Elementary General and Special Education Teachers' Mathematics Skills and Efficacy

Margaret M. Flores
Auburn University

Jennifer Thornton
University of Texas at San Antonio

Toni M. Franklin
Columbus State University
Vanessa M. Hinton
Auburn University

Shaunita Strozier
Valdosta State University

Abstract

The purpose of this study was to extend the literature regarding elementary teachers' beliefs about mathematics instruction to include special education teachers by surveying special education and general education teachers' mathematics teaching efficacy. In addition, the researchers' surveyed teachers' mathematics skills. The participants (n=178) were pre-service elementary level general and special education teachers enrolled in two major state universities in the Southern United States. The participants completed surveys of K-6 mathematics content and completed the Mathematics Teaching Efficacy and Beliefs Instrument (MTEBI). A MANOVA was conducted to investigate the differences between pre-service general and special education teachers' mathematics computation skills, problem solving skills, personal mathematics teaching efficacy, and mathematics teaching outcome expectancies. Findings indicate differences in participants' outcome expectancies and problem solving performance. However, both groups of pre-service teachers performed similarly in the areas of computation and teaching efficacy. The results have implications for teacher preparation.

The ability to demonstrate mathematical skill is critical for individuals' success, accounting for variances in employment, income, and work productivity more so than intelligence and reading ability (Rivera-Batiz, 1992). Early mathematics skills lay the foundation for advanced mathematics performance (Houchins, Shippen, & Flores, 2010). Therefore, it is essential that all children receive quality mathematics instruction in the early grades. In an effort to promote quality instruction for all students, reform efforts such as implementation of the National Council of Teachers of Mathematics Standards (NCTM, 2000), the *No Child Left Behind Act* (2002), and the *Individuals with Disabilities Education Improvement Act* (2004) have emphasized standards for practice, promoted evidence-based instruction, and progress monitoring. Additionally, the National Mathematics Advisory Panel (2008) calls for continued improvement of pre-service teachers' knowledge and pedagogical skills in mathematics.

A framework that has been adopted by many states as a way of meeting the challenge of reform efforts is response to intervention (RTI). RTI is a multi-tiered intervention model that involves an interdisciplinary approach involving both general and special education. This model involves implementation of evidence-based practices and ongoing progress monitoring (Fuchs, 2003; Harris-Murri, King, & Rostenburg, 2006). RTI consists of instructional support for learning and is provided in levels called tiers which help students achieve educational goals, and become more specific and intensive depending on students' needs. RTI typically consists of three tiers of instruction (Hoover & Patton, 2008). Tier one is evidence-based core instruction that all students receive with progress monitoring occurring approximately three times a year. In tier one, all students, are provided evidence-based instruction in a general education classroom. Students who do not make adequate progress within the context or tier one receive tier two instruction. Tier two instruction is targeted interventions that address students' needs, provided through differentiated instruction within small groups of students in the inclusive setting by a general education teacher. Students who do not make progress in tier two are provided intervention support known as tier three. Tier three interventions are intensive, individualized, and are provided by someone who specializes in the student's area of need, often a special education teacher. Because of the multi-tiered approach to education and the various reforms that emphasize standards for practice, evidence-based instruction, and progress monitoring, both general and special education teachers must work as partners to meet the educational needs of all students. It is important for both general and special education pre-service teachers to have the knowledge and pedagogical skills to create effective partnerships and implement multi-tiered quality mathematics instruction for all students.

The implementation of these reforms and RTI are affected by the attitudes and beliefs of the teachers who implement them (Tschannen-Moran & Woolfolk, 2001). To explore this further, researchers have investigated elementary pre-service teachers' efficacy beliefs related to mathematics instruction. However, federal mandates related to student achievement include the progress of all students, including students with disabilities and require the special education teacher to be highly qualified in content knowledge. Thus it is important that research related to mathematics education examine special education teachers' efficacy in mathematics instruction. Specifically, special education teachers must be prepared in providing interventions for students at-risk for mathematics failure, and partnering with general education teachers in the implementation of tier one instruction. For students in tier two and tier three who need effective interventions in mathematical content, it is imperative that their teachers have adequate preparation to provide mathematics instruction. In addition, each school must show students with disabilities are making adequate yearly progress in the grade level curriculum required by the states. Therefore, it is important that special education teachers demonstrate competence in mathematical content as well as the attitudes and efficacy that are conducive to effective teaching for students who struggle in mathematics. There is a paucity of literature regarding mathematics teaching efficacy within the field of special education. However, the existing literature regarding mathematics efficacy of pre-service general education teachers can be used as a framework for exploration of the efficacy beliefs of special education teachers (Charalambous, Philippou, & Kyriakides, 2008; Gresham, 2009; Swars, Daane, & Giesen, 2006).

It is important to review the research related to pre-service teachers' mathematic teaching efficacy to gain insight that can improve teacher preparation and the quality of instruction for all students. Charalambous, Philippou, and Kyriakides (2008) studied the effect of field work on mathematics teaching efficacy. Eighty-nine pre-service general education teachers completing field experience in disciplines across grade levels and certification areas participated in the study. The researchers found that pre-service teachers' mathematics teaching efficacy changed during their field experience. Daily experiences teaching mathematics and interactions with mentors, tutors, peers, and children greatly influenced these changes. Mentor teachers had the greatest influence on pre-service teachers' mathematics teaching efficacy. The feedback from a well regarded mentor had the greatest impact on the pre-service teachers' efficacy beliefs. Additionally, a large discrepancy between the mentor's teaching style and beliefs and those of the pre-service teacher had a negative influence on mathematics teaching efficacy.

Although experiences during one's teacher preparation program may influence efficacy, perhaps pre-service teachers have certain traits or characteristics that influence their efficacy as well. Swars, Daane, and Giesen (2006) investigated the influence of mathematics anxiety on pre service teachers' mathematics teaching efficacy. Twenty-eight pre-service teachers enrolled in a mathematics methods course participated in the study. The participants completed the Mathematics Anxiety Rating Scale (Richardson & Suinn, 1972) and the Mathematics Teaching Efficacy Beliefs Scale (Enochs, Smith, & Huinker, 2000). Four participants participated in semi-structured interviews based on their high or low mathematics anxiety ratings. The rating scales and interviews showed that high anxiety was related to low mathematics efficacy.

Gresham (2009) extended Swars, Daane, and Giesen's (2006) research by surveying a larger group of pre-service elementary general education teachers who were enrolled in a mathematics methods course. The participants completed the Mathematics Anxiety Rating Scale (Richardson & Suinn, 1972) and the Mathematics Teaching Efficacy Beliefs Instrument (Enochs, Smith, & Huinker, 2000). A portion of the participants were interviewed. The researchers found that pre-service teachers who had lower mathematics anxiety had higher mathematics teaching efficacy. Both the quantitative and qualitative measures suggested that there was a negative relationship between mathematics anxiety and teaching efficacy beliefs.

Bates and Latham (2011) continued the line of research regarding pre-service teachers' mathematics teaching efficacy by investigating its relation to their mathematics knowledge. Eighty-nine early childhood pre-service teachers completed the Mathematics Self-Efficacy Scale, the Mathematics Teaching Efficacy Beliefs Instrument (Enochs, Smith, & Huinker, 2000) as well as the Illinois Certification Testing System Basic Skills Test. The researchers found the pre-service teachers who scored high on the basic skills test rated both their mathematics efficacy and their teaching efficacy higher than those achieved lower scores on the basic skills test.

Research has shown that teachers' mathematics efficacy is influenced by the amount of mathematics coursework (Chang 2009; Swacjamer et al., 2009), mentorship during pre-service field experiences, mathematics anxiety (Gresham, 2009; Swars, Daane, & Giesen, 2006), as well as level of mathematics knowledge (Bates & Latham, 2011. While the aforementioned studies provide insights pertaining to pre-service general educators' mathematics efficacy, they are missing information regarding the mathematics teaching efficacy of pre-service special education teachers. In addition, it is unknown whether there are differences between teaching efficacy of special education and general education teachers. This is significant because special education teachers at the elementary level provide mathematics instruction through their status as highly qualified teachers per the *No child Left Behind Act* (2002). The same concerns regarding the relationship between teaching efficacy and quality instruction should apply to all elementary-level teachers. The purpose of this study, then, is to investigate the mathematics teaching efficacy of elementary general education and special education pre-service teachers. In addition, this study seeks to extend the literature by investigating general and special education teachers' elementary-level mathematics content knowledge, exploring the relationship between the teaching efficacy and mathematics skills.

Method

Participants

The participants in this study consisted of 178 pre-service graduate and undergraduate students enrolled in either an elementary general or special education program. All participants were seeking initial elementary certification (kindergarten through grade six) and were chosen because the mathematics knowledge surveyed included content through the sixth grade level. The participants who were graduate students had undergraduate degrees in fields other than education and were seeking initial certification in special or elementary education. These students' course of study included the same course content requirements as the undergraduate participants, including coursework in elementary mathematics. The participants were enrolled in two public universities that were equivalent in size, one located within the Southwestern region and the other located in the Southeastern region of the United States. In addition, the teacher preparation programs within each university were equivalent in size. None of the participants were or had been employed as teachers; their only teaching experience involved field experiences within their preparation programs. The participants had completed field experiences in classrooms, but had not completed their internship or student teaching, meaning that none of the participants had been solely responsible for classroom instruction; they had observed and taught under the supervision of a cooperating teacher in the public schools. All of the participants had completed their programs' mathematics content requirements as well as methods courses in teaching mathematics to elementary level students. The general education participants' mathematics methods course had a field component in which pre-service teachers observed and taught in elementary mathematics classes. The special education participants' methods course did not involve a mathematics field experience component as part of the course; the participants' concurrent field experience was in a special education setting in which mathematics may have been one of the instructional areas. Of the students participating in the study, 64% (n = 113) identified themselves as future general educators, while 36% (n = 65) identified themselves as future special educators. Within teacher preparation programs at each university, the size of special education programs as compared to general education programs is equivalent or smaller than the proportion within this study. In addition, the proportion of elementary general education teachers (1,655,800) to special education teachers (459,600) in the United States is slightly less than 3:1, according to the Bureau of Labor and Statistics (2012). Gender demographics were 6% (n=11) male, 94% (n=167) female. Demographic information associated with cultural background were 5% (n=9) African American, 16% (n=28) Latina/Latino, 76% (n=136) White, 2% (n=3) Asian, and 1% (n=2) Other. The participants' ages fell into the following categories: 18-20 years (20%, n=36), 21-29 years (59%, n=105), 30-39 years (12%, n=21), 40-49 years (7%, n=12), and 50-59 years (2%, n=4). The demographic data are summarized in Table 1.

All of the participants in this study were seeking teacher certification at the elementary level within their respective states. The pre-service special education teachers were seeking an additional certification in special education. Therefore, the two groups were comparable since both groups would be considered highly qualified to teach mathematics to students at the elementary level after completion of their programs.

Survey Instruments

Computational knowledge for this study was surveyed using the *Math Operations Test-Revised* (MOT-R)(Fuchs, Fuchs, Hamlett, & Stecker, 1991). The MOT-R measures mathematical operations skills through the sixth grade level. The MOT-R is correlated ($r = .78$) with the computation sub-test of the *Stanford Achievement Test* (Fuchs et al.). This instrument was chosen based on the number of items related to each skill. Rather than one item per skill, the participants had multiple opportunities to demonstrate each computational skill.

Mathematical problem solving skills were surveyed using the *Math Concepts and Applications Test* (MCAT) (Fuchs et al., 1994). The MCAT measures mathematical reasoning through the sixth grade level. The items survey knowledge of number concepts, numeration, applied computation, geometry, measurement, charts and graphs, and word problems. The criterion validity of the MCAT with the Concepts of Number subtest of the *Stanford Achievement Test* was .80 and the internal consistency reliability was .92 (Fuchs et al.). This test was chosen based on the variety of skills assessed and the format of the instrument.

The survey packet also included a questionnaire, eliciting demographic information and a mathematics teaching efficacy scale. Participants were asked to identify the following: their (a) age; (b) cultural background; and (c) area of future certification. The participants also completed the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs, Smith, & Huinker, 2000). The MTEBI consists of twenty-one items, thirteen on the Personal Mathematics Teaching Efficacy subscale and eight on the Mathematics Teaching Outcomes Expectancy subscale (Enochs, Smith, & Huinker). The Personal Mathematics Teaching Efficacy subscale relates to pre-service teachers' beliefs in their individual capabilities to be effective mathematics teachers. The Mathematics Teaching Outcomes Expectancy subscale relates to pre-service teachers' beliefs that effective teaching can bring about student learning regardless of external factors. The MTEBI uses a Likert scale with five response categories: strongly agree, agree, uncertain, disagree, strongly disagree. Possible scores range from 13-65 on the Personal Mathematics Teaching Efficacy subscale. Possible scores on the Mathematics Teaching Outcomes Expectancy subscale range from 8-40. Higher scores are indicative of stronger efficacy beliefs. Reliability analysis produced an alpha coefficient of 0.88 for the Personal Mathematics Teaching Efficacy subscale and 0.75 for the Mathematics Teaching Outcomes

Expectancy subscale (Enochs, Smith, & Huinker). Confirmatory factor analysis indicated that the two subscales are independent, adding to the construct validity (Enochs, Smith, & Huinker).

Procedures

The surveys and questionnaire were distributed and completed by graduate and undergraduate students enrolled in general education and special education courses specific to methods within each major. The participants volunteered for the study and completed the background questionnaire at the beginning of a class meeting. The background questionnaire and MTEBI were completed first so that the mathematics tasks within the problem solving and computation survey did not interfere with the participants' METBE ratings. At the next class meeting, participants completed the computation and problem solving surveys using pencil and paper. No time limit was assigned, but surveys were completed in an average of 30 minutes. The order of the computation and problem solving surveys were counterbalanced so that half of the participants completed computation first and the other half completed problem solving first.

Data Analysis and Results

A Multivariate Analysis of Variance (MANOVA) was conducted using the Statistical Package for the Social Sciences (SPSS) version 20. A MANOVA was chosen for this analysis because there were multiple dependent variables and a MANOVA simultaneously tests two or more related dependent variables while controlling for the correlations among the dependent variables (Mertler & Vannatta, 2005). The independent variable was certification, general or special education certification. The dependent variables were: (a) the percent correct scores in computational, (b) percent correct scores in problem solving, (c) ratings on the Personal Mathematics Teaching Efficacy (PTME) Scale, and (d) ratings on the Mathematics Teaching Outcomes Expectancy (MTOE) Scale.

The results of the MANOVA indicated significant differences for certification area, Wilk's $\Lambda = 0.937$, $F(4, 171) = 2.9$, $p < .05$. Univariate analysis indicated that Mathematics Teaching Outcome Expectancy and problem solving performance differed based on certification. ANOVA results for MTOE were $F\ (1, 174) = 4.66$, $p<0.05$, and for problem solving were $F\ (1, 174) = 4.9$, $p<0.05$. General education pre-service teachers indicated higher outcome expectancy, whereas special education pre-service teachers had higher problem solving scores. There was no significant effect between general education and special education with regard to Personal Mathematics Teaching Efficacy or computation performance. The means and standard deviations are summarized in Table 2.

An additional analysis was conducted to examine the relationship for both general education and special education pre-service teachers' level of efficacy and their mathematics skills. The pre-service teachers' teaching efficacy scores were divided into three groups (PTME of 38 or less, PTME of 39-51, and PTME of 52 or more) and their outcome expectancy scores were divided into three groups (MTOE of 24 or less, MTOE between 25 and 31, and MTOE of 32 or more). A multivariate analysis of variance was conducted to determine differences among computation and problem solving skills as related to level of PTME and level of MTOE. Differences were found for PTME, Wilk's $\Lambda = 0.927$, F (4, 336) = 3.23, p<0.05. ANOVA results indicate that there are differences in computation and problem solving skills based on all participants' PTME scores with computation F (2, 169) = 4.22, p<).05 and problem solving F (2, 169) = 4.08, p<0.05. Post Hoc analyses show that participants with lower scores (PTME less than 38) demonstrated lower computation and problem solving scores (Tukey HSD, $p < .05$). Therefore, both special and general education pre-service teachers who indicated a lower level of perceived teaching efficacy had lower scores for computation and problem solving skills compared to pre-service teachers who indicated higher levels of perceived teaching efficacy. There were no significant differences in computation or problem solving scores based on general and special education pre-service teachers' perceived level of mathematic teaching outcome expectancies. The means and standard deviations for calculation and problem solving based on efficacy are summarized in Table 3.

Discussion

The purpose of this study was to extend previous research regarding mathematics teaching efficacy to include special education teachers and investigate differences in pre-service teachers' content knowledge or skills. The inclusion of special education teachers into this line of research is needed since special education teachers' responsibilities have changed over the past decade with increased expectations for achievement for students with disabilities and changes in intervention models (e.g., RTI) for students at risk for failure. The participants in this study demonstrated their knowledge of mathematics computation and problem solving skills within content ranging from the kindergarten level to the sixth grade level. In addition, the participants completed the MTEBI, rating their mathematics teaching efficacy and outcomes expectancy.

Mathematics Efficacy and Outcome Expectancy

This study extended the research of Swars, Daane, and Giesen (2006) and Gresham (2009) by including pre-service elementary special education teachers. The participants in the current study rated their teaching efficacy on a scale from 13 to 65 (mean=51.2) and outcome expectancy with a scale from 8 to 40 (mean=29.5) similarly to the ratings obtained by Swars, Daane, and Giesen (teaching efficacy mean=48.9 and outcome expectancy mean=29.1) and Gresham (teaching efficacy mean=50.8 and outcome expectancy mean=31.4). In the current study, there was no statistically significant difference in general and special education teachers' mathematics teaching efficacy. Both groups of teachers reported similar levels of teaching efficacy (51.8 by general education and 50.0 by special education). There was a statistically significant difference between pre-service teachers' teaching outcome expectancy, general education being higher (mean=30. 0) than special education (28.7). However, the difference in scores was less than two points and it is not clear that this is a socially valid difference. This may indicate that there is a slight difference between general education and special education teachers' beliefs that their students will be successful when provided with effective mathematics instruction. The pre-service special education teachers who participated in this study were completing a generic program in which they were prepared to teach children with high incidence as well as low incidence disabilities who participate in the general education curriculum to varying degrees. The slight difference may indicate that pre-service special education teachers believe that factors other than effective instruction may influence their students' mathematics performance. If statistical difference truly reflects a real difference, pre-service special education teachers may perceive disabilities as factors that influence performance to a somewhat greater extent than effective mathematics instruction. This speculation seems contrary to the beliefs one might expect from pre-service special education teachers. One might expect future special education teachers to advocate for individuals with disabilities and expect that effective and intensive instruction would result in positive student outcomes.

Another explanation of the difference may be program preparation. The coursework related to mathematics in both special education and general education was similar; however, there was a difference in focused fieldwork. General education pre-service teachers completed a focused field experience related to teaching mathematics as part of their methods course and special education pre-service teachers' field experiences are not split by content area. Perhaps experience in an elementary mathematics classroom has an impact on one's teaching outcome expectancy since this is an opportunity to observe outcomes related to teaching methods.

Computation and Problem Solving Performance

The computation skills assessed represented the content that these future teachers will teach to children in schools. There was no statistically significant difference in the mathematics computation performance of general (77% correct) and special education (79% correct) pre-service teachers. There was no difference in participants' performance and this may be a reflection of their preparation. One might expect that general education pre-service teachers' focused field experience might perform differently; however, computation skill may be related more closely with other types of mathematics coursework which did not differ between groups.

Approximately 10% of the participants' computation scores were at or above 90% correct. The computation items that appeared to the be the most difficult, based on errors were: (a) operations such as addition, subtraction, multiplication of fractions and mixed numbers with like denominators (failure to attend to the whole number); (b) adding fractions with unlike denominators (adding both the numerator and denominator or cross multiplying); (c) multiplying decimals (aligning decimals and bringing them straight down to the answer, e.g., 3.25X1.52=949.00); and (e) dividing decimals. Division of decimal numbers appeared to be the most difficult since many responses consisted of series of question marks or comments such as the exclamation, "I don't know!" These computation items represent more complex skills which are similar to the skill areas that are difficult for children, as reported by research related to student achievement (Cawley, Parmar, Foley, Salmon, & Roy, 2001). It is crucial that all elementary teachers can effectively deliver instruction in skills that provide the basis for advanced mathematics study. One might argue that the ability to complete complex computation, such as the division of decimals, would be a pre-requisite for effective instruction of decimals.

Contrary to computation performance, there was a statistically significant difference between general education (80% correct) and special education (84% correct) pre-service teachers' problem solving performance. This finding is contrary to the similarities and differences in preparation between groups described above. Mathematics content coursework is similar and general education pre-service teachers participate in more focused mathematics field work. Therefore, one might expect this group to perform as well or better than their peers in special education programs. Although special education pre-service teachers performed better than their general education peers, there were similar error patterns across groups. The most difficult items appeared to be: (a) adding standard units of measurement with regrouping (failure to regroup as evidenced by an answer such as 2 yards, 4 feet, and 16 inches); (b) determining the volume of a cube when given the measurements of the height, base length, and base width; and (c) solving a word problem involving multiple steps and multiple operations (inappropriate choice of operations or failure to attend to the need for an operation).

The findings related to mathematics skills show that pre-service special education teachers' mathematics skills are similar to, or slightly better than, those of their general education peers. This is contrary to past criticisms of special education teachers' content knowledge (Brownell, Sindelar, Kiely, & Danielson, 2010). Perhaps these results reflect the changes in special education preparation programs over the past decade, emphasizing content preparation and general education certification at the elementary level. Perhaps the results are reflective of the expansion of content knowledge general educators are responsible for covering as evidenced by the addition of grade levels in some elementary and early childhood state certificates.

It is important to include special education teachers in the research related to effective mathematics instruction and related areas, such as skill and efficacy because they receive certification that qualifies them to teach mathematics content. Due to reforms and RTI, both elementary and special education teachers' responsibilities go beyond collaboration. In a particular, elementary and special education teachers provide interventions to students with and without disabilities through the RTI model. This study is an initial investigation into the skills and efficacy of special education pre-service teachers and it is promising that this group of future teachers demonstrates skill and efficacy similar to their general education peers.

Limitations and Suggestions for Future Research

Results of the current study have limitations. The majority of the sample came from just two geographical regions of the country; therefore, the results may not be representative of the whole country. All of the participants in this study were enrolled in a traditional teacher preparation program, thus the results may not be as realistic because measures were not taken from individuals enrolled in alternative certification programs. In particular, special education is known to struggle with personnel shortages. Due to personnel shortages, the inclusion of pre-service teachers enrolled in alternative certification programs may provide a more realistic measure of competence and efficacy within the field of special education. It is possible that a more inclusive sample of pre-service special education teachers would yield different results. Perhaps individuals within alternative programs would perform differently because their preparation is brief which might lead to lower efficacy (Tissington & Grow, 2007).

Another limitation of this study is its failure to address pre-service teachers' pedagogical knowledge. It is unknown how the participants would have organized instruction related to the computation and problem solving skills assessed. Furthermore, it is unknown how the participants' content knowledge, teaching efficacy, and pedagogical knowledge are related.

Continued investigation is needed with regard to secondary mathematics content as this study addressed only skills from elementary content. For example, this content could include algebra, geometry, and other areas of mathematics included on high school exit exams. It is not known how general education and special education teachers at the secondary level fare with regard to mathematics efficacy and teaching outcome expectancies. This information would inform current practices, especially with the increased focus on cooperative teaching and requirements of highly qualified status for special education teachers.

Future Research

In order to address some of the limitations of this study, future research might investigate the mathematic skills and efficacy across other regions. Since participants in this study were enrolled in large state universities, future research should include university sites of different sizes and missions. In addition, the inclusion of different types of teacher preparation programs, including alternative certification programs, would also provide a more accurate characteristics.

The current study investigated special education and general education pre-service teachers' skill and efficacy; however, it is not known how pre-service teachers might actually design and implement mathematics instruction. Teachers' instructional practices and instructional interactions with students are a more critical component of improved mathematics achievement of children within our schools. With increased expectations for achievement associated with the *No Child Left Behind Act* (2002), especially for students with disabilities, it is critical that teachers provide effective instruction in the area of mathematics. Future research might explore pre-service teachers' explanations of how they would approach instruction of a particular mathematics task or concept. The inclusion of a qualitative component to this line of research might shed more light on how skill and efficacy relate to instructional practice(s). In addition, the demonstration of evidence-based practices could be investigated with respect to pre-service teachers' skill and efficacy. For example, observations of culminating field experiences could be included in future investigations. Another area of investigation might include the relationship between teachers' mathematics skills and their students' mathematics progress and achievement. Future research might investigate the performance of students as it relates to their teachers' skill and efficacy. Finally, future research could investigate specific skill areas, since the pre-service teachers in this study demonstrated consistent patterns of errors. More emphasis in these areas during preparation programs could address these weaknesses.

References

Bates, A. B., & Latham, N. (2011). Linking pre-service teachers' mathematics self-efficacy and mathematics efficacy to their mathematical performance. *School Science and Mathematics, 111*(17), 325-333.

Brownell, M. T., Sindelar, P. T., Kiely, M. T., & Danielson, L. C. (2010). Quality and preparation: Exposing foundations, constructing a new model. *Exceptional Children, 76,* 357-377.

Bureau of Labor Statistics, U.S. Department of Labor (2012). *Occupational Outlook Handbook, 2012-13 Edition,* Special Education Teachers. Retrieved from: http://www.bls.gov/ooh/education-training-and-library/special-education-teachers.htm

Bureau of Labor Statistics, U.S. Department of Labor (2012). *Occupational Outlook Handbook, 2012-13 Edition*, Kindergarten and Elementary Teachers. Retrieved from: http://www.bls.gov/ooh/education-training-and-library/kindergarten-and-elementary-school-teachers.htm

Cawley, J., Parmar, R., Foley, T. E., Salmon, S., & Roy, S. (2001). Arithmetic performance of students: Implications for standards and programming. *Exceptional Children, 67,* 311-328.

Chang, Y. (2009). A case study of elementary beginning mathematics teachers' efficacy development. *International Journal of Science and Mathematics Education, 8,* 271-297.

Charalambous, C. Y., Philippou, G. N., & Kyriakides, L. (2008). Tracing the development of pre-service teachers' efficacy beliefs in teaching mathematics during fieldwork. *Educational Studies in Mathematics*, *67*, 125-142.

Enochs, L. G., Smith, P. L., & Huinker, D. (2000). Establishing factorial validity of the Mathematics Teaching Efficacy Beliefs Instrument. *School Science and Mathematics, 100,* 194-203.

Fuchs, L. S. (2003). Assessing intervention responsiveness: conceptual and technical issues. *Learning Disabilities Research and Practice , 18,* 172-183.

Fuchs, L. S., Fuchs, D. , Hamlett, C. L. ,& Stecker, P. M. (1991). Effects of curriculum-based measurement and consultation of teacher planning and student achievement in mathematics operation. *American Educational Research Journal, 28*, 617-641.

Fuchs, L. S. , Fuchs, D. , Hamlett, C. L. , Thompson, A. , Roberts, P. H., & Kubek, P. (1994). Technical features of a mathematics concepts and applications curriculum-based measurement system. *Diagnostique*, *19*(4), 23-29.

Gresham, G. (2009). An Examination of mathematics teacher efficacy and mathematics anxiety in elementary pre-service teachers. *Journal of Classroom Interaction*, *44*(2), 22-38.
Harris-Murri, N., King, K., & Rostenburg, D. (2006). Reducing disproportionate minority respresentation in special education programs for students with emotional disturbances: toward a culturally responsive response to intervention model. *Education and Treatment of Children , 29*, 779-799.

Hoover, J. J. & Patton, J. R. (2008). The role of special educators in a multitiered instructional system. *Intervention in School & Clinic,* 43, 195-203.

Houchins, D. E., Shippen, M. E. , & Flores, M. M. (2010). Math assessment and instruction for students at-risk. In R. Colarusso, & C. O'Rourke (Eds.), *Special education for all teachers*. Dubuke, IA: Kendall/Hunt.

Individuals with Disabilities Education Improvement Acts of 2004, Pub. L. No. 108-446, 118 Stat. 2647 (2004) (amending 20 U. S. C. §§ 1440 et seq.).

Mertler, & Vannatta (2005). Advanced and Multivariate Statistical Methods Practical Application and Interpretation. 3rd edition. Glendale, CA: Pyrczak Publishing

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the national mathematics advisory panel*. Washington, DC: U.S. Department of Education.

Richardson, F. C. , & Suinn, R. M. (1972). The mathematics anxiety scale: Psychometric data. *Journal of Counseling Psychology*, *19*, 551-554.

Rivera-Batiz, F. L. (1992). Quantitative literacy and the likelihood of employment amoung young adults in the United States. *The Journal of Human Resources*, *27*, 313-328.

Swars, S. L. , Daane, C. J., & Giesen, J. (2006). Mathematics anxiety and mathematics teacher efficacy: What is the relationship in elementary pre-service teachers? *School Science and Mathematics,106*(7), 306-315.

Tissington, L. D., & Grow, A. (2007). Alternative certified teachers and students at risk. *Preventing School Failure, 51*(2), 23-27.

Tschannen-Moran, M., & Woolfolk, Hoy A. (2001). Teacher efficacy: capturing an elusive construct. *Teaching and Teacher Education*, *17*, 783–805.

U. S. Department of Education. (2002). *No Child Left Behind: A desktop reference.* Washington, DC: Author.

Table 1. *Participant Personal Demographic Information*

Gender	
Male	11
Female	167
Cultural Background	
African American	9
Latino/Latina	28
White	136
Asian	3
Other	2
Age	
18-20 years	36
21-29 years	105
30-39 years	21
40-49 years	12
50-59 years	4

Table 2.
Means and Standards Deviations Mathematics Efficacy and Knowledge Surveys

Survey	Preservice Teachers	Mean	Standard Deviation
Perceived Teaching Efficacy	General Education	51.84	7.10
	Special Education	50.03	7.94
Outcome Expectancy	General Education	30.01*	3.97
	Special Education	28.68	3.79
Percent Correct Computation	General Education	76.71	10.28
	Special Education	78.79	9.67
Percent Correct Problem Solving	General Education	80.19	11.60
	Special Education	83.90*	8.78

* statistically significant at .05

Table 3.
Means and Standards Deviations of Computation and Problem Solving Scores Based on Efficacy

Efficacy Levels	Computation Mean	Computation Standard Deviation	Problem Solving Mean	Problem Solving Standard Deviation
PMTE scores 52 and Above	77.47	10.56	82.29	10.72
PMTE scores 39 to 51	78.23	9.13	81.62	9.56
PMTE scores 38 and Below	70.17*	11.33	74.50*	15.28
MTOE scores 32 and Above	75.67	12.12	80.03	12.17
MTOE scores 25 to 31	77.77	9.03	81.68	9.86
MTOE scores 24 and Below	79.71	8.77	84.95	9.75

* statistically significant at .05