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Hispanic Female Preservice Elementary Teachers' Mathematics Teaching Self-Efficacies, Attitudes, and Student Outcome Expectations

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The current study examined consistency among Hispanic female preservice elementary teachers' (n=35) self-efficacies, attitudes, and student outcome expectations toward mathematics. Results indicated that while almost all subscales were significantly correlated in anticipated directions, the MTEBI Outcome Expectancy subscale had no relationship with other subscales. Overall, the results suggest that the Hispanic female preservice teachers generally had positive mathematics self-efficacies and low anxiety toward mathematics, yet they did not have congruently affirmative student outcome expectations. Findings are contextualized by participants' descriptions of mathematics as: (a) particularly difficult to learn, (b) causing long-term negative impacts if poorly taught, and (c) prone to having students with pre-existing negative dispositions.

Key words: Hispanic preservice teachers, elementary mathematics, mathematics teaching self-efficacy, mathematics attitudes, mathematics student outcome expectations

The challenge of improving Hispanic-American undergraduate students' college education access and success has been conceptually positioned within a "college opportunity framework" (Gonzalez, Stoner, & Jovel, 2003). Research addressing the optimal supports for assisting such Hispanic students seeking to enter and succeed in undergraduate education have focused on numerous factors including academic preparedness of Hispanic college students (Boden, 2011), motivation of Hispanic students' to succeed in higher education (Easley, Bianco, & Leech, 2012), standardized college entrance exams amongst Hispanic college-bound students (Contreras, 2005), and engaging Hispanic parents in supporting college pathways for their children (Auerbach, 2004). Research has shown that Hispanic students' "sense of belonging" at an undergraduate-serving institution is impacted by numerous academic and social integration variables, as well as perceptions and experiences of campus diversity (Maestas, Vaquera, & Munoz-Zehr, 2007).

Some of the factors impacting Hispanic students' access and success at undergraduate education have repeatedly been demonstrated as relevant, for example research on disparities in participation patterns of Hispanic American compared to Anglo-American and non-Hispanic minority university students (Brown, 2008). Research has shown that even when there is growth in participation and performance of Hispanic students in pre-college preparation, "the rates of increase differ across groups with Hispanic participation improving more slowly than the participation of other ethnic subgroups" (Brown, 2008, p. 225). Follow up research has analyzed the self-reported perspectives and explanations given by Hispanic students for how they strive to overcome the personal and academic challenges that they face while pursuing an undergraduate degree (Cavazos, Johnson, & Sparrow, 2010). Remediation for Hispanic and other underserved students who have entered college lacking some of the academic fundamentals necessary to succeed as an undergraduate student has been recognized as a "social and economic imperative" (Day & McCabe, 1997) and "high stakes" (Roueche & Roueche, 1999). Bahr (2010) argued, "remedial coursework represents a lifeline in the ascent to financial and social-structural stability for individuals who face significant deficiencies in foundational subjects" (p. 209).

One of the foundational subjects often requiring remediation for struggling undergraduate Hispanic students is mathematics (Bahr, 2010). Insight into why such disparities in participation in mathematics remediation exist in the first place is provided by a 2003 study that set out to determine why a predominantly Hispanic university was experiencing consistently high failure rates for their entry-level college algebra course. The authors had over a thousand students complete a survey self-reporting their attitudes towards math among other variables, and found a lack of significant difference between Hispanics and other ethnic groups on the variables measured (Acherman-Chor, Aladro, & Gupta, 2003). They determined that: "Increased minority retention in higher education may result from shifting the focus away from the 'usual suspects' in math failure—that is, student characteristics—to issues of curriculum, teaching, and learning" (p. 142).

In recognition of the need for research on (a) shifting the focus of undergraduate mathematics remediation away from student characteristics and towards pedagogical characteristics, and (2) alleviating the disparities in participation in mathematics remediation between Hispanic and non-Hispanic undergraduate students, the mixed-methods study presented in this paper was designed. Specifically, this study aimed to assess and understand the consistency of self-efficacies, attitudes, and student outcome expectations toward mathematics among female Hispanic undergraduate students of a particular demographic, namely those preparing to become future elementary teachers. The self-efficacies, attitudes, and student outcome expectations toward mathematics among this selected demographic of Hispanic undergraduate students is particularly apt in that these are the future teachers of Hispanic youth at their earliest phase of formal education; and therefore these preservice teachers' mathematics self-efficacies, attitudes, and student outcome expectations not only impacts their own academic and professional future, but also that of all future students that they will teach (Duru, 2009; Koller, Baumert, & Schnabel, 2001; White et al., 2005).

Undergraduate students that are preservice elementary teachers are the future instructors of impressionable primary students during their earliest years of formal education. Research has shown the influence of teachers' mathematics beliefs on their elementary students' mathematics self-efficacy (Tiedemann, 2000). Within this context, the focus of study was the consistency of mathematics self-efficacies, attitudes, and student outcome expectations of Hispanic female preservice elementary teachers. The specific constructs measured pertained to the participants' attitudes towards mathematics including value, enjoyment, self-confidence, motivation, and anxiety, as well as mathematics teaching self-efficacies and student outcome expectations. These particular constructs were measured as the focus of this study because the mathematics self-efficacies, attitudes, and student outcome expectations of female preservice elementary teachers are a critical component of the K-12 STEM education pipeline towards careers in STEM, and mainline towards non-STEM careers that benefit from STEM skills. Within this context, the following research questions guided the study:

1. What is the consistency of Hispanic female preservice elementary teachers' self-efficacies, attitudes, and student outcome expectations toward mathematics among and within validated mathematics attitude assessment instruments?
2. What are the participants' self-reported explanations and perceptions describing any discrepancies between their self-efficacies, attitudes, and student outcome expectations toward mathematics among validated mathematics attitude assessment instruments?

Review of Literature

This literature review will: (1) discuss the importance of preservice elementary teachers' self-efficacies, attitudes, and student outcome expectations toward mathematics, and then (2) discuss the specific challenges facing Hispanic undergraduate preservice elementary teachers.

Importance of Preservice Elementary Teachers' Self-efficacies

Developing high-quality mathematics teachers has been identified by the Education Alliance (2006) as a crucial component for improving U.S. students' mathematics achievement and thereby closing the mathematics achievement gap. Undergraduate and graduate level teacher education programs across the country prepare preservice mathematics teachers to eventually enter the classroom and assume the responsibilities of an inservice teacher. At the middle school and high school grades, these future teachers are often specialists with an active interest in mathematics and mathematics education as evidenced by their enrollment in a mathematics education program. Conversely, at the elementary school grades preservice teachers are most often generalists responsible for teaching multiple subject areas, including a foundation of basic skills colloquially referred to as "the three Rs" of *r*eading, w*r*iting, and a*r*ithmetic (Midgley, Anderman, & Hicks, 1995). The requirement of pedagogical generalization, along with other factors including the students' ages, has resulted in the typical profile of a preservice elementary teacher being someone who prefers generalization as opposed to the type of specialization involved in teaching more advanced math education (Ansalone & Biafora, 2004). While many of these generalists have full competence as high-quality math educators, others are less prepared; evidence has indicated that traditional mathematics curriculum and instructional methods are not serving all students well, particularly minority and female students (Hiebert, 1999).

Many students and teachers have reported that a major barrier to developing a positive attitude towards mathematics is the presence of persistent mathematics-related anxiety (Ashcraft, 2001; Bursal & Paznokas, 2006; Harper & Daane, 2012; Ho et al., 2000; Sloan, 2010). Efforts to reduce students' math anxiety, as well as help them increase their positive attitude towards math and STEM more broadly, have attempted to incorporate various approaches to supporting contextualized mathematics education that engages students through authentic connections with their real-life interests and ambitions (An, Kulm, & Ma, 2008; An, Capraro, & Tillman, 2013; Cohen et al., 2012; Slykhuis et al., 2012; Tillman et al., 2012; Tillman et al., 2011). Math curriculum in this vein attempts to alleviate the shortcomings often associated with learning abstract mathematics concepts which are sometimes difficult for students because of a lack of connections with their real-life experiences, resulting in a scarcity of student engagement (Hanula, 2002). Students who are disengaged from mathematics education often have trouble learning mathematics because of a lack of relevant connections with their existing knowledge and interests, reducing students' motivation and engagement with the topic, and negatively impacting their attitude towards the subject (Ma, 1999; Sherman, & Wither, 2003).

A teacher's confidence in their own ability to effectively teach a subject to their students was termed *self-efficacy* by Bandura (1977) and has since been recognized as a key component of effective mathematics teaching that distills positive mathematics attitude among students (Bursal & Paznokas, 2006). Preservice teachers that have reported success in their own K-12 math education acknowledge family support as a factor in their success in math education, but also hold beliefs that mathematics ability is inherited, and that sociocultural factors can either promote or restrict learning (de Freitas, 2008). If their own future students are to succeed as prospective STEM professionals it will require that these students not only develop both specialized content knowledge (Ball, Hill, & Bass, 2005; An, Kulm, & Wu, 2008) but that they also develop long-term positive dispositions towards the STEM fields and particularly mathematics (Lajoie, 2003; Sadler & Tai, 2007; Tai et al., 2006). Both of these factors can be negatively impacted by the teacher's own poor self-efficacy with mathematics and other STEM subjects (Christensen, 2002; Gunderson et al., 2012).

Challenges Facing Hispanic Female Preservice Elementary Teachers

Hispanic female preservice elementary teachers face several challenges while pursuing their future careers, some of which are typical of those facing aspiring elementary teachers; other challenges are specific to their particular demographic as a minority. General challenges include a recognized historical tendency for preservice elementary teachers to often have low mathematics teaching self-efficacy (Bursal & Paznokas, 2006; Harper & Daane, 1998; White et al., 2006). This can result in long-term negative impacts on their students' math education and attitudes, in that multiple "national and international comparisons of student achievement indicate that it is between fourth and eighth grade when U.S. students in general, and minority students in particular, fall rapidly behind desired levels of achievement" (Balfanz & Byrnes, 2006, p. 144).

Exacerbating the impacts of this larger context of low self-efficacy for teaching mathematics and mathematics-related topics, there are also additional challenges specific to Hispanic female preservice elementary teachers resulting from their status as underserved minorities. These include but are not limited to: (a) a high percentage of the population is not native English speakers (over half the participants in this study were not native English speakers), and (b) many of the members of this population are not full-time students since they have financial and family obligations that exclude that option (Arana et al., 2011; Gloria & Castellanos, 2012; Jones, Young, & Rodriquez, 1999).

These hindrances combine to create a perplexing context for many Hispanic undergraduate students, wherein these additional stressors compound the obstacles facing a typical undergraduate student (Clark & Flores, 2001) as they prepare to become an elementary teacher. These combined stressors might cumulatively have an impact on Hispanic female preservice elementary teachers' mathematics teaching self-efficacy beliefs, attitudes, and anxiety that differs from the norm in terms of established correlations between these mathematics-related attitudinal constructs. In order to obtain empirical evidence to support or refute this hypothesis, the research design described in the next section of this paper was developed and implemented.

Methods

Participants and Setting

The current study took place at a large public university in western Texas, with a campus located less than a mile from the U.S.-Mexico border. The university's undergraduate student population is over 75% Hispanic, which is the highest percentage of Hispanic undergraduates for any public university within the United States. A total of 35 Hispanic female preservice teachers participated in the study after being recruited from two sections of an introductory teaching methods course. The course was populated by junior and senior undergraduate students, averaging 26 years of age, and was part of a series of required core courses for future elementary teachers on the fundamentals of elementary classroom education.

Instrumentation

ATMI. The Attitudes Toward Mathematics Inventory (ATMI; Tapia & Marsh, 2004) is a 40 item instrument that asks how respondents feel about statements related to math. There are four subscales: Value (10 items), Enjoyment (10 items), Self-Confidence (15 items), and Motivation (5 items). Answer options were on a Likert scale and included: "Strongly Agree," "Agree," "Neutral," "Disagree," and "Strongly Disagree." Example statements include "Mathematics is one of the most important subjects for people to study" (Value) and "I really like mathematics" (Enjoyment). Eleven items were negatively worded, where a response of "Agree" indicated low levels of the construct the item measured. Reliability for Value was .88, Enjoyment was .93, Self-Confidence was .97, and Motivation was .86.

MTEBI. The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI; Enochs, Smith, & Huinker, 2000) is a 21 item Likert scale instrument that measures two constructs, Teaching Efficacy Belief (TEB) and Outcome Expectancy (OE). Example items included "I will continually find better ways to teach mathematics" and "The inadequacy of a student's mathematics background can be overcome by good teaching." Response options were "Strongly Agree," "Agree," "Uncertain," "Disagree," and "Strongly Disagree." Reliability for the TEB scale was .90 with 13 items and for OE was .64 with eight items.

MARS-A. The Mathematics Anxiety Rating Scale - Abbreviated version (Suinn & Winston, 2003) is a 30-item survey that asks respondents to rate perceived anxiety about a number of different circumstances that involve math in school or daily activities. While the instrument as a whole measures general math anxiety, there are two subscales present that are 15 questions each and measure Test Anxiety (i.e., taking a math exam) and Numerical Anxiety (i.e., figuring out a budget). There were five response options: “Very much,” “Much,” “A fair amount,” “A little,” and “Not at all.” Reliability for the instrument was .95. For the Test Anxiety (TA) subscale reliability was .96 and for the Numerical Anxiety (NA) subscale it was .94.

Preservice Teacher Open-response Questions Survey. Students completed four open-ended questions. These questions asked students to explain what they thought were qualities of an effective math teacher, techniques for teaching students to apply and understand math, how to best help a student struggling with math, how to evaluate a student’s understanding of math concepts, and to reflect on their math experiences in school and relate them to how they feel about math today.

Data Collection

Students filled out one survey at the beginning of class every other week for a total of six weeks: Students completed the MTEBI survey during the first week of the class, completed the ATMI survey during the third week, and completed the MARS-A during the fifth week of class. In general, students took no more than 10 minutes to complete each survey. Towards the end of the semester, all students were given a series of open-ended questions and had one week to answer the questions and then electronically returned their responses to the instructor.

Data Analysis

Surveys. Total scores were calculated for the subscales on each instrument. Answer options on the ATMI and MTEBI were identical with the exception of the exact wording for the response that fell between agree and disagree, so these surveys were coded with the same numerical scheme. Responses were coded with scores of 5, 4, 3, 2, and 1 for “Strongly Agree,” “Agree,” “Neutral/Uncertain,” “Disagree,” and “Strongly Disagree,” respectively. Reverse worded items were coded with the opposite scale (i.e. “Strongly Agree” received a 1 and so on). For the MARS-A, responses were also scored with 5, 4, 3, 2, and 1 for “Very much,” “Much,” “A fair amount,” “A little,” and “Not at all,” respectively. Total scores and z-scores were then calculated for each subscale on the three instruments. In addition to basic descriptives, Pearson correlations were computed with a two-tailed p-value for all variables.

Open-response Questions. Notes were taken on each student’s individual answers to open-response questions, with important keywords pulled from the transcripts. These keywords were then counted within each question to look for the most common categories that described the answers.

If keywords were very similar in meaning, such as "stressful" and "anxiety," they were put together. After similar keywords were matched, the tallies were examined and words were grouped together by theme. The most prominent themes were then selected and quotations from the exams that best exemplified the theme or specific categories within the theme were extracted to supplement the survey results.

Results

Before running any statistical tests, the data were examined for normality. The ATMI Value subscale was negatively skewed and the MARS Numerical Anxiety subscale was positively skewed, indicating that more responses were on the higher and lower ends of the distribution than normal, respectively. To ameliorate these skew statistics, individual z-scores were examined to find the most extreme outliers in the sample on these two constructs. There was one student who was over four standard deviations above the mean on the ATMI-Value subscale and two students who were more than two standard deviations below the MARS Numerical Anxiety. To keep as much of the data as possible, the largest outlier, the student who was more than four standard deviations above the ATMI Value mean, was deleted (Warner, 2013). Following deletion of this student, the ATMI Value subscale had a normal distribution, while the MARS Numerical Anxiety subscale still had a positive skew, though less than before outlier deletion. However, to preserve the data, no additional students were deleted. After deletion of these three students, the final sample consisted of 35 participants with an average age of 26. Reliability for each subscale remained above .70, with the exception of the MTEBI Outcome Expectancy Subscale that remained at .64, which were all acceptable reliability coefficients (George & Mallery, 2003). To examine preservice teacher's math self-efficacies, attitudes, and student outcome expectations and the relationships between each specific construct, two quantitative analyses were done. First, descriptive statistics were calculated to gain a profile of participants' self-efficacies, attitudes, and student outcome expectations toward math as indicated by their survey responses. These included z-scores, which provide a standardized way to compare and examine subscale calculations. Next, correlations between each subscale were calculated to understand if there were any relationships between these more specific attitudinal areas toward mathematics.

Means

Descriptives for each subscale can be found in Table One. In general, there was a noticeable spread in scores for the dependent variables, with somewhat large standard deviations. For most of the scales, the average scores were closer to the maximum than the minimum, with the exception of the MARS scales where teachers were closer to the lower end of the spectrum. The MARS Numerical Anxiety had the largest and smallest z-scores out of all of the subscales, at 2.56 and -.87, respectively. The lowest z-score was from the MTEBI Self Efficacy subscale at -2.59, with the ATMI Self-Efficacy subscale the second lowest at -2.03. Overall, these scores suggest that the preservice teachers generally had positive self-efficacies and low anxiety toward mathematics.

Table 1
Descriptives for Survey Subscales

Construct	*n*	Mean	*SD*	Min	Max	*z*-Min	*z*-Max
ATMI - Value	35	42.9	4.7	30	50	-1.87	1.22
ATMI - Enjoyment	35	35.7	9.3	19	50	-1.77	1.58
ATMI - Self-Efficacy	35	53.2	15.8	21	75	-2.03	1.40
ATMI - Motivation	35	16.5	4.8	7	25	-1.97	1.81
MTEBI - Self-Efficacy for Teaching	34	56.7	8.5	35	68	-2.59	1.35
MTEBI - Outcome Expectancy	35	30.7	3.8	23	37	-2.02	1.59
MARS - Test Anxiety	35	45.1	15.5	20	75	-1.65	1.88
MARS - Numerical Anxiety	33	24.6	10.8	15	52	-.88	2.57

Correlations

Correlations for the subscale scores are in Table 2. While almost all of the subscales had strong correlations with each other, one of the main findings was that the MTEBI Outcome Expectancy subscale did not have a relationship with any other subscale including the Teaching Self-Efficacy subscale on the same instrument. Additionally, the ATMI Value scale was not correlated with either of the MARS subscales. All other correlations were significant and in the anticipated directions, with MARS subscales negatively associated with all other responses and the remaining subscales positively correlated with each other.

Open-ended Response Questions

A breakdown of the most often cited keywords and topics is presented in Table Three. Looking at each question, a few key themes emerged. When describing what they felt were the best pedagogical techniques to teach children to understand and apply what they learn, most responses mentioned interactive and engaging techniques with ample student participation. Along those lines, a number of responses also mentioned group work, which is also interactive in that it provides students with opportunities to interact with their peers. In terms of how to help struggling students understand and feel comfortable with a math topic, there were 13 responses that math was a particularly difficult and complex subject to teach and help with, but that did not mention specific techniques for helping. When teachers did note techniques they thought would be helpful for students, they often mentioned techniques that were very guided, such as modeling for students and presenting examples. Looking at the next question, the overwhelmingly most cited response for what makes an effective teacher was patience, with almost half of respondents noting this trait. Many responses also focused on the importance of the teacher not only having a positive attitude, but also making sure the teacher encouraged the students as well. Many of the responses indicated that tests and quizzes were the most appropriate way to evaluate a student's understanding of math, but there were also almost as many responses noting that more applied work such as projects would be a good way to gauge student understanding. Some participants also noted that tests and quizzes were appropriate for figuring out a student's specific weaknesses to guide focused instruction where the student needed extra help, and that this type of focused assessment was a good reason for using such tests and quizzes.

Table 2

Subscale Correlations

	ATMI Enjoy	ATMI Motiv	ATMI - SE	ATMI Value	MARS TA	MARS NA[1]	MTEBI OE	MTEBI SE[2]
ATMI Enjoy	-	.91**[1]	.85**	.64**	-.53**	-.34 (.05)	-.02 (.89)	.71**
ATMI Motiv		-	.80**	.61**	-.42*	-.28 (.11)	.09 (.61)	.64**
ATMI SE			-	.52*	-.70**	-.44*	.07 (.70)	.65**
ATMI Value				-	-.10 (.56)	-.28 (.12)	-.01 (.94)	.54*
MARS TA					-	.45**	.07 (.67)	-.45*
MARS NA						-	.21[1] (.25)	-.41*[1]
MTEBI OE							-	-.05 (.98)
MTEBI SE								-

*Note: *Correlation significant at p = .05; **Correlation significant at p = .01*

[1]Due to missing responses, all MARS NA subscale correlations are with 33 participants

[2]Due to missing responses, MTEBI SE subscale correlations are with 34 participants (except for MARS NA statistic at 31 participants)

Table 3
Teachers' Self-Reported Explanations and Perceptions

General Themes (*n* = 35)	Specified Themes	# Times
Effective Strategies to Help Students Apply And Understand What They Are Taught	Interactive/participation/engaging/hands on/fun	31
	Math can be difficult/students are afraid of it	14
	Group work	13
	Variety instructional techniques	8
	Problem solving/real world applications	9
	Step by step explanations/demonstrating/practice/repetition	6
Best Ways to Help Struggling Students Learn And Feel Comfortable With Material	Math is complex/difficult	13
	Repetition/detailed instructions/examples/modeling	12
	Step by step	11
	One on one	8
	Manipulatives/hands on	7
	Modify/accommodate teaching/different ways teach subject	6
Qualities of Effective Teacher	Patience	16
	Positive attitude/encouraging	12
	Good at passing on knowledge/communication/simplifies topics	9
	Loves/cares about students	8
	Math is special and complex/difficult	7
Best Ways to Evaluate Students' Understanding Of Material	Tests and quizzes	22
	Problem solving/projects	17
	Get at student's specific weakness	9
	Informal assessments/observe students/ask questions	8

These responses indicate the participants' general self-efficacy expectations about important areas in math, such as teaching approaches and evaluating students, but they also provide some insight into areas of interest in the survey responses from Table Two. The most striking finding from the quantitative analyses was that the MTEBI Outcome Expectancy subscale was not significantly correlated with any other subscale, including the other subscale from the same instrument (Teaching Self-Efficacy). The correlations suggest that the preservice teachers felt that student outcomes from their teaching did not have any relationship with their own self-efficacy toward math, meaning that despite some participants' generally positive self-efficacy toward math and their own ability to teach math as indicated by the other MTEBI scale, they did not have strong expectations about subsequent student outcomes in math. One recurring theme in their open-ended responses was that this group felt that math was a difficult and particularly sensitive subject for many students, which may explain why they seemed skeptical about the relationship between their own efforts and their students' math outcomes. Within this theme, there were two main strands. The first one was that these preservice teachers put a lot of weight on how the teacher approached and taught the subject and that the stakes were particularly high for how they presented math. One participant stated: "Math is a very detailed subject that needs proper steps and if the teacher fails to provide the student with that step the whole lesson will be no longer validated which can result to the student picking up bad habits which will later be hard to correct." Responses indicated sentiments that the teacher is responsible not only for practicing high-quality mathematics pedagogy, but must also at the same time maintain a demeanor that is calm and encouraging. One participant stated:

> Teaching math is stressful but you should not let it affect the positive environment in your classroom. If the students see you stressed out while you teach math, they will get stressed with math because they really think of the teacher as a person that knows everything. If they see this person stressing then they will put the stress on themselves and they will think that they will never be able to master or fully understand this subject.

Despite these open-ended responses suggesting that these preservice teachers strongly emphasized the role the teacher has in preparing students to succeed academically and psychologically with learning mathematics, the participants' survey responses however indicated they did not associate these qualities with the other primary construct within the survey, namely student mathematics outcomes. So even when the participants had generally positive self-efficacy toward math and confidence in their ability to teach it, they still did not seem to associate these feelings with positive student outcomes in mathematics.

In the second strand of the open-ended responses, the preservice teachers indicated that they believed many students enter a classroom having already developed a negative attitude towards math, and that high-quality math instruction is needed to combat this negative perception of math. These preservice teachers felt that among all the subject areas, students were most likely to come to their classroom already afraid of math or frustrated with their experiences in math, and that helping students overcome these feelings was likely going to be a necessary part of teaching math effectively. One participant stated: "Because I think that there are more students that are afraid of math, I think you have to go about it differently in a way that doesn't scare the children and they aren't afraid to learn." Another participant stated: "Mathematics is a topic while [sic] future teachers have to be extremely careful when teaching many students are already afraid of mathematics when it comes to this subject." A third participant stated: "You have to have the right mind to work all those math problems! … Any other subject I think is not as complex as math is."

In describing what they had enjoyed and disliked about their own K-12 math education experiences as students, the participants noted that they had positive memories of teachers who had been responsive to answering questions as well as teachers that were fun to be around, and had negative memories of strict or difficult teachers who created or permitted a stressful student learning environment in the classroom. Some of the participants indicated they sometimes struggled with mathematics during their own childhood and wanted to avoid creating this same type of frustration in their students, with one participant stating: "I still to this date don't like math very much. I always have had much trouble with it so my experience there is not so well … When I become a teacher I will help my students in every way so they can learn without being frustrated and learn to love math in a way that will make them understand every competency being taught." Another stated that in such a case the teacher has a responsibility to combat this tendency in students when they teach:

> Some students already have a predetermined idea about math. If they go into already thinking 'I HATE MATH' or I am not going to understand this, they are already in a bad mindset. We need to remind students math can be fun… I think math sometimes needs the teacher to think more outside the box to come up with fun ways to teach math.

These preservice teachers' description of math education as (1) a particularly difficult subject to learn and therefore also difficult to teach, (2) with long-term negative student learning ramifications for poor teacher instruction, and (3) the belief that many students enter the classroom having pre-existing strong negative dispositions towards math from poor previous experiences, combine to provide a context for interpreting the quantitative findings showing a lack of correlation with the preservice teachers' MTEBI Outcome Expectancy subscale and any other subscale including the Teaching Self-Efficacy subscale on the same instrument. It is possible that these preservice teachers felt that students' math outcomes were independent of their teachers' efforts or generally positive self-efficacy toward math because of these reasons they discussed in their open-ended responses.

Discussion

This section will next tie the findings from this study back to the themes from the literature review, namely (a) the importance of undergraduate preservice elementary teachers' self-efficacies, attitudes, and student outcome expectations toward mathematics, and (b) the specific challenges facing Hispanic female undergraduate preservice elementary teachers. One of the main findings was that the MTEBI Outcome Expectancy subscale did not have a relationship with any other subscale including the Teaching Self-Efficacy subscale on the same instrument. Improving U.S. students' mathematics achievement requires developing high-quality mathematics teachers (Education Alliance, 2006), and yet these Hispanic female preservice elementary teachers self-reported that they do not correlate their own ability to teach math and their future elementary students actually learning math. This is a misconception that these future teachers carry, and an example of one of the specific challenges facing some Hispanic undergraduate preservice elementary teachers.

This discussion section will integrate the quantitative and qualitative results from the previous section, and use the qualitative findings to support an explanation of the quantitative findings. Overall, the quantitative results suggest that the Hispanic female preservice teachers generally had positive mathematics self-efficacies and low anxiety toward mathematics; yet they did not have congruently affirmative student outcome expectations. It is disconcerting that the participants' beliefs about actually impacting their students mathematics learning outcomes was not correlated with other positive indicators of a good mathematics teaching environment such as teacher's mathematics self-efficacy or teacher's lack of math anxiety. As discussed in the literature review section, numerous factors, as well as their interdependent interactions, have been shown to impact undergraduate students' attitudes towards math and math education (Christensen, 2002; de Freitas, 2008; Gunderson et al., 2012; Sadler & Tai, 2007; Tai et al., 2006). The persistence of math anxiety in both elementary teachers and students has proven to be a difficult nemesis to eradicate, and maintains position as a major barrier to math education engagement and motivation (Ashcraft, 2001; Ho et al., 2000; Sloan, 2010). Efforts to reduce students' math anxiety while increasing their math engagement have strived to connect the students' real-life interests with contextualized mathematics education (An, Capraro, & Tillman, 2013; Cohen et al., 2012; Slykhuis et al., 2012; Tillman et al., 2012; Tillman et al., 2011).

As discussed in the literature review, some of the challenges facing Hispanic female preservice elementary teachers such as low math teaching self-efficacy are typical of preservice elementary teachers (Bursal & Paznokas, 2006; Harper & Daane, 1998; White et al., 2006). But other challenges appear, at least within this sample, to be specific to the Hispanic demographic, as well as perhaps other minority demographics. It is possible that there is a "vicious cycle" wherein Hispanic elementary teachers with low math self-efficacy impart this negative belief to their Hispanic students. Other obstacles discussed earlier include, but are not limited to, a high percentage of this population is not native English speakers (as mentioned, over half the participants in this study were not native English speakers), and many of the members of this population are not full-time students since they have financial and family obligations that exclude that option (Gloria & Castellanos, 2012; Arana et al., 2011; Jones, Young, & Rodriquez, 1999). These additional stressors compound the obstacles facing a typical undergraduate student (Clark & Flores, 2001). An unexpected outcome of this compounding of obstacles is that, in confirmation of the hypothesis posited earlier, these combined stressors appear to cumulatively have an impact on Hispanic female preservice elementary teachers' mathematics teaching self-efficacy beliefs that differs from the norm in terms of established correlations between mathematical attitude constructs, specifically the belief that if they are competent math teachers their students will learn math. The empirical evidence in this article confirms that these teachers do not self-report this belief to be true, and in fact believe that their own teaching self-efficacy is not correlated with their students' math learning outcomes. One partial explanation might be displayed in the simple statement from one of the participants that: "Any other subject I think is not as complex as math is." This teacher's belief that the complexity of mathematics is greater than any other discipline is an incomplete, but important, facet of the problem but not a full explanation for why these participants did not correlate students' learning outcomes with other positive mathematics learning factors.

One preservice elementary student that participated in this study stated, regarding her own future elementary students, that: "Some students already have a predetermined [negative] idea about math." Clearly this statement also applies to some of the participants in this study as well, who themselves are students currently pursuing careers as future teachers. Their predetermined ideas about mathematics are biasing them towards a belief that they will not have positive student mathematics learning outcomes as teachers, even should they create positive mathematics learning environments. This is a detrimental belief that deserves addressing, and for this reason the remaining section of this paper will focus on an articulation of further research recommendations for studies that will address the primary finding of this study, namely that while most of the Hispanic female preservice elementary teachers' mathematics attitudes were significantly correlated in the anticipated directions, the MTEBI Outcome Expectancy subscale results were not significantly correlated with the other scales including the Teaching Efficacy subscale from the same MTEBI instrument.

Limitations and Recommendations for Further Research

Before addressing how findings from this study provide implications and directions for additional research, a few limitations should be noted. First, this study was performed with a population sampled from one geographic area and therefore generalizations may be limited. Additionally, the qualitative data were archival and logistics prevented follow up interviews from being performed after analyzing the written responses. Lastly, students self-selected into the classes from which study participants were drawn so there was not random selection of the participants. However even with all of these limitations, this study presented quantitative results combined with qualitative self-reported explanations demonstrating that participating Hispanic female preservice teachers generally had positive mathematics self-efficacies and low anxiety toward mathematics, but nonetheless did not have correspondingly favorable student outcome expectations.

This paper concludes with some recommendations for further research, and argues for deeper empirical study of why the Hispanic female preservice elementary teachers who participated in this study demonstrated a self-reported lack of positive correlation between high-quality mathematics educational environments and their future elementary students actually learning mathematics content. This is especially alarming since almost all of the other correlations, with the exception of the ATMI Value scales that was not correlated with the MARS subscales, were significant in the anticipated directions. That the participants did not display a belief in the capacity of high-quality mathematics educational environments to result in actual mathematics learning with their own future elementary students is a disconcerting finding, and invites further investigation.

Guidance as to where such research should initially focus is provided by the participants self-reported concerns about teaching mathematics, and specifically their beliefs that math education is a particularly difficult subject to learn and possibly the most difficult, that low-quality math instruction can have long-term detrimental impacts on a students ability to learn more advanced math, and that because of this many students will enter their classroom already having a negative attitude towards math. Further research addressing mechanisms for potentially alleviating these pedagogical impediments could focus on disentangling the illegitimate from legitimate aspects of these preservice teachers' concerns so that any misconceptions can be countered with professional development. As an example, research addressing preservice elementary teachers' beliefs about math education as a particularly difficult subject for students to learn might investigate interventions attempting to counteract this misconception through pedagogical preparation teaching high-quality developmentally appropriate math lessons to real elementary students. As a concluding thought, we hope this study encourages further inquiry into how the mathematics-related attitudes and concerns of preservice elementary teachers can provide guidance to research and development aimed at improving teacher preparation.

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