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An Investigation into Pre-service Special Education Teachers' Mathematical Skills, Self-Efficacy, and Teaching Methodology

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Abstract

The purpose of this mixed method study was to investigate future special education teachers' preparation for effectively teaching mathematics. During the last semester of their program, pre-service special education teachers completed elementary level mathematics computation and problem solving assessments, a mathematics efficacy beliefs survey, and an open-ended question about their teaching methods. The assessments were analyzed using qualitative and quantitative methods. Analysis revealed that participants who described their instruction as solely procedural in nature rated their teaching outcome expectancies lower and achieved lower computation scores than other participants. The results and their implications will be discussed.

Introduction

In response to low levels of student achievement, the No Child Left Behind Act (NCLB, 2002) holds schools accountable for the adequate achievement of all students, including students with disabilities. To support this expectation, each state has defined "adequate yearly progress" (AYP) to measure achievement. These AYP standards are primarily based on state assessment results, but include high school graduation rates and school attendance rates. Evaluations of AYP must include the progress of the majority (95%) of students with disabilities included in AYP assessment. In addition to the requirements of NCLB, teachers serving students with disabilities must adhere to the regulations of the Individuals with Disabilities Education Improvement Act (IDEIA, 2004), ensuring that students with disabilities receive access to the general education curriculum and meet AYP standards. Although it is difficult to identify a causal relationship, teachers' content knowledge, methodological training, and education are critical features in promoting student achievement (Kamil, 2003). Studies have shown that teachers with deficits in mathematical content knowledge are less likely to effectively teach mathematics (Bray, 2011; Ma, 2010). Additionally, Hill, Rowen, and Ball (2005) found the higher the mathematical content knowledge of the teachers, the higher the achievement of their students.

Content Knowledge

When teaching mathematics, teachers need to have a strong foundation in the content they will teach referred to as content knowledge (National Mathematics Advisory Panel [NMAP], 2008). Heck et al., 2011 explain the understanding of the content that a teacher possesses directly impacts the instruction they provide in the classroom (Heck et al., 2011). This is a very important issue regarding instruction for students who are diverse because Maccini, Gagnon, & Calvin (2002) find that a significant number of special education teachers were not familiar with the goals of the National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics (2000). When teachers cannot make reference to Principles and Standards for School Mathematics it conveys a lack of understanding of content knowledge. This is a concern because special education teachers are responsible for providing mathematics instruction using general education standards such that students with disabilities make adequate progress according to NCLB (2002) and the IDEIA (2004). Additionally, special education teachers may be responsible for providing mathematic instruction within the response to intervention (RTI) model, assisting general education teachers in differentiating instruction and working directly with students who do not have disabilities.

Mathematics Efficacy Beliefs

Bandura (1994) described self-efficacy and the belief that one can achieve a certain outcome by accomplishing a specific behavior. Self-efficacy more specifically examines a teacher's belief in his/ her ability personally and the ability of all teachers to bring about student learning (Enochs, Smith, and Huinker, 2000). Mathematics efficacy beliefs have been correlated with mathematics anxiety (Swars, Daane, & Gieson, 2006), instructional practices (Swars, 2006; Wenta, 2000). Teachers with low teaching self-efficacy are more likely to use strategies such as lecture, worksheets, and reading from the text (Enon, 1995). Understanding mathematics efficacy beliefs have potential to influence teacher and student success.

Pre-service and Early Career Teachers' Preparedness

Teacher preparation programs lay the foundation for future teachers. Coursework and field experiences are ways to improve special education pre-service teachers' content knowledge (Thames, 2006), pedagogical knowledge (Ma, 2010), and efficacy beliefs (Burton, 2012). Teacher development programs have designed mathematics content classes for elementary preservice teachers that teach the content through reform methods that stress problem solving and reasoning (Cooney & Wiegel, 2003; Thames, 2006). However, rarely are these content courses taken by pre-service special education teachers (Kamil, 2003).

Flores, Patterson, Shippen, Hinton, and Franklin (2010) investigated preparedness with regard to content knowledge using quantitative methods and included special education teachers as well a general education teachers. They compared the performance of elementary and middle level general education and special education teachers. Teaching preparedness was measured using curriculum-based assessments of mathematics K-6 content. In addition, the researchers asked participants whether they felt prepared to teach mathematics to students with disabilities.

Participants included pre-service and in-service graduate and undergraduate teachers at the elementary (K-6) or middle (4-8) levels. Middle level teachers reported greater perceived teaching competence than their elementary level peers. In addition, middle level teachers showed

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higher scores in computation skills with no significant differences between elementary and middle level teachers for problem solving skills. Participants indicating higher levels of competence in teaching mathematics showed higher scores in problem solving skills with no significant differences between perceived competence and their computation scores. No significant differences were found between general education and special education teachers across content knowledge and perceived competence.

There is literature related to measures of content knowledge, mostly with general educators; however, little is known about the self-efficacy and information regarding pedagogical knowledge of pre-service special education teachers. The purpose of this study was to extend previous research in the area of special education pre-service teachers' mathematics skills and self-efficacy by adding a component with regard to mathematics teaching methods. Specifically, the researchers sought to answer the following questions: (a) how would pre-service special education teachers rate their mathematics self-efficacy? (b) how would pre-service special education teachers perform on elementary level curriculum-based assessments used to measure students' achievement of mathematical content?, (c) how would pre-service special education teachers describe their teaching methodology when given an elementary level mathematics concept, and (d) how are mathematics skills and self-efficacy related to teaching methodology?

Methods

Setting and Participants

The setting was a large state university in the Southeastern United States. The surveys were administered within a weekly class meeting connected to student teaching. This was the last course required before graduation from an undergraduate teacher preparation program in non-categorical special education. The thirty-three participants were pre-service teachers who had completed all required coursework, completed 360 hours of field work, passed a national certification exam in the area of elementary level general education, and were engaged in a semester-long internship in which participants taught full-time under the guidance of a cooperating teacher within the public schools and a university supervisor. All of the participants would exit the program as highly qualified special education teachers who could teach content at the elementary level (K-6) and could co-teach content at the secondary level (6-12). In addition, the participants were prepared to teach students who participated in the general education curriculum as well as children who participated in an alternate curriculum based on the general education curriculum. The participants' demographic information was as follows: 97% female, 97% white, 3% African American, and 100% between the ages of twenty-one and twenty-nine.

Data Collection

Data were collected through written questionnaires and surveys. Questionnaires and surveys were administered within a university course over a span of three class meetings. The demographic data and self-efficacy data were collected during the first meeting. Mathematics knowledge data were collected during another class meeting. Qualitative data related to teaching strategies were gathered during a third class meeting.

***Qualitative data collection*.** Data regarding participants' teaching methods were collected through a written question that asked how participants would teach the concept of regrouping in writing. The question was: "You are charged with teaching students how add and subtract with regrouping. Teaching this concept will take time and involve multiple lessons. However, on attached pages, describe the steps that would be needed to teach this concept. In addition, mention any materials or resources that might be needed to teach this concept." The data was analyzed using constant comparison method (Strauss and Corbin, 1998). Each response was coded individually by researchers and then checked for inter-rater reliability. The codes were grouped into broader concepts.

Quantitative data collection. Data related to participants' self-efficacy for teaching mathematics were collected using the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs, Smith, & Huinker, 2000). The MTEBI includes twenty-one items, thirteen on the Personal Mathematics Teaching Efficacy subscale and eight on the Mathematics Teaching Outcomes Expectancy subscale (Enochs, et al.). The Personal Mathematics Teaching Efficacy subscale measures teachers' beliefs in their individual capabilities to be effective mathematics teachers. The Mathematics Teaching Outcomes Expectancy subscale measures teachers' beliefs that effective mathematics teaching can result in student learning despite external factors. The MTEBI uses a Likert scale with five response categories: strongly agree, agree, uncertain, disagree, and 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 on the subscales are indicative of stronger self-efficacy and expectancy 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, et al.). Confirmatory factor analysis indicated that the two subscales are independent (Enochs, et al.).

Data related to participants' math skills were collected using the Math Operations Test-Revised (MOT-R) (Fuchs, Fuchs, Hamlett, & Stecker, 1991) and the Math Concepts and Applications Test (MCAT) (Fuchs, et al., 1994). The MOT-R measures mathematical operations skills using multiple examples of computation 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.). The MCAT measures mathematical reasoning skills including number concepts, numeration, computation, geometry, measurement, charts and graphs, and word problems through the sixth grade. The criterion validity of the MCAT with the Concepts of Number subtest of the Stanford Achievement Test is .80 and the internal consistency reliability is .92 (Fuchs, et al.).

Data Analysis

Qualitative analysis. The findings related to pre-service teachers' instructional methods emerged into themes or subcategories as the researchers analyzed the open-ended survey data. The analysis was conducted by two researchers with expertise in the area of teaching mathematics to students with disabilities. Three major themes emerged: unfounded/unclear instructional procedures, conceptual strategies. Within these themes, the sub-categories of activation of prior knowledge, graduated guidance, and independent practice were identified as codes that were specific strategies. Two researchers analyzed the participants' responses independently and compared their findings. Overall, there was 96% agreement between researchers with regard to responses within the three themes and three sub-categories. There was 100% agreement for the unfounded/unclear instructional procedures theme. For the conceptual knowledge theme, there was 88% agreement. There was 100% agreement for the procedural knowledge theme. For activation of prior knowledge sub-category, there was 100% agreement. Agreement was 85% for the graduated guidance sub-category. Finally, the agreement for independent practice was 100%. For those themes and categories where there was not 100% agreement, researchers met and discussed discrepancies and reached consensus. Once these data were analyzed and major themes emerged, the researchers focused more closely on specific themes. There were a total of twenty-three out of the thirty-three participants who described how to teach a lesson regarding regrouping. Ten participants responded to the open-ended question with answers that were short, vague, and lacking in logic based on the question. These responses consisted of one sentence; therefore, interpretation was difficult. An example of this type of response to highlight the difficulty of interpretation was, “I would tape place values to the students’ desks.” These responses were coded as unfounded/unclear instructional procedures.

Within the major themes that reflected over-all approaches to instruction, the researchers found common instructional methods or components which were considered to be sub-categories. These sub-categories were activation of prior knowledge, graduated guidance, and independent practice. The subcategory of prior knowledge encompasses references to “prerequisite” knowledge. The subcategory of graduated guidance encompasses how teachers scaffold instruction in a way in which students move from dependence on others to independent demonstration of the skill. The subcategory of independent practice encompasses instruction without teacher involvement or guidance. More descriptions depicting each subcategory are provided in the results section.

Quantitative analysis. The three major themes (conceptual, procedural, and unfounded) were analyzed statistically with regard to participants’ computation, problem solving, and self-efficacy scores. The statistical procedure was a one-way multivariate analysis of variance (MANOVA), conducted using the Predictive Analytics SoftWare (PASW) version 18.0. The independent variable was instructional focus, which had three levels: conceptual instructional focus, procedural instructional focus, and unfounded/unclear instructional procedures. The dependent variables were: (a) the percent correct in computation, (b) percent correct in problem solving, (c) ratings on the Personal Mathematics Teaching Efficacy Subscale, and (d) ratings on the Mathematics Teaching Outcomes Expectancy Subscale.

Results

Qualitative Findings

Themes. Themes regarding overall approach to instruction emerged based on the descriptions of instruction as well as materials that would be used for instruction. The themes were conceptual strategies, procedural strategies, and unfounded/unclear strategies. Each are described below and summarize in Table 1.

Table 1.
Number of Responses by Theme and Sub-category

	Total Number	Activate Prior Knowledge	Graduated Guidance	Independent Practice
Conceptual	11	4	4	0
Procedural	12	7	4	0
Unfounded	10	0	0	3

Conceptual strategies. Eleven participants described their instructional approach using conceptual strategies; these involved teaching the mathematical concept and exploring why a specific procedure is mathematically sound. For example, regrouping requires an understanding of the concepts of addition, subtraction, place value, and trading. To provide more rich description, an example was provided. A respondent answering how to teach addition and subtraction with regrouping using conceptual strategies was as follows:

> The first step would be to teach them how to differentiate the ones, tens, and hundreds if they do not already know how to. I would use base ten blocks. Then you need to teach the concept of 10 ones = 1 ten block and 10 tens = 1 hundred block. There would be a lesson on how to trade ones for tens and tens for hundreds. Once they understand this trading, I would introduce the problems.

None of the participants in this theme made reference to written work; instead, they discussed the use of manipulatives and pictures. The responses appeared to focus on the mental representation and understanding of the concept. While the participants might briefly explain a procedure, the focus of the response was centered around conceptual understanding. The manipulative items mentioned most frequently were base ten blocks. Base ten blocks would be used to show the particular value of each number within a computation problem. The concepts of addition and subtraction would be shown by manipulating the blocks: trading ten blocks representing one for one block representing ten. Participants also described this same method using pictures. Whether using physical objects or pictures, participants emphasized the visual and hands-on nature of these activities.

Procedural strategies. Twelve participants described their approach through procedural strategies which included methods that involve the steps or rules required to solve the math problem. To provide more rich description, an example was provided. An example of a respondent's answer regarding how to teach regrouping using procedural strategies follows:

> Then you would teach the students on how to regroup with two digit numbers: example 48 + 59 = (vertical alignment). Then you would begin by telling the students if the top # is larger than the bottom, you have to borrow from its neighbor. Therefore, the neighbor would have one less. Example: 48 – 59 (vertical alignment); the 8 would become an 18- then you would subtract like normal. After students have mastered that skill, you would have them work problem with three digits example: 348-259= (vertical alignment). It's the same thing just keep borrowing from the same number.

Participants mentioned the physical layout of mathematical problems, referring to columns. A common rule or procedure when solving regrouping problems was to attend to the physical layout of a mathematical problem. This may be accomplished by drawing lines between the numbers, creating columns that separate the ones, tens, etc…; computation begins with the ones column and proceeds to the tens column. Participants explained steps that involved moving a number over to the next column or taking a number from the next column. Further, participants made reference to stories for remembering computation procedures. To provide more description an example was provided. One participant wrote, "To teach addition with regrouping, I would tell my students to move the tens over to Mr. Hundred's house because Mr. Ten's house was too full." Another student wrote, "You would teach them that the ones place has to knock on the tens place's door because the ones place must borrow a ten." These participants compared computation procedures to common interactions between neighbors; perhaps, this was an attempt to make a connection between new knowledge and students' previous experience.

Participants who discussed procedural knowledge made reference to the use of worksheets. These were described as teaching tools used for demonstration. Worksheets were also mentioned in reference to teaching about problem layout and drawing columns. Perhaps references to worksheets represented a notion that computation involves written work. Only numerical notation was used in the explanations in these responses. Manipulatives and pictorial representations were never mentioned.

Unfounded/unclear instructional procedures. Ten of the thirty-three participants answered the open-ended question with brief responses. These responses consisted of one sentence that did not include procedures or activities that would be relevant to teaching the concept of regrouping. To provide more rich description, another example was provided. An example of this type of response was, "I would use counting bears." The open ended question was given to participants during a separate class meeting to avoid fatigue associated with completing the other surveys or assessments at the same time. It is not known whether these short responses represent the participants' lack of pedagogical knowledge. For this reason, little could be learned about these participants.

Sub-categories

Within the major themes that reflected over-all approaches to instruction, the researchers found common instructional methods or components. These were considered to be sub-categories. These sub-categories were activation of prior knowledge, graduated guidance, and independent practice; an explanation follows.

Activation of prior knowledge. Twelve participants included activation of prior knowledge within their response; this was defined as priming the students for learning and reviewing prerequisite skills and knowledge. Participants used the term "prerequisite skills" frequently. Some participants named specific pre-requisite skills such as one-to-one correspondence, number recognition, combining groups of objects, recognizing mathematical symbols, demonstrating understanding of place value using manipulatives, and adding single digit numbers using manipulatives as well as using numbers only. Participants' reference to pre-requisite skills corresponded to state mathematics standards for grades K-2.

Graduated guidance. Eight participants included graduated practice which was defined as scaffolding learning by providing different levels of teacher guidance. This may follow a sequence such as teacher modeling and guided practice by the teacher. Examples of this include the following: "Using ones and ten blocks I would help to show students where they were borrowing from and give them the opportunity to use manipulatives allowing guided practice," and "model for students, guide students in examples, let students work independently once they seem to have a good understanding." Responses that referred to graduated guidance appeared to show how teachers would program for generalization of skills, moving from dependence on others to independent demonstration of the skill. The use of graduated guidance is also a common teaching method and shows the participants' practical application of their skills within a classroom setting.

Independent practice. Although, independent practice may be the final step within graduated guidance, independent practice emerged as its own category. It is defined as practice without teacher involvement or guidance. Three of the participants discussed independent practice without reference to any prior guidance or teaching. An example of a student who did not provide any additional instructions or guidance follows: "I would have a worksheet where students would fill in an answer."

Quantitative Findings

The participants completed two curriculum-based assessments with K-6 mathematics computation and problem solving content and a mathematics teaching efficacy scale. The computation assessments were the Math Operations Test-Revised (MOT-R; Fuchs, et al., 1991) and the Math Concepts and Applications Test (MCAT; Fuchs, et al., 1994). The average computation score was 83% correct with scores ranging from 70%-98%. On the problem solving assessment, the average score was 89% correct with scores ranging from 70%-98% correct.

The participants completed the MTEBI (Enochs, et al., 2000), which is comprised of the Personal Mathematics Teaching Efficacy subscale and the Mathematics Teaching Outcomes Expectancy subscale (Enochs, et al.). Personal Mathematics Teaching Efficacy subscale scores can range from 13-65 and the Mathematics Teaching Outcomes Expectancy subscale scores can range from 8-40. Higher scores represent greater self-efficacy or outcome expectancy. The average score on the Personal Mathematics Teaching Efficacy scale was 50 with scores ranging from 34-59. The average score on the Mathematics Teaching Outcome Efficacy scale was 30 with scores ranging from 24-39.

Mathematics skills, self-efficacy, and qualitative response. A one-way MANOVA statistical procedure was conducted to determine the differences among the three types of qualitative responses (conceptual, procedural, and unfounded) on the four dependent variables (perceived mathematics teaching efficacy, mathematics teaching outcome expectancy, problem solving, and computation). The means and standard deviations are presented in Table 2.

Participants were grouped together based on responses that were grouped in the major themes (i.e., conceptual procedural, or unfounded) and then statistical comparisons were made using MANOVA. Significant differences were found among the groups regarding self-efficacy and content knowledge gathered from the MTEBI, MOT-R, and MCAT; Wilk's $\Lambda = 0.55$, $F(8, 54) = 2.35$, $p = 0.03$; thus follow up analyses were warranted to find the specific differences which entailed efficacy beliefs and content knowledge. Therefore, analyses of variance (ANOVA) were conducted as follow up tests to the MANOVA. Statistically significant differences were found regarding computation ability $F(2, 33) = 3.59$, $p = <0.05$, and beliefs of outcome expectancy $F(2, 33) = 4.68$, $p = 0.02$. Post hoc analysis to the univariate ANOVA for the computation ability and beliefs of outcome expectancy scores involved pair-wise comparisons to find which qualitative response affected performance. There was a significant difference between participants whose responses were conceptual and procedural with regard to computation performance; the conceptual group scoring higher. In addition there was a significant difference between participants whose responses were procedural or unfounded/unclear instructional procedures with regard to outcome expectancy; the unfounded/unclear instructional procedures group had higher expectancy scores.

Table 2.
Mathematics Skills and Efficacy Scores by Qualitative Responses Regarding Teaching Strategies

Survey	Qualitative Response	Mean (standard deviation)
Computation	Conceptual	86.00 (4.89)
	Procedural	79.33 (6.40)
	Unfounded	82.20 (6.49)
Problem Solving	Conceptual	90.91 (3.61)
	Procedural	89.17 (8.96)
	Unfounded	85.60 (7.29)
Personal Mathematics Teaching Efficacy Score	Conceptual	50.27 (6.00)
	Procedural	47.58 (8.79)
	Unfounded	51.30 (4.90)
Mathematics Teaching Outcomes Score	Conceptual	31.18 (3.71)
	Procedural	27.50 (2.39)
	Unfounded	29.73 (3.36)

(table continues)

Table 2 (continued)

Discussion

The purpose of this study was to investigate pre-service teachers' mathematics skills, self-efficacy, as well as knowledge of teaching methodology. With the exception of the unfounded/unclear instructional procedures, the themes that emerged were consistent with effective mathematics instructional domains (Flores et al., 2010; Hudson & Miller, 2005; Miller & Hudson, 2006). However, there was variation in the amount of balance among these instructional domains. Some of the participants focused solely on procedures and memorization of procedures without regard for conceptual understanding of the regrouping concept. Research has shown that conceptual knowledge is particularly important for students with disabilities, because lack of conceptual understanding often interferes with their success in mathematics at higher levels, such as pre-algebra and algebra (Mazzocco &Thompson, 2005). In this study the quantitative research suggests that participants' lack of focus on conceptual knowledge may be due to their own lack of mathematics understanding and skill. Those with higher content knowledge scores tended to describe conceptual procedures in their qualitative responses.

The sub-categories that emerged are components of instructional delivery commonly included in pre-service curricula (Miller, 2009). Activation of prior knowledge, graduated guidance, and independent practice are delivery components of research-based mathematics instructional practices (Hudson & Miller, 2006). These sub-categories were part of most responses in which conceptual knowledge or procedural knowledge were described within the context of instructional practices. Only one participant focused solely on independent practice, describing a lesson in which students would complete a worksheet. Within the sub-category related to prior knowledge, participants demonstrated knowledge of a variety of mathematics skills and concepts that form the basis the current regrouping concept. These responses included accurate information that that aligned with the current general education state standards.

With regard to mathematics computation skills, the average score on the K-6 computation assessment was consistent with previous research, but the participants' problem solving scores were better than those obtained in previous research (Flores et al., 2010). Although the participants' mathematics skills were consistent or better than previous research results, about one third of the participants in the current study scored less than 70%. One might expect mastery of such skills would be essential for effective instruction. This has implications for methods courses within special education teacher preparation programs. Perhaps some focus should be directed toward skill as well as pedagogy. It might be assumed that pre-service teachers are proficient in basic mathematics since they complete advanced coursework within their program of study (e.g., college algebra), but these findings call this into question. Important to note is the correlation between content test scores and respondents who described conceptual instruction in the open-ended response. This is similar to previous findings that content knowledge does impact instructional strategies (Heck et al., 2011; Ma, 2010).

Teaching efficacy scores and outcome expectancy scores for the participants in the current study were high which is consistent with those of previous research (Flores et al., 2010). These ratings of efficacy and outcome expectancy are optimistic in that these scales measure teachers' beliefs in their teaching effectiveness and their expectation that students who receive effective instruction will have positive outcomes. One might expect that future special education teachers would have confidence in their students' achievement especially when exposed to appropriate learning experiences. However, these become very informative when related to the instructional themes and scores on the content test.

Participants who focused their instruction solely on procedural strategies rated their student outcome expectancies lower than those who included conceptual knowledge within their instructional methods. With regard to the participants whose instructional focus was conceptual understanding, it is promising that pre-service teachers who describe a more balanced approach to instruction would have higher expectations for their future students. Perhaps these individuals' deeper understanding of mathematics concepts is related to increased confidence that their teaching will produce positive student outcomes. However, due to the lack of explanations that were provided by participants who responded with unfounded/unclear instructional procedures, the relationship with efficacy was not interpreted.

There are limitations of interpretation of responses by the participants who did not clearly report their teaching approach within the open-ended question. It is not known whether their responses are an accurate appraisal of their knowledge. Perhaps these participants did not want to invest the time and effort in answering the question. The question may not have been written in a way that was confusing. The written format of the question may have interfered with their performance; perhaps these participants would have appropriately discussed their methodology using spoken language or through live demonstration. These participants may have appropriate pedagogical knowledge, but did not feel confident in their skills and were hesitant to fully respond. However, based on their high efficacy ratings, one might expect that they would be eager to respond to such a question.

Limitations and Future Research

This study was limited by its sample of participants. The participants were recruited from one preparation program. Future research should focus on surveying larger numbers of pre-service teachers. The diversity of the sample is another issue that should be addressed in future research. The current sample consisted of mostly white females rather than a more representative sample of the teaching field that would include more males and individuals from different cultural backgrounds such as African American and Latino/a pre-service teachers.

Future research considerations include exploring pre-service teachers' instructional practices through focus groups, lesson plans, and observations of teaching to provide greater depth in understanding of pre-service teachers' instructional methodology. This type of investigation might circumvent non-responses, allowing the researchers to probe further. In addition, focus groups, lesson plans, and observations might include a more extensive exploration of instructional methods and skills related to mathematics instruction and student achievement. For example, teachers might be asked about their instructional methods related to a variety of mathematics skills and concepts. Future research could investigate student outcomes as they are related to their teachers' mathematics skills, teaching efficacy and instructional skills. Finally, future research could broaden the focus of investigation beyond elementary level mathematics and/or beyond basic computation to more complex mathematical concepts such as algebra or areas of secondary mathematics curriculum.

Finally, this study did not investigate the participants' expectations or preferences for teaching in particular settings or with students with specific disabilities. Although their teaching certificates indicate preparation to teach at all grade levels and with students with diverse needs across disability categories, participants may expect to only teach in certain settings or with students with certain types of disabilities. These expectations may be related to their focus on particular topics or concepts within their preparation curriculum. For example, someone who hopes to teach students who will learn functional mathematics may not concentrate on methods and strategies related to concepts or skills such as addition and subtraction with regrouping, the topic chosen for the study's open-ended question. Although beliefs such as this are narrow and problematic for our field, future research should address how they may be related to pre-service teachers' learning.

Conclusion

Based on recent reports of students' mathematics achievement (Mullis, et al., 2008; U.S. Department of Education, 2000) and current federal mandates related to academic achievement (NCLB, 2002; IDEIA, 2004), it is imperative that special education teachers provide effective mathematics instruction and support effective mathematics instruction within inclusive general education classrooms. In order to do so, special education teachers need appropriate understanding of the content, beliefs that their instruction will result in learning, and appropriate pedagogical knowledge (Kamil, 2003). The qualitative analysis showed that despite having satisfactorily completed an accredited traditional teacher preparation program and passing a certification exam in the area of elementary level general education, some of the participants demonstrated deficits in content knowledge as well as shortcomings in their approach to instruction. Quantitative analysis highlighted findings similar to previous research about content knowledge and teaching self-efficacy. As teacher educators, further research is needed with regard to effective preparation for all pre-service teachers so that their instruction will facilitate children with disabilities' adequate progress within the mathematics general education curriculum.

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