Arts Teachers were each included in the appropriate "teacher category" based on stated criteria.

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- Hypothesis 3: *Expert teachers* will engage in dialogue regarding their practices daily. They will incorporate knowledge of teaching and learning processes in their mental models. Espoused MMs will resemble in-action models when generating solutions to a given educational problem.
- Hypothesis 4: Teachers whose mental models for teaching more closely match their actual practices will more frequently engage in dialogue with colleagues than those for whom mental representations and actual practice are discordant.

III.

Method

Participants

The sample consisted of 26 teachers and administrators recruited from a suburban public elementary school in the northeastern United States in May of 2004. A total of 80% were female; all were Caucasian. As per the Community's Report Card (U.S. Department of Education, 2007), 98.8% were considered "highly qualified." According to Census data (National Census, 2000), 1.9% of the children in the community lived below the poverty line (as compared to national average of 1.4%) and 4% resided in single parent homes. The median household income for the community in 2000 was $82,000 (National Census, 2000) and median home price in 2003 was $650,000. More than 63% of the community's residents had a bachelor's or advanced college degree. The school ranked in the 90 th percentile for mandated elementary-level state testing and in the 90th percentile statewide for SAT performance. Elementary school teacher/pupil ratio was reported to average 18:1. Professional development of teachers was highly encouraged, and course offerings were available to teachers at no out-of-pocket expense. Pay scale for teachers in the sample ranked within the top 10% for the state. Descriptive characteristics of the participants in this study are presented in Table 1.

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Table 1
Characteristics of Educators, Classrooms, and System

Characteristic	*N*	*%*
Educators		
Caucasian	26	100
Female	22	80
Novice	8	30.8
Experienced	9	34.6
Expert	9	34.6
Teachers		
Classroom, Grades K-4	17	65.4
Language Arts Instructors	2	7.7
Certified Special Ed. Instr.	3	11.5
Administrators:		
Principals	2	7.7
Superintendent	1	3.8
Director of Curriculum	1	3.8
Classrooms (N=16)		
Child-to-teacher ratio	18:1	
Percent poverty		3.1
System		
Mandated State Assessment		90th *percentile*
SAT performance/State ranking		90th *percentile*

	Mean	SD
Years of Experience	18.50	12.0
Years of Education	18.25	1.1

Procedure

Control for Bias

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An interview protocol designed for written responses was developed in order to provide some measure of control for reliability, validity, participant reactivity, and researcher bias. The questionnaire was thus delivered to and retrieved from each participant via regular inter-office mail. No personal contact between the investigator and participants was made during this phase. Teachers were not compensated for participation in the study.

Measures

A written interview protocol questionnaire was created to address factors that would allow for the analyses of the overarching questions of the study (e.g., impact of teacher-education; dialogue with professors, mentors, collaborators.) Teachers were asked to provide information about their level of educational attainment and professional employment history (e.g., how many years taught, grade level, specialties). Further questions were designed to elucidate how each teacher constructed their mental model of teaching and learning (e.g., regarding your formal college teacher-education, what are the five most important things you remember? How do you use what you learned in Ed School to inform your teaching?).

Participants were asked to respond in written format about whether or not they had ever changed their minds about teaching and learning, and were encouraged to identify what had effected the change. Drawing from previous research, variables regarding how teachers inform their practices were presented, and respondents were asked to rank order which factors they deemed most or least important (e.g., developmental considerations, educational assessment, curricular design, relationship with student, goals, objectives, class size). Following these inquiries, educators were given an educational problem and asked how they would attempt a solution. Most pertinent to the hypotheses of this study was whether the respondent deemed processes of learning and development important to their construct of mental models of teaching and learning, and second, whether or not educators employed the knowledge of such in solutions in the educational problem.

Educational Problem

After teachers were queried regarding variables for constructing mental models of teaching, they were provided an educational problem and asked to generate possible solutions in written format. According to National Standards (Nation's Report Card, 2007), the following represents a realistic educational problem:

"Increased curricular expectations for students entering the second grade have resulted in overall lower student performance on assessment measures. Specifically, 20% of the incoming second grade class has performed below grade level with regard to early literacy skills. Briefly name five possible courses of action that should be considered."

Data Coding and Mental Models

Quantitative Measures

Teachers' (N=26) responses in which they rank ordered factors for effective teaching (e.g., developmental considerations, educational assessment, curricular design, relationship with student, goals, objectives, class size) are presented quantitatively as percentages. The importance of talking

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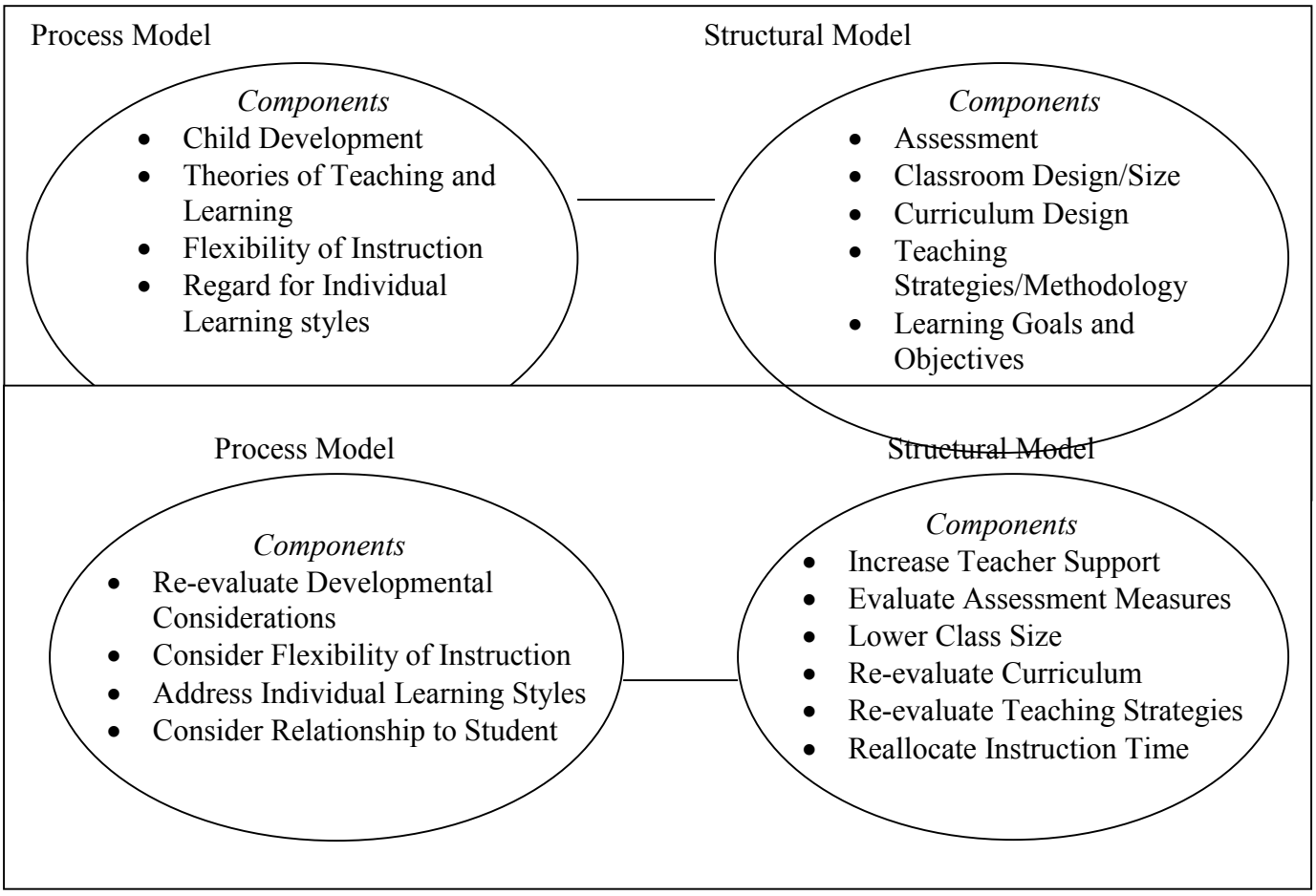
about teaching and learning was rated by teachers on a Likert-type scale of 1 ("not very important") to 10 ("of the utmost importance"), the results of which are presented as frequencies, means, and SDs. Given our small sample size, data pertaining to hypotheses regarding teacher status (e.g., novice, experienced, expert) are presented descriptively as frequencies.

Qualitative

Figure A and Figure B illustrate mental models identified by the teachers in our study. Participants' written responses were first analyzed to determine teachers' MMs as they identified the components deemed most necessary to facilitate effective teaching. Teachers' solutions to the educational problem (i.e., increased curricular demands and poor student performance) were analyzed to identify the constituent components that educators deemed important when faced with an educational problem. Based on the literature, the identified components were parsed into two discrete categorical models: Process and Structural. Two MMs are illustrated pre- (Figure 1) and post-problem, (Figure 2) along with identifying components. To facilitate discussion, the components are organized in terms of categories, but it must be noted that these components are not organized into separate and distinct silos in educators' own minds.

Figure 1: Pre-Problem Mental Models and Components



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IV.

Results

Hypothesis 1: Novice teachers rely on structure to inform mental models of teaching and learning.

When queried about what informed their mental models for teaching, most novice teachers (7 out of 8) cited teaching strategies (e.g., classroom design, grouping models) and curriculum development as the most important pedagogical tools. None of the novice respondents mentioned incorporating learning and development processes into their reasoning. All novice teachers (N=8) referred to using their knowledge of "curriculum and assessment tools" to inform their practice, and provided concrete examples of such. All cited feeling ill-prepared for the realities of the classroom, although none reported knowing how they could have been better prepared. None of the novice teachers referred to a connection between teaching and learning.

When asked whether they had changed their minds about teaching, the novice teachers most often cited classroom experience as having the greatest influence over their thinking (N=7), although they did not explicate what sort of changes had occurred. Another influence cited was "watching good teachers teach" (N=6). While implicit in these references are relational interactions and the potential for meaningful dialogue regarding practice, such influences were not explicitly cited by any of the novice teachers. None of the novice teachers referred to talking about pedagogic practice as a means of effecting changes in their mental models for teaching.

When presented with an educational problem, novice teachers were unlikely to draw upon process information when generating solutions. Instead, these educators were more likely to impose structural solutions (e.g., improved assessment measures, N=6; adjusting teaching strategies, N=5; decreasing class size, N=5). Two novice teachers referred to "changing expectations for students," although neither explicated any process considerations underlying this solution.

Hypothesis 2: Experienced teachers rely on implicit knowledge of the child to inform mental models of teaching and learning.

Of the nine respondents in this category, two incorporated knowledge of teaching and learning processes into their mental models. One respondent characterized theories of learning and development as "too general to be helpful." All experienced teachers (N=9) referred to curriculum choices and strategies for delivering these choices as the primary models for how they taught. Although the experienced teachers alluded to addressing "individual differences of the child" and utilizing "differentiated instruction" in their mental models for teaching, they did not explicate why these components of MMs were important. Two teachers cited "integrating it all" into their practices, but did not elaborate in their written responses what this meant. These two illustrations might be reflective of a disconnect between knowledge implicitly held and knowledge that is made explicit and thus available for professional discourse, reflection, and development.

Experienced teachers most often cited classroom experience and collaboration with colleagues as having the greatest influence over their mental models for teaching and for any changes that these

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MMs had undergone (N=7). Professional development and reading pertinent materials were rated as having the least impact on experienced teachers' models for teaching.

Hypothesis 3: Expert teachers implicate teaching and learning processes as important components of their mental models. They are able to explicate the reasoning underlying their practices and reflect on their development as a teacher.

All of the expert teachers (N=9) cited their understanding of teaching and learning processes as a "very influential" component in their mental models of teaching. Three of the expert teachers referred to mentor relationships and discussions regarding "good practice" as being the most significant influences on their teaching practice. Expert teachers all cited incorporating knowledge of child development into daily practice. One teacher cited using her understanding of "cognitive processes" to "adapt imposed curriculum." Another referred to utilizing what she had learned about the "cognitive, social and emotional development of the child" in order to best "engage them in the learning process."

Expert teachers (N=9) each referred to interaction with students as having the greatest impact on their change of mind. In one teacher's words: "It's the students sitting in front of me…knowing children and their needs is what teaching is all about." Another respondent referred to an in vivo graduate school experience: "Seeing children operate in a developmental classroom that supported their learning provided me a deeper understanding of the theories behind what the instructor was doing." All expert teachers stressed the significance of dialogue with mentors and colleagues as a major influence in developing and adapting their mental models. Furthermore, all respondents in the expert category cited advancements in educational research as having been instrumental in inspiring changes in their thinking about teaching and learning.

What information do teachers believe is most important in order to facilitate effective practice?

Given seven categories from which to choose, teachers most often cited their relationship and interaction with the child as being the most significant source of useful information (77%). The second most important domain cited was process/teaching and learning considerations. Information gleaned from previous teachers input was cited, but only by 6% of the teachers. Information deemed the *least* helpful in facilitating teaching was the socioeconomic status of the student (59% of the respondents named this the least significant factor). Interestingly 35% of the responding teachers regarded their predecessor's report cards as being *not* helpful. This response pattern was evenly distributed regardless of the respondent's status as a novice, experienced, or expert teacher. Interestingly, two administrators and one language arts specialist were the only respondents who labeled assessments as being the most helpful information to have.

How often do educators talk about their profession?

Respondents rated the importance of talking about teaching and learning on a Likert-type scale of 1 ("not very important") to 10 ("of the utmost importance"). The average for respondents was 9, (M =9, SD =.3) indicating that all educators surveyed deemed this activity integral to their profession. When asked "how often" (yearly, monthly, weekly, or daily) each actually engaged in professional dialogue with colleagues, the average response was weekly, (M=6, SD=1.5) for both novice and experienced

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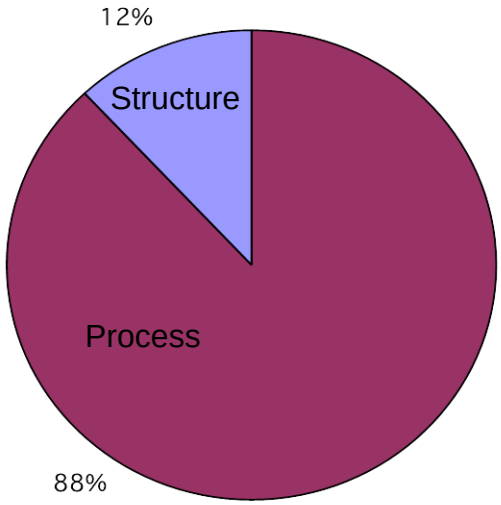
educators. Most significant was the fact that every expert teacher (N=9) reported having daily conversations with colleagues regarding their mental models (MM) for teaching.

Do educators look to the processes of teaching and learning to inform practice?

As Figure 3 represents, prior to being presented with an educational problem, the majority of respondents (88%) reported process considerations (e.g., student-teacher relationship, theories of teaching and learning) as important components of mental models of teaching and learning. Twelve percent of respondents implicated structural considerations (e.g., curriculum design, assessment, physical characteristics of classroom) as important components of their MM.

Figure 3
Teachers' Mental Model Constructs (Pre-Problem)
Most Important Information Necessary To Facilitate Teaching
Structure and Process Considerations



Structure Considerations
Assessment
Classroom Design/Size
Curriculum
Teaching Methods
Goals and Objectives

Process Considerations
Developmental Expectations
Understanding Processes of Teaching & Learning
Flexibility of Instruction
Learning Styles
Teacher-Child Relationship

When generating solutions to the educational problem, most teachers (74%) relied on structural interventions (see Figure 4). Therefore, the discrepancy between espoused mental models (MM) of teaching and in-action MM is salient.

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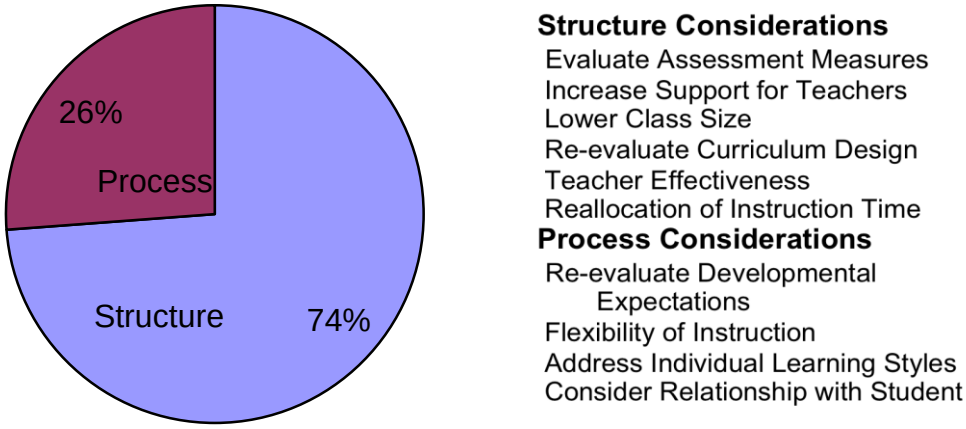
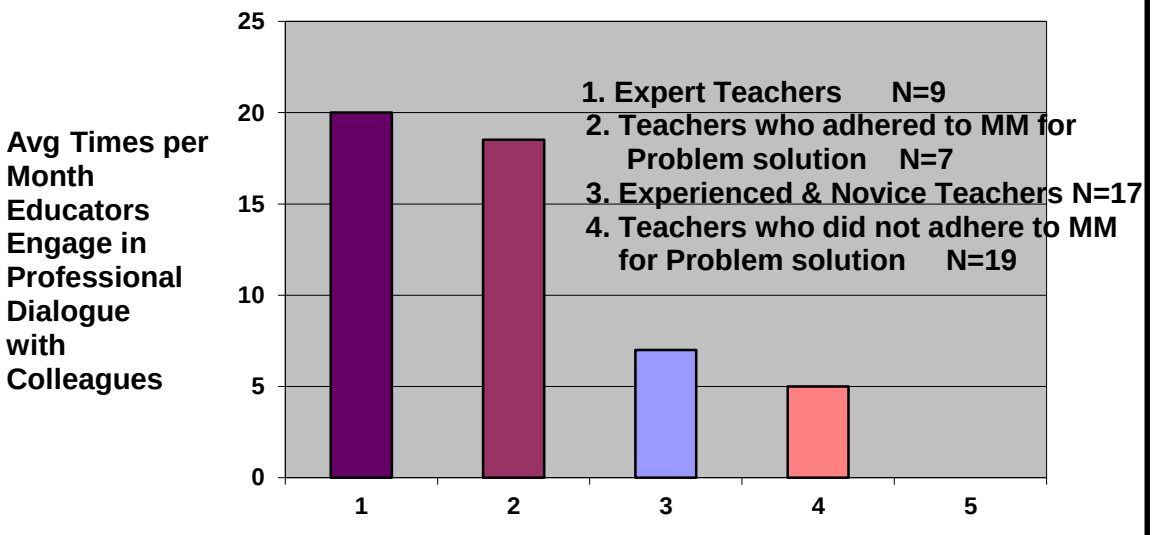
Figure 4
Solutions to Education Problem:
Structure and Process Considerations



Hypothesis #4: Espoused mental models (MM) of teaching and learning are more likely to match with in-action models when educators engage in daily professional dialogue with colleagues (Figure 5).

Figure 5
Making It Explicit:
Mediating Effect of Talking About Mental Models



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V.

Discussion

The novice teachers in this study appeared to rely on previous coursework (e.g., curriculum design, classroom management, and assessment) to inform their mental models of teaching. All novice teachers referred to "goals and objectives" of lessons, and expressed the belief that if these were foremost on their minds while delivering the lesson, then the children were "probably" learning the material. None of the novice teachers explicated how they thought learning occurred, nor did any allude to the minds of their students. Aside from the one-year student teaching requirement, most teacher education programs do not provide in vivo classroom experiences incorporating ongoing mentorship. The tendency for novice teachers to rely on structural pedagogic components in their MM is most likely reflective of their limited experience engaging with students and reflecting on best practices with mentors.

Although some of the novice teachers referred to the processes underlying teaching and learning (e.g., cognitive, social, emotional considerations), they did not elaborate on how these might inform their MM for teaching. When presented with an educational problem, novice teachers were less likely to draw upon process information when generating solutions, instead imposing structural solutions (e.g., improved assessment measures, adjusting teaching strategies, decreasing class size). While facile conclusions should not be drawn, these findings suggest that novice teachers have not yet had sufficient experiences upon which to reflect.

By contrast, the experienced teachers were more likely to implicate knowledge of teaching and learning in their solutions to the educational problem (e.g., re-examine expectations, increase support). Implicit in these solutions are process considerations (e.g., development trajectories, scaffolding for optimal performance). Although the experienced teachers generated solutions in which process knowledge was evidenced, they did not explicate these understandings in their reasoning.

The experienced teachers' ability to call upon implicit understandings of teaching and learning processes might be perceived as behavioral mastery, or the ability to perform automatically without explicit understanding (Karmiloff-Smith, 1992). For example, although the experienced teachers appeared to address children's needs effectively, they did not explain their thinking. None of the experienced teachers cited self-reflection as important components of their MM. Practices employed by experienced teachers might also reflect an implicit use of "causal rules" which have evolved from prior knowledge, (Strauss, 2001) a folk pedagogical response to implicit folk psychology assumptions (Olson & Bruner, 1996).

In any event, the experienced teachers' solutions did appear to incorporate understanding of teaching and learning processes; what remained elusive was the ability to articulate such. This apparent inability for explicitation could have negative ramifications. Models for teaching that are not made explicit are not accessible for reflection; the opportunity to enrich understandings of how children learn and subsequently how to improve teaching is missed. Creativity, flexibility, and the potential for teacher development are inhibited. Interestingly, neither the novice nor the experienced teachers cited the importance of, or need for, interpersonal discourse as a source of gaining insight. When presented

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with an educational problem, these teachers did not adhere to their espoused mental models for best pedagogic practice.

The expert teachers in our sample demonstrated an ability to incorporate both knowledge of teaching and learning processes, and emotion-cognition connections to inform their mental models of teaching and learning. They considered the minds of their students foremost when considering intervention strategies, and invoked teacher-child relationships as instrumental in effecting learning. The expert teachers all cited daily dialogue with colleagues as essential to professional development. As they are able to reflect upon their MM for teaching and learning, these teachers are able to make connections and foster deeper meaning. Capacities for self-perception and awareness of others' beliefs, feelings, and perceptions (ToM, mentalizing capabilities) were evidenced and applied flexibly to the challenging pedagogic problem.

The fact that each expert teacher valued the opportunity to discuss MMs and experiences with colleagues bears great significance. These teachers are able to vocalize previous understandings and conceptualizations, thus creating a collaborative opportunity to increase complexity and gain insight. The ability to recursively redefine previously implicit knowledge could serve as a significant developmental mediator. The interrelationship between social, discursive processes in action and thought, and the ability to then reflexively assimilate this on an individual level represents the crux of professional development. As these teachers reflect upon their teaching, they are continually creating more complex understandings, developing beyond behavioral mastery and into expression of pedagogic creativity (*progressive explicitation*) (Karmiloff-Smith, 1992). Not surprisingly, most of these teachers were able to approach the educational problem with surety and flexibility, adhering to their own model for best practice. One expert teacher, when confronted with the educational problem reported, "Well, first I consult with colleagues and think about it." Another stated simply, "I reflect."

Follow-up informal observations concurred with previous research indicating that teachers' practices were in discord with how they had represented their MM (Strauss & Shilony, 1994). For example, one experienced first grade teacher who espoused valuing a "hands-on activity-based learning environment," conducted didactic instruction for the better part of the morning. Meanwhile, one novice Kindergarten teacher, who spoke of the importance of honoring the "developmental needs" of the child, engaged her class in group meeting (seated on the floor in a circle) for an hour while many squirmed in obvious discomfort. She appeared to rely on previously mentioned "management techniques" to keep control. Subsequent table activities were paper- and pencil-related, inconsistent with developmental considerations. Both of these teachers reported engaging in dialogue with colleagues on a "monthly basis."

By contrast, observation of two expert teachers revealed in-action practices coinciding with espoused MMs of teaching. Interestingly, both of the expert teachers observed reported having daily conversations with colleagues, in which they discussed "what had worked" as well as "trying to figure out how to better construct the lesson." Citing recent findings in cognitive science, one teacher referred to the "theory of nine" method of instruction. She explained that her students would be exposed to a new mathematical concept over a period of three days, in three distinct ways each day. She described in detail the level of mastery expected for each encounter with the materials she would present, and produced assessment tools designed to capture whether her methods were effective. In the hour observed, after a mini-lesson presented by the teacher, groups of children gathered around

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tables and engaged in co-constructing three dimensional objects with cubes and cylinders as the teacher circled the room offering support when necessary.

Another expert teacher cited differentiating instruction to "create efficient pathways" for understanding. She alluded to presenting her material in at least four separate ways in order to reach the various ways in which her students would be "constructing meaning." When later queried, the teacher offered as an explanation her understanding of current research in mind-brain education, which emphasizes the importance of stimulating many parts of the brain in order to invoke conceptual change. Follow-up observation concluded that indeed, this teacher not only explicated her keen awareness of how children learn, but she also demonstrated masterfully how to best facilitate that process. Most notably, this educator revealed she had been talking about this lesson with colleagues earlier in the morning, "Just to get the process going…."

Limitations of the Current Study and Directions for Future Research

There are several limitations of the current study worth noting. First, it is important to acknowledge characteristics of the sample that potentially limit generalizability. Results from this inquiry may not reflect the voices of educators from more diverse socio-cultural and economic settings. Furthermore, participants were surveyed using a retrospective design; a longitudinal study investigating how educators shift mental models of teaching over time might illuminate both the nuances and the trajectory of teacher development. Future inquiry might delve more deeply into the recursive aspects of reflective processes, thereby elucidating more clearly the intricate relationship between thinking and action.

The use of a self-report questionnaire might limit the findings in this study, with caveats pertaining to both accuracy and social desirability. While participants were assured that their answers would be confidential, it is possible that responses were influenced by social desirability, or the wish to be viewed as an effective teacher. Validity of findings might be enhanced quantitatively with follow-up in vivo classroom observations utilizing valid and reliable coding methodology (see CLASS, Pianta, La Paro, & Hamre, 2008). While the informal observations conducted in this study provided interesting anecdotal data for illustrative purposes, the absence of established reliability and validity is noteworthy. It would be valuable to identify potential moderating variables (e.g., classroom size, presence of support staff, student demographics, etc.) contributing to the discrepancy between espoused mental models and actual classroom practices. Although a quantitative approach utilizing a larger sample might identify possible moderators, the qualitative, emic approach taken in this study allowed for an in-depth exploration of internal reasoning and representational processes: an exploration of how 26 ordinary educators make meaning in their profession.

Implications for Policy and Practice

Dewey's 1924 edict remains relevant: the "intellectual responsibility" of the educator is pertinent now more than ever before. The state of education in our nation is in crisis, and the stakes have never been higher. The emerging field of mind, brain, and education integrates cognitive science, biology, developmental psychology, and education to link research imperatives with usable knowledge for educators. The process is dynamic and reciprocal.

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Providing an infrastructure for education research is relevant in order to give impetus and foundation for interdisciplinary researchers and educators to connect empirical data with practice and policy. Research schools, where practice and science could "jointly shape research," (Fischer, Goswami & Geake, 2010, p. 68) might provide a structure where the mediators of teacher development can be unpacked.

Since the inception of the No Child Left Behind Act (NCLB, 2002) debates have raged as to what constitutes a "highly qualified teacher". Experts concur that knowing how to teach is at least as important as knowing what to teach, and that high-quality teaching, knowing the material, and knowing and how to convey it, together make a difference in student achievement. Current restrictive definitions of teacher qualifications erroneously place the foci of attention on content knowledge. Although subject matter expertise is important, of equal weight is the ability to work effectively with students, to develop relationships that matter, and to impart knowledge in such manner that together the zest for learning is unearthed.

With NCLB's (2002) imposed emphasis on standards and testing, the curriculum has narrowed, developmentally appropriate practices have been largely abandoned, and ineffective teaching practices abound. Teaching to the test has become the norm, while once highly revered, theoretically sound constructivist approaches to teaching and learning are in danger of being forgotten. The school experience for educator and student alike has become constricted. Understanding the underpinnings of effective teaching is thus of paramount importance. It appears that as expert teachers approach difficult classroom problems, such as those imposed by current standards, (i.e., via NCLB) they are able to maintain a MM for "best practice" against the odds. The expert educators in our sample were able to act explicitly upon implicit understandings of good teaching practice. Seemingly unthwarted by the destabilizing influence of increasing standards for performance, teachers who maintained self-identified MMs for "best practice" were those who valued and engaged daily in discursive practices with colleagues. The opportunity to engage in relationships with colleagues matters. The expert educators we sampled were able to adhere to the theories, models, and practices of good teaching, even as the stress of imposed demands bore down upon them. Policymakers would be wise to encourage programs that foster opportunities for peer mentoring and dialogue process between teachers.

Wittgenstein argued that language itself is the "vehicle of thought" (1953, p. 329). The discursive "work" of the teachers who valued daily conversations with colleagues served them well: reflexively and in context, they constructed the essence of the objects and events they would encounter; thus holding the truths of "best practice" in thought and action. Not only did the expert teachers in our sample maintain their ideal MMs; in so doing, they engaged in the process of solidifying their identity as educators. Creators of teacher development programs must work to identify the processes by which good teachers come to know, and how this knowledge is transformed into effective, unwavering pedagogic practice. Those who seek to inform policy for teacher education and standards for "highly qualified teachers" would do well to examine the mediating effects of discursive practices to inform their ideals.

The task before us is to encourage educators to make universal, formal, and explicit the knowledge that often remains situational, intuitive, and tacit. Engaging in the social, intersubjective experience of discursive construction of self-as-educator facilitates the development of a knowledge that is usable, creative, and flexible. As teachers move from novice to expert status they acquire skills. If in the

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mentorship and coaching process these skills are copied without explanation of the abstract relationship between structure and function, the opportunity for secondary process reflection and representational redescription is lost. The goal of integrating espoused and in-action MMs of teaching and learning thus remains elusive.

"…And voiceless thought…Returns to shadows chamber." -*Osip Mandelstam* (Vygotsky, 1986).

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