

2014

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Available at: <https://scholarworks.sfasu.edu/mlet/vol1/iss1/1>

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Socioeconomic Status and Mathematics: A Critical Examination of Mathematics Performance in Grades Three through Eight by Mathematical Objective

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Abstract

This quantitative research study examined TAKS mathematics performance data across socioeconomic identifiers and found statistically significant differences were observable in grade three across all objectives between students' not identified as economically disadvantaged and students' receiving free meals. The highest number of quantifiable differences occurred between the mean scores of students' identified as not economically disadvantaged scoring significantly higher on objective means than students' receiving free meals or identified as other economically disadvantaged. After students' move beyond the third grade, the number of statistically significant differences drastically reduces. By the eighth grade, statistical differences are difficult to locate. An examination of within group data did not identify any statistical significance.

Introduction

The *1966 Coleman Report* (Coleman et al., 1966) positioned discussions of educational achievement at the forefront of conversations in the United States. The report magnified that a myriad of factors influence educational achievement and educational attainment. One major acknowledgement in the *Coleman Report* was that socioeconomic status was a major predictor of educational achievement and attainment (Knapp & Woolverton, 2004). Generally, students with higher socioeconomic status have an enhanced chance of reaching higher levels of educational attainment and academic achievement (Coleman et al., 1966; Goldstein, 1967; Knapp & Woolverton, 2004; Mayeske et al., 1972; Persell, 1993). Students who are not academically successful either choose to leave school or are forced out before graduation (Orfield, 2004). One societal impact of the difference in achievement is the correlation of academic success to students leaving school before graduation. Orfield (2004)

analyzed the drop out crisis and identified the relationship between the dropout rate and social challenges. Students who drop out or are pushed out are more likely to earn significantly lower wages over time than students and have an increased likelihood of being incarcerated during their lifetime than students who receive a high school diploma (Howard, 2010). There is an economic trickling effect in regard to student dropout rate.

A student's performance in K-8 mathematics often holds the key to the preparatory mathematics track that a student will have access to in high school and postsecondary education (Oakes et al., 2006). Within the scope of achievement, mathematics and reading receive a tremendous amount of attention. Howard (2010) acknowledges that mathematics and reading are foundational content areas within the educational experience of a student. He emphasizes that careful attention to performance gaps in mathematics and reading will provide "considerable implications for overall success...improving students' performance in other academic areas" (p. 19). Gay (2009) notes that when a subject area holds an elite status, such as mathematics, a certain level of positive and negative bias trickles down and influences students educational experiences and opportunities in that subject area. In turn, students of color, students living in poverty, and students living with connection to other descriptive factors that are in contrast with the determining dominant group are left without receiving the same educational opportunity to access, experience, and expectations (Gay, 2009; Moses & Cobb, 2001; Tate, 1997b).

Ladson-Billings (1995b) stated that "all students can be successful in mathematics when their understanding of it is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter" (p. 141). Performance gap differences provide researchers with clear insights that differences exists, but "how the values and beliefs assigned to different subjects (and aspects within them) affect student and teacher attitudes toward them" (Gay, 2009, p. 192) is less known. Gay emphasizes that:

...revising the socially constructed identity of mathematics, accepting the culturally responsive as a requirement of quality education for ethnically different students, and crafting instructional actions that exemplify them are crucial components of teachers' preparation if they are to provide more equitable learning opportunities for diverse students (p. 193).

Addressing academic achievement, Gay urges educators to critically analyze achievement differences as they relate to students of color and students living in poverty. Stemming from the belief that mathematics achievement occurs in a cultural context, environmental factors must influence scoring. Factors to consider may include the inexperience of test-taking cultural capital, self-concept, self-efficacy, self-esteem, or teacher expectations on academic achievement (Gay, 2009). Research pertaining to mathematics achievement by specific topic across any sociocultural variable is difficult to locate (Lim, 2008; Lubienski & Bowen, 2000). The research attainable lacks specificity and is often very generic (Lim, 2008). Tate (2005) acknowledges that mathematics performance data are often unavailable to researchers and educational

leaders and therefore calls for more specific analysis of mathematics performance data across various demographics to inform and influence education.

The primary objective of this research study was to identify any significant differences in TAKS mathematics achievement in grades three through eight across socioeconomic identifiers. Mathematics TAKS data were examined across grades three through eight in 2004, 2007, and 2010 by specific mathematical objective across socioeconomic status. The intent of the study was to provide a foundational data set for K-8 decision makers, mathematics teacher educators, and researchers to make informed decisions. The data set also provides a basis to expand on theory and praxis in mathematics education.

This article provides a brief summary of the history of Texas assessment programs followed by an overview of TAKS mathematics objectives before reviewing the issue of socioeconomic identifiers and educational influence. Before moving into the research methodology, a description of culturally responsive pedagogy is provided. After describing the guiding research methods, the findings are reported, followed by a discussion that includes closing remarks.

A Brief History of Texas Assessments

Texas students have been required to participate in statewide assessment in the content areas of reading, writing, and mathematics since 1980 (TEA, 2002a). The first required assessment was labeled the Texas Assessment of Basic Skills (TABS) test. TABS was a criterion-referenced assessment from 1980 through 1984 (Cruse & Twing, 2000). Students were assessed in grades three, five, and nine. A mandated statewide curriculum was not available in the early 1980s and the learning objectives were created by various committees of Texas educators. By 1983, students who did not pass the grade nine assessments were required to retake the exam each year until they passed it. However, not passing TABS did not eliminate students from receiving their diploma or graduating (Cruse & Twing, 2000). TABS assessment results were available to the public.

In 1985, Texas students began taking another criterion-reference assessment labeled the Texas Educational Assessment of Minimal Skills (TEAMS). The Texas legislature pushed for a change in terminology and shifted focus from “basic skills” to “minimum basic skills” (Cruse & Twing, 2000, p. 328). TEAMS also assessed reading, writing, and mathematics, but included grades one, three, five, seven, nine, and eleven. By 1987, all students were required to pass the eleventh grade “exit level” assessments to receive their diploma. TEAMS was eliminated in 1989.

Beginning in 1990, Texas replaced TEAMS with another criterion-referenced assessment labeled the Texas Assessment of Academic Skills (TAAS). TEA (2002b) claims that the TAAS shifted away from *minimum skills* toward *academic skills*. TAAS emphasized *higher-order thinking* and *problem-solving* across reading, writing, and mathematics. TAAS was administered in grades three, five, seven, nine, and eleven. TAAS emphasized a broader focus on the essential elements (EE) and was more difficult than the TEAMS. TAAS also provide more information regarding scores and

accountability. Students, campuses, and districts were all accountable for student performance and were susceptible to receiving consequences for not meeting state expectations. TAAS phased out in 2002 and opened the door for the Texas Assessment of Knowledge and Skills (TAKS).

The Texas legislature desired a more rigorous assessment program and desiring to curtail social promotion and created a law that would mandate that students meet certain expectations to exit certain grade levels. Students were required to pass TAKS reading and receive passing grades in grade three to be promoted to grade four. Students in grades five and eight were required to receive passing grades and pass TAKS reading and mathematics assessments to be promoted to the next grade level. The exit-level assessment was moved back to the eleventh grade and students were required to pass TAKS reading, mathematics, science, social studies, and writing in order to be eligible to receive a diploma. Students were also required to earn sufficient high school credits. TAKS has undergone several changes since its inception. Reading is now assessed in grades three through nine; English-language arts (ELA) is administered in tenth and eleventh grades; writing is assessed in fourth and seventh grades; mathematics is administered in third through eleventh grades; science is administered in fifth, eighth, tenth, and eleventh grades; and social studies is administered in the eighth, tenth, and eleventh grades. As of 2010, students in grade three are no longer required to pass TAKS reading to be promoted to the fourth grade.

Texas is now transitioning toward the State of Texas Assessments of Academic Readiness (STAAR). STAAR will use End of Course (EOC) assessments in grades nine through twelve. Freshman classes beginning in the 2011-2012 academic year will be required to take five EOC assessments as a partial requirement to graduate (TEA, 2010). Students will be expected to pass EOC assessments in Algebra I, Biology, English I, English II, and United States History. In grades three through eight, students will take annual assessments in both reading and mathematics.

TAKS Mathematics Objectives

TAKS assessed mathematics across six objectives through multiple-choice and griddable items. Objective one explored numbers operations, and quantitative reasoning. Objective two explored patterns, relationships, and algebraic reasoning. Objective three explored geometry and spatial reasoning while objective four explored measurement. Objective five explored probability and statistics and objective six explored mathematical processes and tools. Mathematics TAKS assessment began with 40 test items in grade three and increased by two items per grade through the eighth grade assessment which had 50 test items.

Objective one was heavily emphasized in both the elementary and middle grades to build a mathematical foundation on number fluency (TEA, 2002a). The emphasis on objective two increased as students approached Algebra. The emphasis on objective three remained constant through grades three through eight (TEA, 2002a). Objective four received more emphasis in elementary school than middle school. The focus on measurement decreased as students start focusing more on algebraic foundations (TEA, 2002a). Objective five was emphasized more in the middle grades than in grades

three through five. Objective six received a heavy emphasis throughout elementary and middle level grades. Objective six attempted to link knowledge and skills from the other five objectives and push students to think critically and to effectively problem solve (TEA, 2002a). A single test item will be represented by a combination of content from multiple objectives (TEA, 2002a).

Socioeconomic Status

Many researchers suggest that socioeconomic status is a major predictor in student achievement (Coleman et al., 1966; Jordan et al., 2007; Knapp & Woolverton, 2004; Persell, 1993). When examining data in Texas, Tajalli and Ophein (2005) found that socioeconomic status was a significant factor in predicting academic performance of fourth and eighth graders. Students from low-socioeconomic backgrounds receive less support than many of their peers from other backgrounds (Jordan et al., 2006).

Jordan and Levine (2009) explored the socioeconomic variation, number competence, and mathematics learning for young children. The foundation of their study is on the premises of “primary preverbal number knowledge and symbolic number knowledge” (p. 61). Jordan and Levine describe primary preverbal number knowledge as an object file system for precise representation of small numbers and an analogue magnitude system for approximate representation of larger sets. They describe secondary symbolic number knowledge as verbal subitizing, counting, numerical magnitude comparisons, linear representations of numbers, and arithmetic operations. Students that struggle early in mathematics usually have difficulties learning verbal and symbolic number knowledge as they progress due to the influence of experiences and instruction. Students from low-socioeconomic backgrounds often do not receive preschool experiences to assist in building verbal and symbolic number knowledge. In another study, Jordan et al. (2007) found that students from low-socioeconomic backgrounds entered kindergarten “well behind” (p. 36) students from middle-class backgrounds in tasks that assess number competence. Jordan and Levine (2009) propose that early interventions at home and school “have potential to help all children develop the foundations they need to learn school mathematics” (p. 65).

Chow (2007) initiated a four-year longitudinal study that analyzed the difference in achievement among students that were identified as receiving free lunches, receiving reduced-price lunches, and students ineligible for free or reduced lunches. The study found that there were no statistically significant differences across socioeconomic status. The study did acknowledge that there were small differences of practical significance in achievement. Students that did not receive free or reduced lunch scored with the highest mean, followed by students receiving reduced price lunch, and then students receiving free lunch. However, most students identified as receiving free lunch still passed the mathematics TAKS test. The study also found that there were not any growth rate differences across time. Scores were consistent providing evidence that students learn the same amount of information. The critical factor is where students start in relation to performance on standardized test after a period of instruction.

Culturally Responsive Pedagogy

There have been numerous discussions about the intersectionality of culture, learning, and the school experience. The contributions of Lev Vygotsky to sociocultural learning theory have paved a way for educational theorists to examine to what extent culture influences the education that an individual incurs. Vygotsky (1986) described learning “as being embedded within social events and occurring as a child interacts with people, objects, and events in the environment” (p. 287). A pedagogical approach that emphasizes sociocultural learning theory is culturally responsive pedagogy (Gay, 2000). Culturally responsive pedagogy (CRP) evolved from other pedagogies that emphasized the influence of culture in student’s learning. Some have describe these pedagogies as “culturally appropriate” (Au & Jordan, 1981), “culturally compatible” (Jordan, 1985; Vogt, Jordan, & Tharp, 1987), “culturally congruent” (Irvine, 2003; Mohatt & Erickson, 1981), “culturally relevant pedagogy” (Ladson-Billings, 1994), and “cultural responsive” (Cazden & Leggett, 1981; Gay, 2000).

Culturally responsive teaching (Gay, 2000) and culturally relevant teaching (Ladson-Billings, 1994) are the most common terms used today to refer to this space of cultural pedagogical theory. Ladson-Billings coined the term “culturally relevant” in response to her research of identifying effective practices and qualities of highly effective teachers of African American students. According to Ladson-Billings (1995a), culturally relevant teaching is a pedagogy of opposition that is committed to collective empowerment that relies on three propositions: 1) students must experience academic success (p. 160); 2) students must develop and/or maintain cultural competence (p. 160); and 3) students must develop a critical consciousness through which they challenge the status quo of the current social order (p. 161).

The first is that students must experience academic success. Academic success is reliant on the development of academic skills such as literacy, numeracy, technological, social and political skills. Ladson-Billings states that these are the minimal necessary skills that students must develop “in order to be active participants in a democracy” (p. 160). Ladson-Billings stresses that “culturally relevant teaching requires that teachers attend to students’ academic needs, not merely make the ‘feel good’...the trick is to get students to ‘choose’ academic excellence” (p. 160).

The second criterion of culturally relevant teaching is that students must develop and/or maintain cultural competence (Ladson-Billings, 1995a). Ladson-Billings states that “culturally relevant teachers utilize students’ culture as a vehicle for learning” (p. 161). The school environment should not be a place where students cannot be themselves. Also, students must develop the skills of translation and code switching.

The third criterion of culturally relevant teaching is that students must develop a critical consciousness through which they challenge the status quo of the current social order (Ladson-Billings, 1995a). Students must be able to move beyond just choosing academic excellence and being culturally aware and competent. It is important for students do develop a “sociopolitical consciousness that allows them to critique the cultural norms, values, mores, and institutions that produce and maintain social inequalities” (p. 162). Teachers must help students construct knowledge of local,

national, and global issues. Culturally relevant teachers assist students in developing the critical thinking and critical examination skills to empower students with the ability to actively critique and challenge sociocultural norms.

Gay (2000) takes culturally relevant teaching into more extensive depths and utilizes the term culturally responsive pedagogy (CRP). Gay's framework is a product of researched based practices and sociocultural approaches to education. Gay (2000) defines CRP "as using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant and effective for them" (p. 29). Gay identifies culturally responsive teaching as being comprehensive, multidimensional, empowering, transformative, as well as emancipatory. Gay's framework of culturally responsive teaching has four critical parameters: 1) caring; 2) communication; 3) curriculum; 4) and instruction.

Caring includes the personal, social, and ethical dimensions of teacher-student interactions (Gay, 2000, p. xv). Caring moves beyond the simplistic forms of kindness, gentleness, and benevolence toward the "dimensions of emotion, intellect, faith, ethics, action, and accountability" (p. 48). A caring teacher has high expectations and values accountability and holds students accountable to their high expectations, always expecting the student's best. CRP relies heavily on the importance of communication. Teachers must learn how to effectively communicate (verbally and non-verbally) with their students. Gay suggests that "aligning instruction to the cultural communication styles of different ethnic groups can improve school achievement" (p. xvi). Another critical parameter of CRP is curriculum. Gay states that "the fundamental aim of culturally responsive pedagogy is to empower ethnically diverse students through academic success, cultural affiliation, and personal efficacy" (p. 111). It is critical to align the curriculum with the inclusive culture of the students and community. Students must be able to connect knowledge to their lives and experience both inside and outside of school.

The fourth critical parameter is instruction. CRP desires to move away from cultural mismatch and toward a curriculum that is "culturally congruent" (xvii) with the students in the specific educational setting. To accomplish this goal, teachers must not only have a curriculum that is congruent with the cultural environment of the classroom, but also must be able to identify and understand the various "procedural, communicative, substantive, environmental, organizational, perceptual, relational, and motivational stimulation preferences" (p.151) of their students. A culturally responsive teacher must be able to modify and adapt instruction to meet the various learning styles and processes of students.

Culturally responsive pedagogy is a dynamic, multifaceted framework that centralizes culture in the educational environment. Culturally responsive teachers are culturally competent, culturally sensitive, and caring. Culturally responsive teachers assist students in their educational journey by helping them develop the critical consciousness to question and challenge the status quo. They also examine the curriculum and instructional practices for bias and cultural mismatch. A culturally

responsive teacher is *responsive* to the needs of the students, community, and global societal and environmental population.

Methodology

This study critically examined TAKS mathematics data through the guiding research question: What are the differences in TAKS scores of students in grades three through eight during the years 2004, 2007, and 2010 by mathematical objective categorized by socioeconomic status? This study used descriptive statistics to describe the differences in TAKS mathematic assessment data across socioeconomic status from TAKS 2004, 2007, and 2010 data. The population for this research study was students from grades three through eight who took the 2004 (N = 1,691,828), 2007 (N = 1,769,783), and 2010 (N = 1,982,189) TAKS mathematics test. The population is categorized by the economic situation of the student's guardians. The categories include *free meals, reduced meals, other, or no*.

The Texas Assessment of Knowledge and Skills (TAKS) mathematics test was the instrument used for this research study. The data used for this research study were Texas TAKS archived data. Archived quantitative data were analyzed using the statistical software *Statistical Package for Social Studies* (SPSS) 16.0 Graduate Pack. A series of one-way Analysis of Variance (ANOVA) trials were performed to determine relationship and significance ($p < .05$) between groups and within groups. To determine the location of specific significant differences, Bonferroni *post hoc* procedures were performed. This study explored both practical and statistical significance in attempt to identify differences between groups.

Findings

Mean scores were critically examined across objectives by socioeconomic identifiers through performing a series of one-way ANOVAs ($p < .05$) to answer the following guiding research question: What are the differences in TAKS scores of students in grades three through eight during the years 2004, 2007, and 2010 by mathematical objective categorized by socioeconomic status? Statistical significance was observed across several grades among groups (see Table 1), but statistical significance was not found within groups. Bonferroni *post hoc* tests were performed to identify specifically where significant differences were located.

Objective 1

Statistically significant differences were most common between students' identified as not economically disadvantaged and students' receiving free meals. Significant differences for objective one (numbers, operations, and quantitative reasoning) were observed between students' identified as not economically disadvantaged (M = 8.63) and students receiving free meals (M = 7.73, $p = .028$) in grade three. Similar differences remained in grade four with students' identified as not economically disadvantaged (M = 9.77) scoring higher than students' receiving free meals (M = 8.93, $p = .045$). No statistically significant differences were observed in grades five through eight for objective one.

Objective 2

Significant differences across objective two (patterns, relationships, and algebraic reasoning) were only observed in grades three and eight. In grade three, students' identified as not economically disadvantaged ($M = 5.16$) mean score was significantly higher than students' receiving free meals ($M = 4.73$, $p = .037$). In grade eight, students' identified as not economically disadvantaged ($M = 7.57$) mean score was higher than students' receiving free meals ($M = 6.37$, $p = .031$) and higher than students' identified as other economically disadvantaged ($M = 6.43$, $p = .042$).

Objective 3

Statistically significant differences were also prevalent in objective three (geometry and spatial reasoning) in grade three and grade five. Statistically significant differences were not present in grades four, six, seven, and eight. Students' paying a reduced fee for meals ($M = 5.07$) mean score was higher than students' receiving free meals ($M = 4.87$, $p = .017$) in grade three. Also in grade three, students' identified as not economically disadvantaged ($M = 5.27$) mean score was significantly higher than students' receiving free meals ($M = 4.87$, $p < .001$), students' paying a reduced fee for meals ($M = 5.07$, $p = .017$), and students' identified as other economically disadvantaged ($M = 4.97$, $p < .001$). In grade five, the only difference of statistical significance was between students' identified as not economically disadvantaged ($M = 6.27$) and students' receiving free meals ($M = 5.77$, $p = .019$).

Objective 4

The only significant differences across objective four (measurement) were in grade seven. Students' identified as not economically disadvantaged ($M = 3.47$) mean scores were higher than those of students' receiving free meals ($M = 2.70$, $p = .015$) and students' identified as other economically disadvantaged ($M = 2.70$, $p = .015$).

Objective 5

Statistically significant differences were observed in grades three and five for objective five (probability and statistics), but not in grades four, six, seven, and eight. The most noticeable differences occurred in grade three where students' identified as not economically disadvantaged ($M = 3.60$) mean scores were higher than students' receiving free meals ($M = 3.33$, $p < .001$), students' paying a reduced fee for meals ($M = 3.40$, $p = .002$), and students' identified as other economically disadvantaged ($M = 3.33$, $p < .001$). Statistically significant differences were not observed in grades four and six through eight.

Objective 6

The objective with the most occurrences of statistical difference among objective means was objective six (mathematical processes and tools). In the third grade, students' paying a reduced fee for meals ($M = 5.57$) scored higher than students' receiving free meals ($M = 5.17$, $p = .036$) and higher than students' identified as other economically disadvantaged ($M = 5.13$, $p = .023$). Also in the third grade, students' identified as not economically disadvantaged ($M = 6.20$) mean scores were significantly higher than all other groups. In grades four through six, the mean scores of students' identified as not economically disadvantaged were significantly higher than students' receiving free meals and students' identified as other economically disadvantaged. In grade seven, significant differences were present between students' identified as not economically disadvantaged ($M = 7.03$) and students receiving free meals ($M = 6.00$, $p = .027$). Grade eight was the only grade that significant differences were not observed for objective six (mathematical processes and tools).

Within Group

There were no statistically significant differences within groups. Within group data were also explored across 2004, 2007, and 2010 by objective and socioeconomic status to identify differences and themes of practical significance. Students across all groups scored higher on objective one (numbers, operations, and quantitative reasoning) in grades three through five than in grades six through eight. Students across all groups also scored slightly lower on objective four (measurement) in grades seven and eight than in grades three through six. In most instances, groups mean scores improved between years within each objective. However, there was a common trend within objective six (mathematical processes and tools). Students in all groups saw a slight decrease in objective six mean scores between 2007 and 2010 in at least one grade level.

Discussion

The objective of this study was to identify any differences that may occur on the TAKS mathematics assessments in grades three through eight in 2004, 2007, and 2010 between students from various socioeconomic situations. This study also examined within group data to identify performance differences across years and objectives. Statistical significance was determined by performing one-way ANOVAs ($p < .05$). Statistical significance was observed between certain groups, but not within any group.

One-way ANOVA results identified that significant differences occurred between students' identified as not economically disadvantaged and all other students at various grades and across various objectives. The only other occurrences of significantly higher scores were between students' receiving reduced meals and students' identified as other economically disadvantaged. The Bonferroni *post hoc* tests identified the location of statistical significance in mean scores by objective across socioeconomic identifiers. The most frequent instances of statistical significance were across all objectives except objective four (measurement) in grade three and across objective six (mathematical processes and tools) in grades three through seven. The highest number of quantifiable

differences occurred between the mean scores of students' identified as not economically disadvantaged scoring significantly higher on objective means than students' receiving free meals or identified as other economically disadvantaged. After students' move beyond the third grade, the number of statistically significant differences drastically reduces. By the eighth grade, statistical differences are difficult to locate.

Further exploration of within group data identified several themes that were prevalent among all groups. All four groups seemed to score higher in grades three through five on objective one (numbers, operations, and quantitative reasoning) than in grades six through eight. Student mean scores on objective four (measurement) tended to reduce in the seventh and eighth grades. Each group also experienced a slight decrease between 2007 and 2010 on objective six (mathematical processes and tools) across at least one grade level. Students' identified as not economically disadvantaged scored at-least slightly higher than all other groups across all objectives in 2004, 2007, and 2010. Culturally responsive pedagogy is a viable option to eradicate the differences in mean scores observed across all objectives.

The following three sub-sections provide suggestions to respond to the findings in this study. The first section is *Preparing the Middle Level Mathematics Facilitator*, which suggests that middle level mathematics education and professional development programs should focus on culturally responsive mathematics pedagogy to develop highly effective middle level mathematics facilitators. The second section is *Socioeconomic Status and the Classroom Environment*, which provides suggestions to improve the educational experience of students from financially oppressed situations. The third and final section discusses *Transitioning to the State of Texas Assessments of Academic Readiness (STAAR)*, which identifies a issue of concern between the middle level TAKS and the middle level STAAR assessment.

Preparing the Middle Level Mathematics Facilitator

Whether it is through teacher education programs or professional development, educators must work to develop highly effective middle level mathematics facilitators. The Association for Middle Level Education (AMLE) provided a position statement highlighting 16 characteristics of successful middle grades schools. Some of the key ideas from those identified characteristics were responsiveness, challenging, empowering, and equity (Strahan & Rogers, 2012). According to the position statement, educators should: value young adolescents, engage in active learning, provide a challenging curriculum, provide multiple approaches to teaching and learning, and provide varied and ongoing assessments. Culturally responsive pedagogy provides a means to address each of the aforementioned characteristics of successful middle grades schools.

The idea of culturally responsiveness seems to be appreciated by many, but how do we develop culturally responsive mathematics facilitators? Gay (2000) provides a framework that emphasizes caring, communication, curriculum, and instruction. Mathematics education should begin with focusing on ideological and *historicity* (Freire, 1971) to create a foundation for Gay's framework. "Ideology can best be understood as a societal lens or framework of thought, used in society to create order and give

meaning to the social and political world in which we live” (Darder, Baltodano, & Torres, 2009, p. 11). To accomplish this, mathematics educators should be encouraged to enter reflective space exploring current and historical influence to develop an understanding of their ideology and the impact of their ideology. Suggested activities to support exploration of ideology are: mathematical autobiographies, reading or discussion reaction statements, and participation in activities that examine power and privilege (Leonard, 2008). Activities such as these provide a pathway for mathematics facilitators to further connect with their *ethic of care* (Noddings, 2003), which includes the personal, social, and ethical dimensions of participatory interactions (Gay, 2000).

A caring mathematics facilitator will seek to develop effective communication skills with students and families from various cultural environments. Mathematics education should provide access to language acquisition for any language spoken in a specific context and strategies to work with students using languages other than that of the mathematics educator (Kersaint, Thompson, & Petkova, 2009). Mathematics education should also assist in training teachers to be knowledgeable of common verbal and non-verbal communication methods of their students. This may include analogies, facial expressions, lyrics, metaphors, and/or similes (Gay, 2000). A caring teacher will take caution with making assumptions about physical expressions.

Once mathematics educators develop the skills of effective communication and identifying power structures, they can work to create a culturally responsive curriculum. The key curriculum elements of culturally responsive pedagogy include: personal experiences from students’ lives; role models; culturally grounded stories, songs, photos, or other ways of expressing community values and beliefs; language and linguistic expressions; multiple perspectives on issues, themes, and/or problems; formal and traditional content; and social issues (Gay, 2000; Ladson-Billings, 1994; Leonard, 2008; Pang, 2005). Creating opportunities for mathematics educators to partake in actual curriculum research and development would assist in developing the skills necessary to create culturally responsive curriculums. In the standards-based era with strict curricular expectations and limited teacher input, one may want to recall Freire (1971) response to pressures of conformity to create counterhegemonic alternatives for students. Freire emphasizes the need to gain a “strong command of one’s particular academic discipline...[and] engage critically classroom content, from their existing knowledge and the events and experiences that comprise their living history” (Darder, Baltodano, & Torres, 2009, p. 13). Once a mathematics facilitator has a strong command of the mandated mathematics curriculum they are able to create a social space to use mathematics as a tool to challenge the current social order.

The fourth tenet of Gay’s (2000) framework is instruction. A caring mathematics facilitator that has a strong connection with the culture, curriculum, and social issues is primed to participate in culturally responsive mathematics instruction. Facilitating mathematics lessons that are culturally responsive to current and future teachers could inspire ideas for future lessons. Mathematics educators may want to encourage current and future mathematics teachers to think local, national, and international when creating mathematics lessons. This will allow for a contextualized instructional approach to mathematics. Beyond providing visual examples of culturally responsive mathematics

instruction, mathematics educators should provide mentorship to mathematics facilitators through lesson development, instructional feedback, instructional resources, and general dialogue. Mentorship will assist facilitators in their growth as a culturally responsive mathematics facilitator. Another instructional recommendation is to move beyond the idea and limitations of “problem solving” (Polya, 1945) to a more advanced “problem posing” (Freire, 1971). Focusing instruction around problem posing will assist teachers and students in developing mathematical literacy to navigate social systems.

Socioeconomic Status and the Classroom Environment

The previous section provided an argument that culturally responsive mathematics pedagogy could be a means to improve the academic experience of students. Culturally responsive pedagogy is an individualized approach to education. However, there are situations where the complexity of culture is minimized and becomes a tool for oppression. For example, you may have witnessed reference to a ‘culture of poverty’, which has been a focus of Ruby Payne’s approach to addressing ‘poverty’ in education. Delpit (2012) reminds us that “what Payne is labeling culture is actually the response to oppression” (p. 7).

How can mathematics educators address difference in performance across socioeconomic variables? Through the use of culturally responsive mathematics pedagogy, facilitators can use mathematics as a tool to address oppression due to the economic structure. One approach is to magnify counter-narratives to the dominant deficit ideology associated with people from financially oppressed groups. Gorski (2011) provides insight to defeating deficit ideology by “learning to ‘spot it’, reflect critically upon your own class socialization, refuse to locate problems in the ‘cultures’ of disenfranchised groups, and [we] must teach about economic injustice and poverty” (p. 167-169). Mathematics educators can develop culturally responsive lessons that focus the critical social issue or economic injustice by drawing attention to social support systems, financial poverty, minimum wage, living wage, property rights, gentrification, and taxation. Swalwell and Gorski (2012) suggest educators to take a resilience approach that is guided by high expectations and empathy. They provide a list of suggestions for educators that is supported by research to have a positive impact on students from oppressed socioeconomic situations:

- Nurture relationships with community organizations (Neuman, 2009);
- Reduce class sizes (Rouse & Barrow, 2006);
- Extend vision screenings to include farsightedness (Gould, 2003);
- Make early childhood education universal and universally high-quality (Feeney, Freeman, & Pizzolongo 2010);
- Examine learning materials for bias – picture books often are particularly class-biased (Mendoza & Reese, 2001);

- Promote reading enjoyment and minimize the extent to which students have to “perform” their literary skills publicly;
- To defend and integrate arts and music (Pogrow, 2006);
- Dress humbly – students from low-income situations struggled to fit in school because of the inability to afford the newest fashions (Brann-Barrett, 2010);
- Express high expectations (Howard 2007);
- Parent outreach (Howard 2007);
- Peer tutoring (Maheady, Mallette, & Harper, 2006);
- Make involvement accessible;
- Never assume access to materials (Gorski, 2009);
- Cooperative learning (Slavin, Lake, & Groff, 2009);
- Teach about poverty (Chafel, 1997);
- Build trust (Hughes, Newkirk, & Stehnhgem, 2010);

Many of the suggestions provided by Swalwell and Gorski are difficult to achieve due to excessive budget cuts. Mathematics educators should organize to challenge deep budget cuts and to advocate for a more equitable educational experience for middle level students. However, many suggestions are without limitations. Having high expectations, taking a caring-centered approach, reaching out and communicating with parents, utilizing cooperative learning, building trust, and teaching about poverty are all within reach for culturally responsive middle level mathematics educators. Dressing humbly can reduce social stress for students (Brann-Barrett, 2010) and inherently positions the facilitator in a social space challenging hegemony associated with ‘professional’ dress. A caring facilitator can dress desirable without perpetuating ageism, classism, racism, and sexism. Each suggestion provided is supported by research and supported by the position statement of AMLE.

Closing Remarks

The results of this study affirm that the influence of socioeconomic variables heavily influence students’ performance on the TAKS mathematics test. Students’ identified as not economically disadvantaged scored significantly higher than students’ receiving free meals in the third grade during each testing year. Even though the number of statistically significant differences reduces after the third grade, students’ identified as not economically disadvantaged mean scores were higher than all other groups across all grade levels and objectives. The objective with the most occurrences of statistical difference among objective means was objective six (mathematical processes and tools). This poses a severe concern as Texas moves from TAKS to STAAR. STAAR is

expected to be more rigorous and is expected to focus more heavily on readiness standards. In doing so, Texas has decided to remove objective six (mathematical processes and tools) as a stand-alone objective. The former objective six is now embedded throughout the new objectives one through five. Students across race/ethnicity (Fox, 2012), gender (Fox & Larke, 2013), and socioeconomic status have scored lower on objective six (mathematical processes and tools). Stakeholders attempting to identify students' strengths and weaknesses will incur a new challenge when examining students' data across mathematical objectives. It is suggested that future studies explore the *intersectionality* of performance data. Further studies are desired to explore why there are specific differences between groups within objectives.

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Appendix A**Table 1. One-way ANOVA Results Between Groups by Socioeconomic Status**

| Grade | Objective | F | p-value |
|-------|-----------|-----------------|-------------|
| 3 | 1 | F(3, 8) = 6.06 | p = .019* |
| | 2 | F(3, 8) = 4.96 | p = .031* |
| | 3 | F(3, 8) = 26.25 | p < .001*** |
| | 4 | F(3, 8) = 4.23 | p = .046* |
| | 5 | F(3, 8) = 28.67 | p < .001*** |
| | 6 | F(3, 8) = 42.22 | p < .001*** |
| 4 | 1 | F(3, 8) = 5.05 | p = .030* |
| | 2 | F(3, 8) = 3.50 | p = .069 |
| | 3 | F(3, 8) = 4.07 | p = .050 |
| | 4 | F(3, 8) = 2.03 | p = .188 |
| | 5 | F(3, 8) = 2.06 | p = .184 |
| | 6 | F(3, 8) = 7.84 | p = .009** |
| 5 | 1 | F(3, 8) = 2.41 | p = .142 |
| | 2 | F(3, 8) = 3.80 | p = .058 |
| | 3 | F(3, 8) = 6.21 | p = .017* |
| | 4 | F(3, 8) = 3.63 | p = .064 |
| | 5 | F(3, 8) = 4.84 | p = .033* |
| | 6 | F(3, 8) = 9.05 | p = .006** |
| 6 | 1 | F(3, 8) = 3.05 | p = .092 |
| | 2 | F(3, 8) = 1.73 | p = .238 |
| | 3 | F(3, 8) = 2.17 | p = .170 |
| | 4 | F(3, 8) = 1.64 | p = .256 |

| | | | |
|---|---|-----------------|------------|
| | 5 | F(3, 8) = 5.09 | p = .029* |
| | 6 | F(3, 8) = 8.30 | p = .008** |
| 7 | 1 | F(3, 8) = 2.90 | p = .102 |
| | 2 | F(3, 8) = 2.27 | p = .157 |
| | 3 | F(3, 8) = 2.05 | p = .186 |
| | 4 | F(3, 8) = 8.49 | p = .007** |
| | 5 | F(3, 8) = 0.83 | p = .511 |
| | 6 | F(3, 8) = 6.40 | p = .016* |
| | | | |
| 8 | 1 | F(3, 8) = 6.06 | p = .190 |
| | 2 | F(3, 8) = 4.96 | p = .018* |
| | 3 | F(3, 8) = 26.25 | p = .048* |
| | 4 | F(3, 8) = 4.23 | p = .196 |
| | 5 | F(3, 8) = 28.67 | p = .138 |
| | 6 | F(3, 8) = 42.22 | p = .040* |

Note: This table addresses statistical significance at $p < 0.05$: * $p < 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.