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Dispositions in Pre-Service Teacher Preparation

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Abstract

This position paper discusses the role that dispositions play in classrooms today and why dispositions should be infused into undergraduate teacher education programs. Dispositions are defined as the attitudes, values and beliefs that teachers hold, which are measurable through analysis of behavior. Understanding what dispositions successful practicing teachers display can help shape the formation of dispositions of pre-service teacher candidates. The formation of appropriate dispositions is a developmental process which emerges over time.

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Introduction

Early in my research career, a professor casually remarked to me that we teach what we know and who we are. With little further commentary, our conversation then drifted on to other topics of mutual interest. It was only later during the process of reflection that I realized a seed had been planted, though I did not recognize at the time what an important and fundamental seed it really was.

So begins my story of how my interest in the topic of teacher development and learning began. I had an immediate understanding of the first part of the phrase – we teach what we know – for subject matter plays such a primary role in the organization and functions of a classroom. Teachers need to have a strong grounding in the subject areas they teach, and an ability to reason and think critically about the content being taught.

The second part of the professor's phrase – we teach who we are – also seemed immediately familiar to me, though more because of stereotypical views than scientific research. In the early history of American public education, teachers were simply expected and presumed to be knowledgeable, patient, understanding, and to act intuitively in a "motherly" way toward their students (Herbst, 1999). By definition, they were supposed to be able to effectively motivate the less-than-willing students, support the shy ones, discipline their more aggressive pupils and command respect from all. These characteristics, or dispositions, which were so much a part of the definition of "teacher" throughout the United States, were powerful images (Joseph & Burnaford, 1994). Books, and later with the advancement of technology, television promoted these stereotypical images; stereotypical images not just of teachers, but of adults in any occupation which serviced the public such as doctor, police officer, or judge (Joseph, 1994). The recent focus on dispositions in teacher preparation comes about because we believe that dispositions play a role in how subject matter is delivered to P-12 students, and because we see teachers as role models (Maylone, 2002). "Different learners perceive the same opportunities differently and react towards them differently, because of their differing dispositions" (Hodkinson & Hodkinson, 2004, p. 176). Thus, dispositions play a central role in what happens day in and day out in classrooms.

This position paper will specifically look at why "who we are" in terms of professional dispositions is important, and consider implications in determining whether individual pre-service teacher candidates also demonstrate the beginnings of these dispositions. For if we know what aspects of "who we are" work in the classroom, then we can better prepare future teachers to display these dispositional behaviors as well.

Dispositions in Education

Dispositions in the field of education have taken on greater meaning since the 2001 publication of the National Council for the Accreditation of Teacher Education

(NCATE). NCATE's website glossary provides a definition of professional teacher dispositions:

> Professional attitudes, values, and beliefs demonstrated through both verbal and non-verbal behaviors as educators interact with students, families, colleagues, and communities. These positive behaviors support student learning and development. NCATE expects institutions to assess professional dispositions based on observable behaviors in educational settings. The two professional dispositions that NCATE expects institutions to assess are *fairness* and the belief that *all students can learn*. Based on their mission and conceptual framework, professional education units can identify, define, and operationalize additional professional dispositions. (http://www.ncate.org/public/glossary.asp?ch=143#P)

The NCATE definition poses a challenge for teacher educators, and provides the impetus behind promoting lifelong learning and the desire to meet the needs of P-12 students in classrooms today. An argument can be made that dispositions are not merely attitudes or habits (see Katz & Raths, 1986), because attitude is a pre-disposition to act and habits come from unconscious motivations. In assessing dispositions, attention is given to conscious behavior observable in the individual. Jung and Rhodes (2008) make a distinction between "character-related dispositions" (desirable teacher characteristics and work ethics) and "competence-related" dispositions (competency in teaching pedagogies) and argued that both should be assessed in teacher candidates. Sockett (2009) used the language "disposition-as-personality" trait and "disposition-as-virtue" to delineate the types of dispositions teachers possess.

There are advantages to assessing dispositions in pre-service teacher candidates. From a financial perspective, Fallon and Ackley (2003) believed that assessing dispositions will help institutions determine which candidates are potentially more committed to the profession, and thus will potentially become better teachers, which in turn allows institutions to maximize their faculty resources, money and field placements. On the academic side, Collinson (1996) developed the concept of beginning and experienced teachers needing to have a triad of knowledge: professional knowledge, interpersonal knowledge and intrapersonal knowledge, with the latter two being tied to dispositions. Eberly, Rand and O'Connor (2007) postulated that dispositions come from an "underlying psychological meaning-making structure" (p. 2) and proposed that attention be given to the developmental aspects of dispositional behavior which dovetails into pre-service preparation. Similarly, Damon (2005) argued that "the NCATE standard brings under the examiner's purview a key element of the candidate's very *personality*" (p. 4, emphasis in original). In other words, we teach who we are.

Given the definition, how can dispositions be measured throughout a pre-service candidate's university experience? Maylone (2002) stated quite clearly that relying on a list of desirable teacher dispositions with "our minds focused on lists as our end product" (p. 6) is not the way to go about measuring a candidate's disposition. Additionally,

understanding dispositions goes beyond just knowing *how* a person perceives things (Taylor & Wasicsko, 2000). Learning from and with others challenges one's perspective, putting it under the spotlight for examination (Collinson, 1996). Teachers need to develop a career-long habit of reflecting on their practice. One argument for including the assessment of dispositions for undergraduates is that dispositions are central to teaching, and this includes character virtues as well (Damon, 2005). Osguthorpe (2008) described this as desiring teachers of good disposition and moral character because of the desire to have P-12 students develop good dispositions and moral character (see p. 292). Secondly, as teacher educators we need to "know what qualities allow some persons to be effective teachers" (Wasicsko, 1977, p. 2) in order to encourage our pre-service candidates to develop these qualities. Thirdly, we need to uncover the beliefs and values candidates bring with them so as to better understand how to guide them in developing positive dispositional traits (Abernathy, 2002). Lastly, if we believe "that the teacher is the filter for whatever happens in the classroom" (Whitaker, 2004, p. 125), then as teacher educators we need to examine the dispositional filters, both personal and professional, our pre-service teacher candidates bring to us.

Experienced Teachers

Personal and professional dispositions are central in the classroom experience. Those who stay in the profession learn from their experiences and are responsive to student needs. Collinson (1996) did research in the area of dispositions with elementary, middle school and secondary teachers. She concluded

> [T]heir understanding of what it means to be a teacher involves developing and integrating professional, interpersonal, and intrapersonal knowledge in ways that allow them to structure the physical, social and intellectual environment of their classrooms. These teachers understand that students need to learn more than subject matter in order to be ready for life beyond the classroom. (p. 10)

Teaching and learning are fundamentally an *exchange, interchange* and, in the best of circumstances, an *intrachange* of self and knowledge among participants. These are the human elements of teaching. These elements are complex, multi-dimensional and personal. The ways we describe and interpret our experiences are intimately connected to our sense of self. This is a feature of our humanness. Consider a formal learning environment, such as a seventh grade, for example. In the constructivist, postmodern model, there are both teachers and learners in that classroom. Within one school day, there are an infinite number of exchanges and interchanges among and between teacher and students. These interactions revolve around subject matter knowledge and exploration, the naturally occurring give-and-take social negotiations associated with peer groups, the perceived balance of power between child and adult, the psychological striving for competition weighed against the desire to fit in, the emotional swings of friendship and the surge of physical development, among others. All of these interactions and more weave their way in and out amongst themselves throughout the educational day. Even if one were able to isolate and study but one of these

interactions, it would be nearly impossible to predict its effect given the infinite number of variables available to interact with it. In this context, education is clearly more than the simple learning of traditionally-defined subject matter groupings. Teaching and learning involves more than just sharing what we know: it also involves who we are.

Effective educators are people-oriented (Wasicsko, 2005), have a sense of self-efficacy (Singh & Stoloff, 2007), share a cluster of mindsets toward student ability (Chandler, 1999), are caring (Demmon-Berger, 1986) and reflective (Collinson, 1996), among others. Traits such as these form a teacher identity which is intimately connected to one's personal identity. Teacher identity includes not only the influences of teachers' own K-12 experience (Lortie, 1975), but also the values, beliefs and goals formed in the process of daily living. Teacher identity influences curricular decisions and pedagogical behavior, as well as represents an important contextual definition. For these reasons, school administrators and teacher education faculty are in error when they consider professional development devoid of personal development. Teachers are adults. Changes in professional circumstances impact changes in personal circumstances and vice versa. The two inform each other, and viewing them in tandem is the only way to gain a full perspective of their interaction. Teaching is dependent to a large degree on how a person acts, and lives; thus, dispositional and ethical development are important in teacher education programs in general (Collinson, 1996) and to pre-service teacher programs specifically.

Pre-service Teachers

Pre-service teacher candidates need to be given the skill to not only teach their subject matter, but also develop effective personal and professional dispositions. The two are connected in theory and in practice. "The possession of positive dispositions helps to insure that teachers are better able to deliver instructional services to children" (Maylone, 2002, p. 8). One of the challenges teacher educators face in working with teacher candidates is helping them make the transition from thinking like a student to thinking like a teacher. "Having experienced schooling from the perspective of the student, pre-service teachers have to learn to view the classroom from the perspective of the teacher" (Parkison, 2009). It is a time when they jumpstart their understanding of personal and professional dispositions for their new context. For most of their lives they have been in "student mode" but that all changes when they begin their field experiences and subsequently move into the student teaching experience. The field experiences, even though they are limited, provide a backdrop for a better understanding of self in this new context. Rather than focusing on a pre-service candidate's deficit in displaying dispositional behavior, Mullin (2003) recommended that teacher educators focus instead on the candidate's assets first as a building block. Their burgeoning development of self can then expand outward from strengths that they have identified.

Ideally, the assessment of dispositional traits is infused into the pre-service teacher training experience. Rather than making it a one-time discussion in one selected class, it should be treated as a developmental process that is carried through

from their introductory education class up to their senior level practicum course and student teaching. Integrating dispositions into the teacher education program allows for the effective behaviors to not only be identified, but also mature over the course of time. Learning should not be viewed as a straight line, with teacher candidates simply moving from Point A to Point B. Instead, it is best viewed as a spiral, where the candidates move up in a circular fashion, revisiting topics to deepen their understanding. Thus, pre-service candidates are first introduced to the concept of teacher dispositions in their introductory class and then revisit it in their sophomore, junior and senior years so that by the time student teaching comes around, the positive dispositions they have cultivated will bear out in practice.

Models for Teacher Education Programs

"Present attempts to operationally define dispositions tend to fall along the continuum ranging from specific observable behaviors to inferable personality traits" (Wasicsko, Callahan & Wirtz, 2004, p. 2). Most of the models for assessing dispositions address at least one of the following three categories: teacher behaviors, teacher characteristics and teacher perceptions (see Wasicsko et al., p. 2-3). Numerous models have been developed for the assessment of dispositions (Abernathy, 2002; Clifton, Perry, Stubbs & Roberts, 2004; Eberly, Rand & O'Connor, 2007; Fallon & Ackley, 2003; Jung, Rhodes & Vogt, 2006; Mullin, 2003; Rike & Sharp, 2008; Singh & Stoloff, 2007; Wasicsko, 1977; Yost, 1997; among others). These models consist of a variety of methods to assess pre-service teachers' dispositions. They include "behavior and characteristic checklists, ratings from observations of candidates in a variety of settings, inferences drawn from course assignments and class participations, evaluation of student journals and self-reflections, and letters of reference" (Wasicko et al., p. 5). Some institutions assess dispositions as part of the department application process, some do it through structured in-class activities, while others assess it in action when the teacher candidate goes out to practicum. Whichever method or delivery model is utilized, the assessment of dispositions is an important undertaking because "effective educators possess discernable attitudes" (Wasicsko, 2005, p. 1).

Conclusion

We teach not only what we know but who we are. Because of this, dispositions have an impact on teaching and learning in P-12 education. These beliefs are very central and often resistant to change (Raths, 2001). During the formation stage, teacher candidates need to understand the importance of "a positive school climate [which] is [created by] the teacher's empathy, rapport, and personal interaction with students" (Percy, 1990, p. 15). By studying experienced teachers' dispositions, teacher educators can better prepare pre-service candidates for the profession.

There are a number of models currently being used to help assess dispositions in undergraduate teacher education programs. While all pre-service teacher candidates have a *potential* for the development of dispositional traits when they begin their teacher preparation programs, not all will be able to successfully engage in dispositional change

(see Bogotch & Piggot, 1992). Dispositions need to be explicitly taught, rather than assuming they will develop on their own in time. Teacher education programs need to create a culture that supports the teacher candidate in the development of dispositions (Dottin, 2009). Throughout a teacher candidate's program, identification of dispositional behavior and the subsequent practice of displaying the behavior may be two different things. Candidates will likely not be challenged until they get out into classrooms and experience teaching first hand. Mastery comes only with practice, but the stakes are high. Because "children respond directly to the dispositions and attitudes of the teacher" (Richardson & Onwuegbuzie, 2003), teacher educators need to give teacher candidates all the tools necessary for a successful career. Developing appropriate dispositions is one of those important tools.

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Test Anxiety and Relaxation Training in Third-Grade Students

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Abstract

As testing becomes an achievement marker for elementary school children, test anxiety would naturally follow for these children. This study looks at test anxiety in third grade students, as well as relaxation training as a treatment modality to deal with that anxiety. One hundred and four third grade students participated in this study. Those students that received relaxation training experienced less test anxiety after the treatment. Students in the control group showed no changes in test anxiety. The use of relaxation training among third grade students may be a beneficial method for teachers to reduce anxiety in their students.

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Introduction

Test anxiety is conceptualized as a relatively stable trait triggered by threatening situations. It is a subtype of anxiety that is defined as a situation specific anxiety trait (Lowe et al., 2008). Test anxiety is a type of distress that is accompanied by physiological components; it can cause symptoms in children such as headache, upset stomach, loss of focus, irritability, and anger. These symptoms can lead to behavioral ramifications such as withdrawal, outbursts, overactive behaviors, fatigue, and avoidance of school. Furthermore, Libert & Morris construed test anxiety as comprised of cognitive (i.e. worry) and emotional (tension, bodily reactions, and perceived arousal) facets (as cited in Lowe et al., 2008). Test anxiety is a multidimensional construct. One theoretical perspective alone does not capture its complexity. When test anxiety occurs, an individual's behavior, cognitions, and physiology are affected. Therefore, test anxiety interventions should focus on the cognitive or emotional facets (Carter, Williams, & Silverman, 2008).

In the twenty-first century, utilizing high-stakes tests such as standardized tests has become a very prominent indicator of academic achievement, school performance, and ultimately, future tenure (Triplett & Barksdale, 2005). As a result, it is now known that high levels of stress can make it more difficult for students to concentrate and master information (Paul, Elam, & Verhulst, 2007). It is also widely researched that too much stress and test anxiety can hinder an individual's performance. In the United States, 31-41% of third through fifth graders are reported to experience test anxiety (Carter et al., 2008).

In a study conducted with elementary students, it was found that students have emotional and physiological effects during testing such as anxiety, panic, irritability, frustration, boredom, crying, headaches, and loss of sleep (Triplett & Barksdale, 2005). An interview-based study was conducted on children's thoughts and feelings in relation to test-taking, and the children reported feeling nervous, sweating, having stomachaches, and losing sleep. Due to the onset of such emotional and physiological effects, it is argued that high-stakes testing causes damage to a child's self-esteem, overall morale, and love for learning. Furthermore, Triplett and Barksdale (2005) collected drawing and writing samples from 225 third grade through sixth grade students from five schools, which was representative of diversity in race and socioeconomic status. Analysis of the students' work revealed that their perceptions of teaching include: worries of time constraints, not knowing answers, and the consequences of not passing. Thus, an abundance of research exists indicating that elementary and middle school students are negatively impacted by test anxiety (Triplett & Barksdale, 2005).

Relaxation is an emotion-focused strategy that decreases emotional and somatic reactions to stressful events. A study by Hiebert, Kirby, & Jaknavorian (1989) shows that there are positive effects of relaxation training in children in comparison to a control group that did not receive relaxation training (as cited in Lohaus & Klein-Hessling, 2003). It is found that progressive muscle relaxation, as well as systematic relaxation training, may reduce tension. Immediate relaxation effects were reflected at a physiological and subjective experience level. Several techniques seem to be useful to induce calmness in children from neutral stories to progressive muscle relaxation. For instance, according to Harris and Croy, students should use

diaphragmatic breathing during exams in attempts to calm or center them (as cited in Paul et al., 2007). Research has indicated that students that utilized diaphragmatic breathing showed significant increases in their academic learning and achievement. In a longitudinal study with sixty-four post baccalaureate premedical students, significant behavior changes occurred when the students were given a continuous opportunity to practice a five minute stress reduction technique that is intended to reduce both physiological and psychological effects that can be associated with academic stress (Paul et al., 2007).

Cheek, Bradley, Reynolds, and Coy (2002) taught the "Stop, Drop, and Roll" technique to students who demonstrated high anxiety reactions. The technique instructs students to "stop" by putting their pencils down and placing their hands on the table while focusing on the coolness of the surface each time they physically felt the "fire" of anxiety and stress. Next, while listening to classical music they were instructed to "drop" their heads forward and gently "roll" them around while taking deep breaths. The sixteen group members reported less stress and worries regarding future testing situations. Even further, the parents and teachers reported a reduction in stress-reaction behaviors. This study reveals that relaxation training is an important component of test anxiety reduction (Cheek et al., 2002).

Additionally, Lolak, Connors, Sheridan, & Wise (2008) examined the effects of progressive muscle relaxation training on anxiety and depression in patients with chronic breathing disorders. Progressive muscle relaxation was utilized as an adjunct to pulmonary rehabilitation, a multi-disciplinary program of care designed to optimize physical and social performance and autonomy. The findings of this study suggest that adding progressive relaxation training to a pulmonary rehabilitation program can reduce anxiety and depression.

Turner, Biedel, Hughes and Turner (1993) found that anxiety was highly prevalent among African American elementary school children from a sample of 168 students in grades three through six, (as cited in Carter et al., 2008). In another study, 36 students who identified as text-anxious were randomly assigned to an intervention group or a control group. The intervention group consisted of stretch-tense, deep breathing, release-relax, and positive suggestion sequences. The intervention group received five sessions, for 31 minutes each, over half the school year. It was found that the intervention group showed a significant decrease in test-anxiety over the control group (Miller, Morton, Driscoll, & Davis, 2006).

Grawe, Donati, & Bernauer (2001) conducted a meta-analysis, and documented that in sixty-six studies progressive muscle relaxation or another similar therapeutic intervention was utilized. They found that in 76% of the studies, muscle relaxation led to significantly positive changes (as cited in Conrad & Roth, 2007). Furthermore, research has shown that students experience high levels of stress at college. In a stress management pilot program (SMPP), relaxation, deep breathing, coping skills training, and guided imaginary techniques, among others, were utilized in managing such high levels of stress experienced by college students. The results suggest that one could appropriately use SMPP to deal with high levels of stress and improve students' academic performance and health (Iglesias et al., 2005).

There are many research studies that indicate relaxation training is empirically found to reduce anxiety. In order to evaluate the effects of relaxation interventions on third grade students who perceive themselves as displaying characteristics of test anxiety, the present study utilized elevator breathing and guided muscle relaxation. Students increasingly exhibit test anxiety due to the growing emphasis on high-stakes testing. This particular type of anxiety is associated with a variety of negative impacts on the child's life and ability to perform in the classroom. The present study tested three hypotheses: 1) the pre-test and post-test differences for the experimental group will show a significant decrease in anxiety level, 2) the pre-and post-test differences for the control group will show no significant decrease in anxiety levels, and 3) there will be a significant post-test difference in anxiety levels between the experimental and control groups.

Method

Participants

The sample was made up of 104 third-grade students at a midwestern public elementary school, 58 males (55.8%) and 46 females. Ages ranged from 8 to 10 years with a median of 9 years. The greatest percentage of participants reported their race as Caucasian (82.7%), followed by African American (3.8%), Hispanic (2.9%), and Asian (1.9%). The remaining participants identified themselves as mixed (5.8%) or indicated "other" (2.9%).

Instrumentation

Westside Test Anxiety Scale. The Westside Test Anxiety Scale (WTAS: Driscoll, 2007) was designed to identify participants with anxiety impairments who could benefit from anxiety – reduction and yields a general test anxiety score. The WTAS consists of 10 items, each using a Likert response scale where 1 = "never true" and 5 = "always true." The instrument was modified for the purpose of this study in an attempt to make the items easier to understand by the young participants. For example "exam" was replaced with "test," "fail" was replaced with "bad job" and "mind sometimes wanders" was replaced with "daydream."

The WTAS was constructed to measure anxiety impairments with six items assessing incapacity (i.e., memory loss and poor cognitive processing) and four items measuring worry and dread (i.e., catastrophizing) which interferes with concentration (Driscoll, 2007). Scores for the two subscales, incapacity (items 1, 4, 5, 6, 8, & 10) and worry (items 2, 3, 7, & 9), are obtained by summing the respective item responses; a total score is obtained by adding up the scores and dividing by 10 (Grimes & Murdock, 1989) where higher scores indicate a greater level of test anxiety. The present researchers used the total score to obtain a general level of test anxiety.

In a combined sample study of 25 students, a negative correlation of .49 was found between anxiety-reduction on the Westside Test Anxiety Scale and positive gains in test scores ($df = 23$, $p < .01$) (Driscoll, 2007). In other words, as anxiety was reduced, test scores improved, suggesting a fairly strong connection between these two constructs. In a related study, test change scores for 34 fifth grade students were studied. Test scores for the intervention group

improved an average of 7 percentile points over test scores for the control group. A modest decline in anxiety levels for the treatment group was found. A correlation of $r = .40$ was found between reduction of anxiety levels and positive gains on test scores ($df = 32$, $p < .01$) (Miller, M., Morton, J., Driscoll, R., & Davis, K.A., 2006) . In a study looking at scale validity, Driscoll (2007) averaged the two attained correlations from Miller et al. (2006) and Driscoll (2007) and found the correlation to be $r = .44$.

Procedure

Relaxation training and data collection took place at a Midwestern public elementary school. All third-grade students were invited to participate in the study. Those students who returned a signed parental consent form were included. All participants were given the WTAS (pre-test) and a short demographic questionnaire to complete.

Using the pre-test scores, a random matched-paired strategy was used to assign participants to the two experimental conditions. That is, pre-test scores were first rank-ordered. Next, participants with the two highest scores were randomly assigned to either the treatment group or control group. The procedure was repeated with subsequently lower scores until all participants were assigned. The initial size of the experimental and control groups were 50 and 54, respectively. Due to school absences, three participants of the treatment group did not complete the post-test measure.

Members of the treatment group were taught relaxation techniques by one of the investigators. Training took place at school, two days a week, over a five-week period. On training days, the participants were moved from their regular classrooms to a quiet, empty classroom. During training, relaxing music was played in the background. Members of the control group were given free time to read or complete homework assignments or went to recess. While in training, participants in the treatment group were taught both deep breathing exercises (i.e., elevator breathing) and progressive muscle relaxation (i.e., guided relaxation for children).

Elevator Breathing. Elevator breathing (Teel, 2005) was one of the interventions utilized in this study to help children relax quickly when facing stressful situations. Breathing techniques are very important for inducing relaxation. Through training, an individual's breathing will automatically slow down and deepen, bringing more oxygen into their bodies and helping them to relax. Diaphragmatic breathing, or "belly breathing," is a particularly helpful way to release mental and physical stress and tension. It calms the mind and induces a state of relaxation in one's body. Elevator breathing incorporates visualization for children. Participants practiced breathing exercises for five minutes at each of the 10 sessions.

Guided Relaxation for Children. Guided relaxation for children (Teel, 2005) was also utilized in this study to help manage levels of anxiety that children may be experiencing. Progressively relaxing each of the muscle groups along with deep breathing is intended to promote relaxation and counter the physiological components of arousal by first tensing the major muscle groups then relaxing those muscles. The investigator would instruct the students to get comfortable (i.e., lying down, closing eyes, or resting against a wall) and then begin reading

the relaxation script to the participants while incorporating the deep breathing. This portion of the experiment took approximately 8 to 10 minutes at each session. At the conclusion of the five weeks, participants in both the experimental and control groups completed the Westside Test Anxiety Scale (post-test).

Results

Descriptive and inferential statistics for the present study are presented in Table 1. An independent-samples t-test was conducted to examine differences between the treatment and control groups. A significance value of .05 was utilized. Pre-test differences in mean scores between the experimental and control groups showed no significant difference (t (102) = 0.67, ns) indicating no real differences in anxiety levels between the groups prior to initiating the experimental treatment. A significant difference between pre- and post-test mean scores was found for the treatment group (t (49) = 2.39, $p<.05$). There was no significant difference found between pre- and post-test mean scores for the control group (t (53) = 1.62, ns). More specifically, the treatment of relaxation training had a significant effect on lowering overall test anxiety between pretest (M = 27.7, SD = 8.9) and post-test (M = 24.8, SD = 10.2) for the experimental group. Lastly, there was no significant difference in post-test anxiety levels between the experimental and control groups. Post-test coefficient alpha estimates for the 10-item test anxiety scale were .85, .72, and .79 for the experimental, control, and combined groups, respectively.

Table 1

Descriptive and inferential statistics.

Group	Mean / sd (pre-test)	Mean / sd (post-test)	*t*-value (pre – post)	df	alpha
Experimental	27.7 / 8.9	24.8 / 10.2	2.39 *	49	.85
Control	26.8 / 7.8	25.0 / 9.3	1.62	53	.72
Combined	27.2 / 8.3	24.9 / 9.7	–	–	.79

* $p < .05$.

Discussion

The present study investigated the effects of relaxation techniques on test anxiety in elementary school students. Third-graders were taught two relaxation techniques; after which the group reported a significant decrease in anxiety as compared to a group of their peers receiving no training. Participants in this study were from eight to ten years of age. The present results support earlier findings that relaxation techniques can be learned and utilized successfully by young children (Zaichkowsky & Zaichkowsky, 1984; Lohaus and Klein-Hessling, 2002). That is, the first two hypotheses presented above were supported. Students completing relaxation training reported a significant reduction in test anxiety scores, whereas students in the control group reported no significant change in levels of anxiety.

On the other hand, the third hypothesis presented in this study was not supported by the findings. A significant difference in post-test anxiety scores between the experimental and control groups was not found. One or more threats to internal validity may account for the lack of group differences in anxiety scores (see Heppner, Livlighan, & Wampold, 1999). Specifically, since students of the same class were randomly assigned to the two groups studied, a diffusion of the treatment may have taken place. Students receiving relaxation training may have shared their learning with peers assigned to the control group. Moreover, the sharing of training techniques may have created a competitive rivalry between some members of the two groups. Thus, by learning the relaxation techniques, some of the students in the control group may have out-performed students in the treatment group. A cluster sampling procedure could minimize these threats. Assigning classes of students, located at different schools, to the respective research groups could reduce or eliminate both the diffusion of treatment across the groups, as well as potential competition among group members.

Lack of parent and teacher reports of participant test anxiety could also explain the lack of significant differences in post-test anxiety scores between the experimental and control groups. Due to the cognitive skills required to reflect on one's experience, children at this developmental age are not always good reporters of their symptomology and may be influenced by other factors in terms of how they rate themselves. For example, the high face validity of the WTAS may have led some third-graders to believe their anxiety was supposed to decrease. In fact, 33.3% of the control group had post-test scores that decreased from 5 to 22 points. Many popular children's television shows now include programming on relaxation (e.g Sid the Science Kid, ni hao, kai-lan). In addition, 32% of the control group reported having treatment for anxiety in the past. Developmentally, children in this age group, particularly anxious children, like to please others. Such treatment may have primed group members to believe that a decrease in scores was desirable, thereby activating previously learned coping skills. Asking about such exposure on the demographic questionnaire may prevent potential problems such as these in future studies.

Another limitation of the present study reflects a procedural issue. In other words, the participants were not faced with high-stakes testing when they were trained with the relaxation techniques. The fact that the pre-test anxiety scores of the WTAS for both groups fell in the high normal range could have influenced the results. It is recommended that the procedure be modified when used for future participants who are preparing for scheduled mandated testing. While the present findings of reduced anxiety were significant in the treatment group, results from an actual testing scenario could suggest alternative interpretations.

Conclusions

The increase in test anxiety among children may be highly attributed to the increase in high-stakes testing in American public schools (No Child Left Behind Act, 2002; Black, 2005). This higher anxiety can result in students becoming overly concerned with the consequences of failure (Spielberger & Vagg, 1995), thus adversely affecting their ability and desire to learn (Cheek et al., 2002).

Parents, teachers, and counselors alike can take a more active role in becoming aware of the effects of test anxiety and providing opportunities for children to learn appropriate coping skills. High-stakes testing is causing elementary students to exhibit intensified physiological responses (Zeidner, 1998; Vandenbos, 2007), negative emotional reactions (Triplett & Barksdale, 2005; Paul, Elam, & Verhulst, 2007), and inappropriate behaviors (Cheek et al., 2002). However, one cannot presume that all students experience test anxiety in the same manner or for the same reasons. In order to identify test anxiety as a problem for students, parents and teachers must first be aware and informed about the negative effects of high-stakes testing. It is only in this way that school officials and parents can provide effective interventions such as deep breathing and progressive muscle relaxation activities.

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"Math is Hard," Said Mrs. Ford; "Not for Me," Said Mrs. Honda: Does Culture Matter in Teaching and Learning in Elementary Mathematics?

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Abstract

This article is a discussion of the practices of teaching and learning in elementary mathematics from the perspectives of Eastern and Western cultures. It focuses on the differences in teaching pedagogy in math between the United States and three Asian countries: Singapore, Japan, and China.

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"Math is Hard," Said Mrs. Ford; "Not for Me," Said Mrs. Honda: Does Culture Matter in Teaching and Learning in Elementary Mathematics?

Does culture matter in the teaching and learning of elementary mathematics? In 2003, there were significantly different levels of achievement in math and science education on the Trends in International Mathematics and Science Study (TIMSS) between the East and West (American Institute of Research, 2005). The TIMSS collected data from half a-million students from 46 countries in 1995-96 with the purpose of comparing the mathematics and science achievement in these countries. Students were grouped at three levels (Grade 4, Grade 8, and Grade 12), and the results covered a spread of 300 points from the 5th to 95th percentile. The TIMSS is a sample-based assessment- meaning that is administered to a sample of all students in such a way that the results can be generalized to the larger population (Trends in International Mathematics and Science Study, 2003). In this study, the United States (U.S.) students scored above average at Grade 4 and ranked 16th of 46 participating nations at grade eight. However, the distribution of the U.S. scores starts and ends lower than other nations. This means that the average level of general knowledge in mathematics among students in a majority of these countries matched that of the top quarter of the U.S. students. In fact, scores for the U.S. students were among the lowest of all industrialized countries (American Institute of Research, 2005). On the other hand, Singapore, a small Southeast Asian country with a population about the same as Chicago's, ranked first in the world and their students performed well in all five TIMSS mathematics content areas: (a) fractions and number sense; (b) measurement; (c) data representation, analysis and probability; (d) geometry; and (e) algebra (AIR, 2005). The U.S. students scored significantly lower in all five content areas. These results caused great consternation among educators, providing the impetus to look at what we teach, how we teach it, and how we assess it.

According to a 2001 report by the National Center for Education Statistics, American 12th graders of different ethnicities had very different scores on mathematics tests. Asians and Pacific Islanders scored 319 compared to Whites (308), Blacks (274), Hispanics (283), and American Indians (293). These data showed that ethnic Asians tend to be good in mathematics regardless of whether they are living in their native cultures.

The U.S. educational system has no official national mathematics framework, and state frameworks differ greatly from state to state. In addition, the U.S. framework does not make provisions for students' variability in mathematical ability and therefore does not provide students with alternative frameworks (American Institute of Research, 2005). The National Council of Teaching Mathematics' framework, which emphasizes higher order and twenty-first century skills in a visionary way, lacks the logical mathematical structure of the mathematical framework. It identifies content only within broad grade bands (e.g., K-2, 3-5) and only in general terms, thus providing inadequate content guidance to educators (American Institute of Research, 2005).

In general, the Asian educational system seems to excel at producing students with a strong grasp of mathematical content knowledge, and students in Asian countries

tend to receive the highest scoring on the TIMSS. However, according to the TIMSS report, Western systems have other strengths such as being successful at helping students develop problem-solving skills and the ability to apply knowledge to real-life situations (American Institute of Research, 2005).

In this article, I discuss the practice of teaching and learning in elementary mathematics from the perspectives of Eastern and Western cultures. I focus on the differences in teaching pedagogy in math between the U.S. and three Asian countries: Singapore, Japan, and China.

Mathematics Teaching: What is the Difference between the U.S., Singapore, Japan, and China?

Singaporean Math and U.S. Math

According to the results of a study conducted by the American Institute of Research (2005), Singapore has a world-class mathematics system with quality components designed to produce students who learn mathematics to a mastery level. These components include "Singapore's highly logical national mathematics framework, mathematically rich problem-based textbooks, challenging mathematics assessments, and highly qualified mathematics teachers whose pedagogy centers on teaching to mastery" (American Institute of Research, p. ix). Singapore's mathematics curriculum places a greater emphasis on developing mathematical concepts and fostering the ability to apply them in mathematical problem-solving situations. In addition, its format is similar to that of the TIMSS study test items.

In spring 2000, the Montgomery County public schools in Rockville, Maryland, conducted a pilot study in an effort to improve and accelerate mathematics instruction. The purpose of the study was to determine whether, and to what degree, implementation of the Singapore Math program in grades one through five in four selected schools could alter how mathematics concepts were presented by teachers, and elevate and accelerate the mathematics performance of the Montgomery County public school elementary schools students (Gross & Merchlinsky, 2002). In the study, Singapore Math curriculum materials were compared to the U.S. curriculum Everyday Math. Results showed that students who participated in Singapore Math were exposed to mathematics earlier than was typical in Montgomery County public schools, and significantly outperformed the students who used U.S. math (Gross & Merchlinsky, 2002).

The Singapore framework lays out a balanced set of mathematical priorities centered on problem solving. It includes an emphasis on computational skills along with more conceptual and strategic thinking processes. The framework covers a relatively small number of topics in-depth and is carefully sequenced grade by grade, following a spiral organization in which topics presented in one grade are covered in later grades, but at a more advanced level. Students are expected to have mastered prior content, not to merely repeat it (Ministry of Education Singapore, 2001).

Singapore mathematics curriculum is based on the concept of mastery learning, which proposes that all children can learn when provided with the appropriate learning conditions in the classroom. Mastery learning is based on Benjamin Bloom's Learning for Mastery model, is predominantly group-based, and utilizes a teacher-paced instructional approach, in which students learn by cooperating with their classmates (American Institute of Research, 2005). Mastery learning does not focus on content, but on the process of mastering it. Mastery learning ensures numerous feedback loops, based on small units of well-defined, appropriately sequenced outcomes. This type of learning works best with the traditional content-focused curriculum that is based on well-defined learning objectives organized into smaller, sequentially organized units. In this approach, the teacher provides frequent and specific feedback by using diagnostic, formative tests, as well as regularly correcting mistakes students make along their learning path. In addition, teachers evaluate students with criterion-reference tests rather than norm-referenced tests.

Singapore Math textbooks and workbooks were meant to be used as a part of a system of learning in which adult supervision and independent practice go hand in hand (Ministry of Education, Singapore, 2001). The main feature of this series is the use of the Concrete Pictorial Abstract approach. The students were provided with the necessary learning experiences beginning with concrete and pictorial stages, and followed by abstract stages to enable them to learn mathematics meaningfully. This approach encourages an active thinking process, communication of mathematical ideas, and problem solving and helps develop the foundation students will need for more advanced mathematics. Practice exercises are designed to provide the students with further practice after they have done the relevant workbook exercises. Review exercises are provided to offer cumulative reviews of concepts and skills (Ministry of Education, Singapore, 2001).

The U.S. math textbook emphasizes definitions and formulas, not mathematical understanding; its assessments are not especially challenging (Emerson, 2007). The U.S. math books produce students who have only learned to mechanically apply mathematical procedures to solve routine problems and who are, therefore, not mathematically competitive with students in most other industrialized countries (Chang, 2008). However, the U.S. mathematics system has some features that are an improvement on Singapore's system, notably an emphasis on twenty-first century thinking skills such as reasoning and communications and a focus on applied mathematics. For example, the Everyday Math textbook uses a problem-based learning approach, which presents multistep real-world mathematics problem. Such application give students practice in understanding how to apply mathematics in practical ways, but lessons using real-world applications without providing the foundation of strong conceptual topic development do help children less in solving skills in mathematical problems (Gross & Merchlinsky, 2002).

The U.S. math curriculum and pedagogy appear to be quite different from those of the top scoring countries in the TIMSS such as Singapore. The U.S. curriculum contains too many topics and contains more topics in every year from K-12, resulting in learning that is "mile wide, inch deep". In curriculum comparisons, the U.S. mathematics

curriculum lacks the coherence, focus, and rigor of the curriculum taught in other countries that participated in the TIMSS (Furner & Robinson, 2004).

In fact, the U.S. textbooks covered 75% more topics than those in any other country in the TIMSS. This indicates that the U.S. textbooks cover many ideas, but do so superficially, leaving students with knowledge of techniques but lacks of mastery of the underlying concepts. The textbooks lack a centrally identified core of mathematical content that provides a focus for the rest of the system (American Institute of Research, 2005).

Zhao (2005) stated that Asian students spend a lot of time on each individual subject, but math is the top priority. Asian students spend much more time on homework than do their counterparts in the U.S. In particular, Singaporean students receive more homework than U.S. students (Ng, 2001). Two-thirds of Singaporean eighth graders were assigned at least 30 minutes of mathematics homework at least twice a week, compared with only 25 percent of U.S. eighth graders (Ministry of Education, Singapore, 2001). In most Asian countries, more than 50% of the homework is in mathematics (Ma, 1999). A high proportion of Singapore's children receive additional after-school help with their school work from private tutors (Ng). Parents pay large amounts of money to pay tuition for these classes. Singaporean parents place a high value on math and understanding mathematics is as important, culturally speaking, as knowing how to read well.

Japanese Math and U.S. Math

Japanese teachers widely practice what the international mathematics education research community recommends, while U.S. teachers do so less frequently. Teachers in the U.S. focus primarily on the acquisition and application of skills rather than problem solving and thinking; "While 62% percent of Japanese 8th grade mathematics lessons included deductive reasoning, no American lessons did" (American Institute of Research, 2005, p.1). Most U.S. teachers spend their class time telling students how to do something, and students follow their lead. As a result, students have a very passive view of learning, quite at odds with what we know about how learning actually occurs (Trends in International Mathematics and Science Study, 2003).

Another finding from the TIMSS study was that U.S. teachers focus on skills, whereas Japanese teachers focus on understanding. This is reflected in the U.S. high-stakes tests, which have traditionally valued skill acquisition and speed. However, Bracey (1997) argued that in the U.S. more topics are introduced each year and are repeated in subsequent years to reflect the pursuit of the oft-espoused goal of the "spiral curriculum" (p. 656). He further stated that "the U. S. teachers used overhead projectors 50% of the time whereas Japanese teachers used chalkboard 80% of the time to demonstrate step by step math problems to find the right answers and the teachers left the illustrations up for the entire time for students to refer while they practice the math problems" (Bracey, p. 657). The Japanese teachers also used illustrations as the focus of

discussion on the chalkboard, while American teachers use them as a means of directing students' attention before moving on to something else.

In the TIMSS study, 24% of U.S. teachers used lesson activities that are not related to math, such as commenting about the previous night's sports scores. The percentage of lessons that suffered from off-topic distractions was 31% (Stigler & Hiebert, 2007). In Japan, none of the lessons contained off-topic comments. In addition, 70% of the instructional time in the Japanese classroom was devoted to understanding the concepts while U.S. classroom spent math class time on how to work problems (Furner & Robinson, 2004).

Perhaps the most important finding of the TIMSS study is the amount of hours the Japanese teacher spent on class preparation; their preparation time was almost double what the U.S. teacher spent. The Japanese teacher spent one hour of preparation for two hours of instruction time, whereas U.S. teacher spent 30 minutes preparation for two hours instruction time (Trend International Mathematics and Science Study, 2003).

According to the TIMSS, when asked to describe the educational goal, the typical U.S. teacher said it was to teach students how to do something, while Japanese teachers felt the goal was to help students understand the concepts (Furner & Robinson, 2004). A typical Japanese teacher stands up in front of the class, offers a complex, thought-provoking problem, and allows students to work to find a solution. Ideas are exchanged before the teacher intervenes only when necessary or in order to summarize the lesson. Students then practice similar problems. Japanese teachers believe the key to mathematical understanding is the ability to communicate ideas and problems. Mastery takes time as students first experience a problem and then struggle with the solution. "A U.S. teacher is more inclined to instruct the students how to do something rather than to allow the student the opportunity to develop the concepts on their own" (Furner & Robinson, p. 8).

One factor that may contribute to the difference in performance between Japanese students and U.S. students is the teacher's ability to anticipate students' thinking. This ability is an important indicator of good mathematics teaching because it plays an important role before, during, and after the lesson. For example, in the introductory lesson on division with fractions, a second-grade teacher in Japan posed division problem and asked the students to find the answers by using what they had learned (Watanabe, 2001). The students were asked to divide 1¾ by ½, explain how they did the calculation, and make up a good story problem. Many students responded that they knew the answer was 2¼ (how many ½'s in 1 ¾ by using the quotitive meaning of division). The teacher anticipated that students would use various strategies to find the answers they have learned in the previous lessons of division, subtraction, addition. For example, some students will use ⅞ ÷ ½ instead of how many ½'s in 1¾. In the view of the National Council of Teachers of Mathematics standards, this practice is appropriate and meets one of the standards (2000):

> Effective mathematics teaching requires a serious commitment to the development of students' understanding of mathematics. Because students learn by connecting new ideas to prior knowledge, teachers must understand what their students already know. Effective teachers know how to ask questions and plan lessons that reveal students' prior knowledge; they can then design experience and lesson to respond to, and build on, this knowledge (p.18).

There are three major reasons for the high achievement of Japanese students in the international comparisons: (a) their parents' high expectations for education, (b) the diligence of the Japanese people, and (c) a school system with a national curriculum and good teachers (Shimizu, 2001). Students spend extra hours after school working on math problems, and mathematics is regarded as key subject. In mathematics teaching, children receive instruction focused on the procedures to solve problems after they understand the mathematical concepts. Students are able to understand the power of mathematics in applied work rather than see mathematics merely as an exercise in problems assigned by the teacher.

Japanese teachers work very hard to craft lessons that will reach all students (Fuji, 2001; Shimizu, 2001). Although Japanese teachers have larger class sizes, ranging from 40 to 45 students as compared to the 30 to 35 students in a typical U.S. classroom, they provide new instruction for 35 minutes in a 50-minute period daily as opposed to the U.S. teacher who provides new instruction for only 20 minutes in a 50-minute period (Sugiyama, 2001). The rest of the time in U.S. classroom is spent reviewing concepts, going over homework, and offering in-class time for practice. Japanese teachers focused on the procedures to solve problems (Shimizu, 2001) but U.S. teachers focused on the understanding of mathematical concepts (Stigler & Hiebert, 2007). This argument can be explained in the context of how teachers' perspective about teaching math influenced their ability to teach the subject.

The American Institute of Research's (2005) study results show that student's poor performance is actually due to the fact that the teaching pedagogy is not conducive to learning math. This statement is supported by Lee's (2004) findings on the predictors of kindergarten teachers' practice of developmentally appropriate mathematics: attitude toward mathematics, attitude toward teaching mathematics, and pedagogical content knowledge of mathematics. Lee reported that kindergarten teachers' attitudes toward teaching mathematics and pedagogical content knowledge of mathematics were found to be significant factors in predicting whether their teaching practice would be conducive to learning mathematics. In a study of teacher's beliefs about teaching mathematics, Hazelton (2004) indicated that another factor of poor performance and low scores in mathematics was U.S. teachers' belief that students' math ability is innate and difficult to improve. By contrast, Japanese teachers believe that all children can learn math if they are given the "right environment." For example, all Japanese children are taught math at the same level even though they may be behind in some of the concepts because the teachers believe that in this way the children will be in the same pace with other children. The parents of the children who are behind in math will do special math tutoring at home or send their children to after-school math classes evenings and weekends (Shimizu,

2001). Parents will spend a considerable amount of money to pay the tuition because they believe that math is the foundation of good education for their children.

Chinese Math and U.S. Math

In most Asian countries, mathematics teachers are well prepared in pedagogical content knowledge and skills (Chang, 2008; Lee, 2004; Ma, 1999). In other words, teachers really understand how to teach mathematics and believe that this understanding makes a classroom genuinely helpful for children. Ma commented,

> While they [U.S. teachers] did not know advanced math, elementary math was simple; they already knew it, and the only need was to learn how to teach. But Chinese teachers thought they still needed to learn about the subject – not only about how to teach. They saw teaching as a way to learn more about math (p. 3).

By contrast, U.S. teachers try to teach what they think they already know. Ma clearly explained that U.S. teachers' mathematical understanding of teaching mathematics subtraction is merely related to their own knowledge and sometimes are incorrect procedures to solve mathematical problems. The difference shows up in the simplest problems: "We can't subtract a bigger number from a smaller one," said one U.S. teacher in explaining how to solve 62 - 49 = 13 (Ma, p. 3). Making false mathematical statements will confuse or create misconceptions for children. Another misleading but common technique for teaching subtraction is the concept of "borrowing" (e.g., the 2 "borrows" 10 from the 6) which "suggests that the two digits of the minuend are two independent numbers rather than two parts of one number" (Ma, p. 3). According to Ma, the language used is the key defining difference between American and Chinese teachers; American teachers "speak like a lay person" (p. 4). Teachers with an understanding use math terms that would make the instruction more clear.

U.S. teachers aimed to teach students correct procedural knowledge, while the Chinese taught problem-solving strategies. However, for more complex problems, such as dividing by fractions, most U.S. teachers did not even get the calculation right. In a study conducted at Michigan State University, many U.S. elementary school teachers were found to have problems with fractions, some in doing and explaining calculations, and more with making up word problems (American Institute of Research, 2005). Chinese teachers were able to put problems on the board and have the students compare the different meanings they represent. Then the students were asked to make up their own story problems to represent different models of divisions by fractions. Most of the examples given by U.S. teachers dealt with round food, like pizza, or money, while the Chinese examples were from many different areas.

Is the Chinese method of elementary mathematics teaching better than the U.S. method? According to Ma (1999), yes. Chinese teachers continue their education after they begin their teaching careers. They study their text books very carefully and figure out different ways to work the problems and explain the materials to students. Most Chinese teachers specialize in only one or two subjects at different grade levels, so that

they develop a deeper understanding of other levels of mathematics. A number of teachers Ma interviewed had developed what she called "profound understanding of fundamental mathematics" (p. 21). Ma stated, "A teacher with profound understanding of fundamental mathematics is not only aware of the conceptual structures and basic attitudes of mathematics inherent in elementary mathematics, but is able to teach them to students" (p. xxiv).

Chinese students use more abstract or closed-end strategies than U.S. students. U.S. students are less likely than Chinese students to use generalized problem-solving strategies (Ma, 1999). One possible reason for this is that teachers in the U.S. less frequently encourage their students to move to more abstract representations and strategies in their classroom instruction.

A common conception held by some teachers in the U.S. is that concrete representations or using manipulative materials are the basis for all learning. These teachers believe that pictorial representations or concrete materials can facilitate students' conceptual understanding. However, some research shows that the use of manipulative or concrete experience alone does not guarantee students' conceptual understanding (American Institute of Research, 2005; Chang, 2008). The purpose of using concrete visual representation is to enhance students' conceptual understanding of the abstract nature of mathematics, but concrete experiences do not automatically lead to generalization and conceptual understanding. If the concrete strategy does not extend to the abstract level, students' development of mathematical-reasoning abilities may be limited (Cai, 2000).

When teachers use manipulatives such as cruisers or counting beads, children will understand because they can visualize the ideas. However, when faced with actual figures and numbers, many children cannot transfer the skills. On the other hand, if students have been trained to solve problems using mental math, they will calculate answers in their heads instead of visualizing beads or cruisers. They think of numbers rather than objects. Teaching mental math helps students solve most problems using logical steps; they often do not need to use pencil and paper. Mental math allows children to quickly calculate answers rather than memorize facts and figures. Therefore, children are requiring a firm mathematical foundation and mathematical thinking (Cooney, 2001).

Fifty percent of U.S. teachers used overheads on a regular basis as compared to Chinese teachers, who virtually never use the overhead (Cooney, 2001). Some U.S. teachers spend less time talking through and detailing the steps to all levels of student's ability. Chinese teachers spend more time in explaining and detailing the steps of how to solve the problems. Chinese teachers thoroughly explained math problems step by step on a chalk board until the students understand and can do the exercises on their own to find the correct answers. Ma (1999) indicated that mathematics teaching and learning require a substantial amount of time to understand the concepts and to practice the skills to solve problems. In contrast to Chinese students, U.S. students do not spend much time in math practice either at school or at home (American Institute of Research, 2005).

Many parents in Asian countries see knowledge of mathematics as basic to the foundation of learning that allows them to master other learning areas such as language arts or reading. Asians do not see learning math as just another class to pass but as the way people solve problems in everyday life (Chang, 2008). In contrast, parents in the U.S. are worried if their children cannot read or write well in the elementary grades and are not as concerned about whether they can solve mathematical problems (Bracey, 1997).

Many U.S. children lack understanding of number facts. For example, when they see a certain fact such as 3 + 2 = 5 or 5 – 3 = 2, the children must calculate the answers each time rather than knowing them by heart. They also had trouble understanding how to conserve quantity as well as the concepts of centering, transductive reasoning, and irreversibly. Six-year-olds can count objects accurately to 100 by ones, twos, fives, and tens, add and subtract vertically, and do equations, but they have difficulty understanding equations in which the unknown is in different positions such as 3 + □ = 5 or 5 - □ =2 (Lee, 2004).

In addition, many U.S. children often understand things on a concrete level but have trouble with the written expression of the same idea. In the first grade, children have to learn the chevron symbols for greater than or less than, and learn about measurement and understand the concepts. Among the concepts that first grade U.S. children find most difficult is the associative property of numbers, known as regrouping. An example of regrouping is found in the following problem: 5 + 3 = 8, 5+ (2 + 1) =?, 7 + 1 + □ = ? (Trends In International Mathematics and Science Study, 2003). However, this issue does not appear for most Asian children (Cai, 2000; Cooney, 2001).

What are the Problems of U.S. Math Teachers?

Math reformers argue that we should be teaching for understanding; however, teachers who themselves do not fully understand even the most basic mathematical operations cannot be expected to help their students build reasoning skills (Gorman, 2006; Ma, 1999). Most of U.S. children's failure in mathematics is due to poor teaching. Some teachers are unable to do their jobs effectively. For example, Gorman found that very few teachers have more than a limited understanding of concepts as basic as subtraction. Ma wonders, "What kind of 'teaching for understanding' can we expect from teachers who do not have a 'profound understanding of fundamental mathematics' themselves" (p. 34)? A teacher with profound understanding of mathematics is not only aware of the conceptual structure and basic attitude of mathematics inherent in elementary mathematics but is also able to teach them to students. In addition, teachers need a corresponding understanding of how children learn. Teaching mathematics with understanding means creating experiences in which these interconnections can be made. Without these interconnections, there is a real danger that questions offered in isolation would make the learning process piecemeal and incoherent.

Teachers' attitudes towards mathematics content and teaching mathematics indirectly influence their students' learning of mathematics (Lee, 2004). Future teachers must realize that all students really need to graduate from high school feeling good about their math performance, because it can influence their future career choices. It truly is a teacher obligation to foster students' positive attitudes toward math. Teachers who lack strong content knowledge should attend practical training as part of their professional development. According to Ma (1999), "Math is not a mastery that cannot be solved. I believe that anyone can learn math. The problem is how we teach them. We have to build math concepts and skills step by step" (p. 58).

Undergraduate Mathematics Teacher Preparation in the U.S.

Continued improvement of mathematics education in the U.S. is crucial. Evidence from a variety of sources makes it clear that many students are not learning the mathematics they need or are expected to learn. The reasons for this deficiency are many. In some instances, student teachers have not had the opportunity to learn important mathematics concepts. In other instances, the curriculum offered to students does not engage them. The quality of mathematics teaching is highly variable. Nevertheless, mathematics teaching cannot be improved substantially without taking into consideration the teachers' pedagogy content knowledge and teacher preparation programs (American Institute of Research, 2005; Cain, 2000; Cooney, 2001).

Teacher training colleges and university must make a requirement that all students entering teacher programs take at least three levels of math education: elementary, tertiary, and advanced. Many teacher education programs' preparation for teaching math is lacking. In some colleges and universities, mathematics education courses are offered through the Math department rather than in the elementary education programs. There are huge differences between mathematics courses taught in Mathematics departments and in Education departments. Courses taught in Mathematics departments are about how to *learn* math, while courses in Education departments are about how to *teach* math.

Courses in school mathematics should focus on a thorough development of basic mathematical ideas (Wu, 2009). Attention to the broad and flexible application of basic ideas and modes of reasoning is preferable to superficial coverage of many topics. All courses designed for future teachers should develop careful reasoning and mathematical common sense in analyzing conceptual relationships and in applied problem solving (Gorman, 2006). National Council of Teachers of Mathematics (2000) suggests that future teachers should learn how basic mathematical ideas combine to form the foundation on which specific mathematical lessons are built. Teacher preparation programs should consider collaborating with Professional Development Schools in order to let pre-service teachers work with classroom teachers and students to better plan effective lessons (Wu, 2010). Brewer and Daane (2002) have shown that when a team of teachers work together and discuss best practices and constructivist teaching approaches, all teachers on the teams are more likely to translate theory into practice in their classrooms.

Classroom teachers must have more time to plan for instruction in order to craft each math lesson the best possible lesson for all students (Stigler & Hiebert, 2007). An increase in educator's instructional planning time to craft quality lessons must be viewed as high priority. Teaching math is challenging. Teachers must not only understand the mathematics that they are to teach but also know how to engage students in the content (Wu, 2009). Teachers need scientific knowledge about how children learn mathematics as well as knowledge of mathematics itself (Hill, Rowan, & Ball, 2005). Prospective teachers need a solid basis on which to build their understanding of mathematics a basis that includes not only mathematical knowledge and attitudes but also a sense of how students learn.

Prospective mathematics teachers need to "be able to represent mathematics as coherent and connected enterprise" (National Council of Teachers of Mathematics 2000, p. 17). They must be capable of developing and fostering classrooms in which students can use their imagination, skills, and knowledge to explore new situations with confidence and with the expectation of success. From their mathematical experiences, students should understand the importance of rigor and communication. Prospective teachers should be taught to educate in this manner (National Council of Teachers of Mathematics). Now, can we ask teachers who are teaching math in elementary schools to accept the fact that they need a right way to teach math to young children? Our biggest long-term problem, according to Stigler and Hiebert (2007), is not how we teach but that we have no way of getting better. It is more helpful to direct attention to the factors most closely connected to students' performance, the curriculum they experience, and the effectiveness of the way that teachers teach the curriculum. In the U.S. there is a "vicious circle formed by low-quality mathematics education and low quality teacher knowledge of school mathematics" (American Institute of Research, 2005, p. 2).

Changing how mathematics courses in undergraduate teacher programs are taught is a more difficult challenge, but is even more essential. Pedagogical changes both in undergraduate content and in method courses will happen only if the culture of the collegiate faculty changes (Furner & Robinson, 2004).

It is the teacher's job to understand how children think about mathematics when they come to school and to build on this informal understanding (Brown, 2005). However, parents play an equally important role in helping their children with math homework. It is the parents' job to make sure their children understand how to apply math in their everyday life (Cai, 2000). This is one way to make sure that math learning is meaningful. Successful mathematics learning can be measured by how accurately students use math skills and concepts in their everyday lives.

Cultural Resources of Asian Children

Literature on Asians' success in math has focused on claims that they have access to cultural resources which place primary emphasis on the academic and stress effort, rather than natural ability, as the key to success (Md-Yunus, 2006; Pearce, 2006): "This emphasis on effort over ability is a central component of Asian success in math" (Pearce,

p. 81). One of the foundations of the educational frameworks in many Asian countries is based on the Confucian philosophy of teaching and learning for young children (Md-Yunus). Confucius emphasized achieving goals and using philosophy to guide achievement. In many cases, children nurtured with this mentality tend to be more receptive to what they are told by parents. Moreover, this kind of philosophy, in which receptiveness and diligence are considered virtues, helps Asian children more easily become accustomed to studying mathematics. Children are often exposed to situations in which adults are using numbers. Nurtured in a situation where adults are very good at counting and computing, children feel a desire to emulate them. The more they are exposed to situations that use numbers in daily life, the better the environment is for mathematics education.

Teaching and learning mathematics can be perceived in relation to the nature of society and its values. The results of the TIMSS study give a comprehensive look into math performance and instruction on a global level. Perhaps U.S. math teachers must decide, which if any, of their societal circumstances have implications for teaching and learning mathematics. Asian students' success in mathematics has been seen to be related to the nature of their society and its values. The high achievement of Asian students in mathematics seems to be a result of a combination of various factors, including the importance given to education in general, parental commitment to their children's education, teachers' preparation, and the significance of mathematics for every student's successful future. Uy (2001) summed up the distinct educational values hold by the Asian parents and children:

> Parents point out early in life that nothing is handed out freely, that everything must be earned, that hard work and effort will pay off in the future, and that children must be patient as their time will come. This approach to life is very Confucian – both hard work and discipline are essential in success. When an Asian student performs badly, she or he blames herself or himself for failing to exert enough effort. When confronted with something unfamiliar in a test, Asian students often blame themselves for failing to anticipate such a problem. The bar is always set higher. Asian students and parents rarely blame teachers for low grades. They simply accept it and hope to do better next time (p. 25).

Conclusions

No one argues that learning math is one of the primary sources of lifelong learning and helps the country to the progress for civilization. Math education in some Asian countries is designed for the students in those countries and may be not suitable for students from other countries. Although the U.S. needs to acknowledge the excellence of math programs and the success of some Asian students, the U.S. has its own math programs, curricular, and pedagogy which are based on the culture of its society (Stigler & Hiebert, 2007).

In addition, U.S. educators also need to examine both the effective and ineffective practices of other system before making assumptions that other nations' programs are

better than those in the U.S. System of Teaching mathematics are not easily transported from one culture into another. We need to look at each strategy and practice in an integrated manner to produce the desired effects. U.S. teachers also must examine other nations' experiences from their own perspective and culture, so that they do not misinterpret what we defined as "excellence and less competitive" in the U.S. educational system. It is important to realize that cultural expectations play a large role in determining how we educate our children. Teaching, as a cultural activity, fits within a variety of social, economic, and political forces in individual society. The effects of teaching are determined, in part, by all of these forces.

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