Beliefs of Teachers in Urban Elementary Mathematics Classrooms: Results of a Mixed-Methods Study

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Abstract

A mixed-methods study investigated the relationship between teachers within urban Title I elementary schools (e.g., high versus low performing) and their mathematics problem-solving beliefs in six constructs (*perseverance, procedural, conceptual, importance, effort,* and *usefulness*). The 181 teachers of students in third to fifth grades in 26 schools (93% response rate) took the 36-item *Indiana Mathematics Belief Scale,* and 11 were interviewed. Descriptive and inferential statistics and qualitative thematic analysis were conducted. No statistical difference between teachers in high and low-performing schools in their mathematical beliefs was found in any of the six constructs. The qualitative results did deepen the quantitative findings in offering insights into teachers' recognition of the importance of conceptual understanding in mathematics. The implications and directions for future research are discussed, including further inquiry on addressing professional development supports for teaching problem strategies in mathematics.

Keywords: urban education, mathematics beliefs, problem-solving

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Introduction

Althauser (2017) contended that the United States does not produce citizens who grasp logic, numbers, probability, and problem-solving skills. Evident in children and adults, mathematical innumeracy is defined as the "inability to deal comfortably with the fundamental notions of number and chance" (Paulos, 1988, p. 135). The National Center for Education Statistics (NCES, 2003) found that 55% of American adults could not calculate the cost of ordering office supplies and determining whether a car had enough fuel to get to the next gas station. Similarly, mathematics literacy has long been a struggle for many students. Darling-Hammond et al. (2017) suggested that district and school leaders be encouraged to provide and participate in more systemic mathematical professional development, training, coaching, and collaboration for educators to improve instructional strategies with the goal of impacting student achievement. To assist teachers in implementing effective mathematical instructional strategies, school leaders should be at the forefront of being the lead learners and instructional leaders of these best practices. The foundation of mathematics literature starts at the elementary level of schooling.

Background of the Study

Policymakers and educational leaders turn to international, national, and statewide assessment results to grasp student mathematics performance trends, particularly for elementary grades. The Trends in International Mathematics and Science (TIMSS) measure and compare achievement scores among fourth-grade students. TIMSS uses benchmark performance characterized by four levels: *advanced* (minimum score of 625), *high* (550^{+}), *intermediate* (475^{+}), and *low* (400^{-}) on a reported scale from 0 to 1000 (M= 500, SD = 100).

According to TIMMS results gathered by the Institute of Educational Studies (https://nces.ed.gov/timss/), 47% of fourth-grade students in the United States scored *high* (i.e., 550 – 624), with their performance described as having the ability to apply knowledge and solve word problems involving operations with whole numbers, simple fractions, and two-place decimals. These students could demonstrate an understanding of geometric properties, including angles less than or greater than a right angle, and interpret data in tables and various graphs to solve problems. In comparison, about a third of the who performed *low* (i.e., 400 – 474) could barely add and subtract whole numbers, had a minimum understanding of multiplication by one-digit numbers, and struggled to solve straightforward word problems. In comparison, 10 (out of 48) countries had higher average fourth-grade mathematic scores than the United States. However, in the United States, those schools with the highest poverty level (75 percent or more eligible for free and reduced lunch [NSLP] scored lower, on average than students from schools in all other NSLP categories by up to 94 points. In addition, the results revealed that the United States had relatively large score gaps between the top and bottom-performing students relative to other countries.

Comparably, the National Assessment of Educational Progress (NAEP) is used to gauge fourth- and eighth-grade students' knowledge, skills, and ability to solve real-world problems and skills and their ability to solve problems in real-world contexts (NAEP, 2019). NAEP produces scores in the 0 to 500 range (M = 250, SD = 50), with three achievement levels: *advanced* (minimum score of 282), *proficient* (249^{+}), and *basic* (214^{+}).

On the most recent NAEP administration, 59% of fourth-grade students in the United States attained *basic* or *below basic* (NCES, 2019). Disaggregation results had gaps, as seen with 84%

of English language learners, 83% of students with disabilities, 76% of minorities, 74% from low-socioeconomic disadvantaged, and 63% for urban districts attaining *basic* or *below basic* levels. When comparing mathematics performance for fourth-grade students in 2019 with 2017, 40 states showed no significant change in the percent of students scoring *basic* or *below basic*. In fact, for over 25 years, the NAEP assessment results in mathematics have found that students' problem-solving ability is one of the highest deficits (Kilpatrick et al., 2001).

One relatively new component of NAEP is the Trial Urban District Assessment (TUDA). The purpose of TUDA is to focus on large urban districts, representing half of the country's public-school students and disproportionally educating high percentages of Black and Hispanics eligible for participation in the National School Lunch Program (NSLP) (NAEP, 2019). These results indicated that students who attend urban districts showed a disproportionate percentage (60%) of fourth-grade students performing at *basic* or *below basic* levels.

Indicators of mathematics performance in Alabama – particularly those in urban settings, are comparably lower than their peers nationally. Ranking 49th of all states and justifications, Alabama's NAEP 2019 mathematics results yielded 43% of fourth-grade students scoring *basic* and 29% scoring *below basic* (NCES, 2019). The 2019 fourth-grade mathematics performance was not significantly better than in 2017. These national results are comparative to state results. In Scantron's statewide assessment, 53% of elementary students scored *below proficient* in mathematics (Alabama State Department of Education [ALSDE], 2020).

In this industrialized nation, mathematics performance appears stagnant, especially in problem-solving, as illustrated by measures such as TIMMS, NAEP, TUDA, and statewide results. Economically disadvantaged students and those in a minority group are disproportionally impacted by mathematical innumeracy, particularly as citizens in a global economy (TIMMS 2015). So, what are the teachers' beliefs on problem-solving strategies that can enhance mathematics performance, particularly in urban Title I urban elementary schools?

Statement of the Problem/Purpose of the Study

There have been few studies (e.g., Arabeyyat, 2017; Arikan, 2016) that intentionally focused on teachers' beliefs regarding using evidence-based problem-solving strategies to support the development of the conceptual understanding of mathematics for students in urban elementary schools. In Armour-Thomas's words (1989), "the investigation of teachers' thought processes is an exciting new area in research on teaching, in that 'the field promises to yield information that may revolutionize the way we traditionally conceived the teaching-learning process" (p. 35). About 20 years later, Beswick (2012) suggested that more attention should focus on teachers' beliefs due to the cumulative experience of learning mathematics in primary and secondary schools and universities and experienced teachers from years of involvement in the profession. Therefore, with a focus on Title I urban elementary districts in Alabama, we focused this study on two urban districts to gather the teachers' beliefs on problem-solving strategies (e.g., schema-based instruction, reasoning, modeling, manipulatives, and communication) that can enhance student mathematics performance.

Theoretical Framework and Review of Literature

The foundation for this research study was the Constructivist Learning Theory. This approach holds that the learner actively constructs or makes their knowledge and that reality is determined by the learner (Elliott et al., 2000). According to Jones et al. (2010), the principles of this theory are that it enables learning that is (1) active and reflective, (2) designed to allow students to understand new experiences, and (3) is social. Learning requires interaction to develop a deep conceptual understanding and build positive relationships with other learners.

A constructivist approach to teaching problem-solving in mathematics involves delivering instruction for understanding. The student's current knowledge and experiences are the basic blocks for future structures to build upon that prior knowledge. This approach helps students develop the ability to transfer their skills and knowledge to new contexts through problem-solving, enhancing their skills (O'Dwyer et al., 2015). Bullock (2017) denotes that this practice, in companion with the acceptance of any solution method or presentation of understanding, speaks to students' prior knowledge and their experiences' uniqueness.

Since the Elementary and Secondary Education Act of 1965 (ESEA, P.L. 89-10), the federal legislation has provided supplemental support for basic skills (e.g., development of literacy and mathematics) to communities with high percentages of students economically disadvantaged. With each reauthorization of ESEA (i.e., No Child Left Behind of 2001, Every Student Succeeds Act, etc.), the federal government has taken an increasingly active role in becoming involved in "…core matters of school governance [including]…academic standards, student assessment, teacher quality, school choice, and school restructuring" (McGuinn, 2015, p. 78). These expectations have shifted how the federal government perceived its approach to school reform and continuous improvement efforts.

The Every Student Succeeds Act of 2015 (ESSA, P.L. 114-95) emphasized that evidence-based instructional practices support school improvement. Under ESSA, an activity, strategy, or intervention is defined as evidence-based if it demonstrates a statistically significant effect on improving student results on achievement or other pertinent outcomes based on the following: strong evidence from an experimental study, moderate evidence from a quasi-experimental study, or promising evidence from a correlational study with statistical controls for selection bias (Zinskie & Rea, 2016). Dynarski (2015) and Sparks (2016) stated that the context of evidence is imperative because schools need to focus on evidence from studies in similar settings and populations to their students. For example, low-performing schools with a large population of economically disadvantaged students should seek evidence from high-poverty, high-performing schools. In addition to researching what has worked, Chenoweth (2016) indicated that schools must test these strategies in their learning environments. Under ESSA, State Education Agencies (SEA) now set school accountability standards, while local school districts gain flexibility and responsibility for crafting school improvement plans (Klein, 2016). Moreover, for SEAs to receive federal funding, they must submit a State plan to the federal government for approval.

The National Council of Teachers of Mathematics (NCTM) has identified eight research-informed mathematics instructional practices considered essential for effective teaching to all students, especially at the elementary level: 1) establishing goals to focus on learning, 2) implementing tasks that promote reasoning and problem-solving, 3) using and connecting representations, 4) facilitating meaningful discourse, 5) posing purposeful questions, 6) building procedural fluency from conceptual understanding, 7) supporting productive struggle in learning, and 8) eliciting and using evidence of student thinking (NCTM, 2017). These teaching strategies foster conceptual learning, promote learning retention and a deeper understanding of mathematics, and rely less on computation, memorization, drills, and repetition (NCTM, 2014). This further aligns with ESSA legislation requiring evidence-based mathematics strategies, activities, and interventions. It has also defined evidence-based research when choosing an activity, strategy, or intervention designed for improvement (Lam et al., 2016).

Alabama has developed a new strategic plan, *Alabama Achieves A New Plan for A New Decade* (herein, *Alabama Achieve,* 2020)\. *Alabama Achieves* addresses five overarching strategic priorities to support local schools and school systems: (1) academic growth and achievement, (2) college, career, and workforce ready, (3) safe and supportive learning environments, (4) highly effective educators, and (5) customer-friendly services.

Given *Alabama Achieve* focus on academic growth and achievement, a focus on problem-solving may play an integral role in mathematics instruction delivered to elementary students. Problem-solving refers to mathematical tasks that have the potential to provide intellectual challenges for enhancing students' mathematical understanding and development (NCTM, 2014). Additionally, problem-solving refers to a situation that poses a question where the solution is not immediately accessible to the solver. However, knowing how to incorporate problem-solving purposefully into the mathematics curriculum is not necessarily evident to elementary teachers. Nieuwoudnt (2015) contended that problem-solving generally involved the following steps: mastering the prerequisite mathematics ideas and skills, practicing the newly mastered concepts and skills in solving word problems, learning general problem-solving processes, and finally, applying the learned ideas and skills to solve real-life problems.

Elementary school mathematics learners are not natural problem-solvers; therefore, teachers must teach problem-solving skills and strategies (Lesh & Zawojewski, 2007). Researchers (e.g., Jitendra et al., 2015; Lesh & Doerr, 2003; Mueller et al., 2014; Peltier & Vannest, 2017) identified strategies for improving student achievement in mathematics. Problem-solving strategies include (1) schema-based instruction, (2) reasoning, (3) modeling, (4) manipulatives, and (5) communication.

Researchers (e.g., Jitendra et al., 2015; Peltier & Vannest, 2017) have found that schema-based reasoning is an instructional strategy that supports problem-solving in elementary students. Schema is often described as a system or framework developed to solve problems, organize knowledge, provide scaffolding, and support future instruction and learning (Peltier & Vannest, 2017). The schema-based instructional strategy for elementary students generally has two variations: (a) schema-based instruction and (b) schema-broadening instruction (e.g., Peltier & Vannest, 2017)**.** Peltier and Vannest found schema instruction generally involved categorizing word problems into problem types to identify a solution plan. However, schema-broadening instruction involved the following: (1) identify the schema; (2) write the corresponding algebraic equation (i.e., converting a word problem to a numerical statement); (3) identify the solution plan; and (4) carry out the plan and check for reasonableness. Students cannot determine the necessary steps to solve the solution if they cannot develop a problem representation. According to Peltier and Vannest, schema instruction can also improve students' ability to analyze the story problems' underlying structure and identify potential PathSolutions.

Mata-Pereira and DaPonte (2017) and Mueller et al. (2014) have studied reasoning as another evidence-based instructional strategy supporting mathematics performance. NCTM described reasoning as using evidence to conclude and the development, justification, and use of mathematics generalizations and guides teachers in promoting reasoning by allowing multiple strategies. Mata-Pereira and DaPonte found that reasoning involved teachers guiding students to investigate, evaluate conjectures, and develop mathematical arguments to convince them that they are correct.

Scholars (e.g., English & Watters, 2005; Novotna et al., 2014) have asserted modeling could also be used with elementary students. Mathematical modeling has been considered a way of improving students' ability to solve real-life problems (Lesh & Doerr, 2003), including young learners (English & Watters, 2005). Schorr and Amit (2005) positioned that modeling activities could help students build on their prior knowledge, and engage in thought-provoking, multi-faceted problems within reliable real-life situations.

Furthermore, Carbonneau et al. (2013) and Sherman and Bisanz (2009) have studied manipulative-based instruction's impact as a practical approach to improving student mathematics achievement. NCTM (2014) suggested using representational models as a significant area of mathematics instruction so that students interpret representations in many ways, such as illustrations, virtual manipulatives, and physical hands-on manipulatives or didactics. Carbonneau and Marley (2012) have found that a manipulative-based approach also included students' physical opportunities to interact with objects to learn target information.

Researchers (e.g., Huang & Normandia, 2009; Nartani et al., 2015) have further studied how communication can be another evidence-based instructional strategy. NCTM (2000) asserted that communication is essential for understanding mathematics. Jones and Tanner (2002) found that students who can communicate can share ideas and concepts that will help them learn to be critical thinkers through problem-solving. Huang and Normandia (2009) similarly found that teachers must allow students to communicate their ideas and views with other students by promoting small group activities.

However, what do we know about teachers' beliefs about problem-solving strategies? While various researchers have identified instructional strategies to help elementary students enhance their problem-solving skills, Arikan (2016) asserted that teachers' beliefs are imperative to improving student learning and how teachers conceptualize their roles in the mathematics classroom, their selections of learning activities, and the instructional strategies they intend to introduce to students. NCTM further declared that "teachers' beliefs influence their decisions about how they teach mathematics" (2014, p.10). Researchers (e.g., Arikan, 2016; Correa et al., 2008) have classified teacher-centered and student-centered teaching beliefs. Correa et al. offered that while the teacher-centered view aligns with the content-focused view focusing on performance, the student-centered teaching view's idea parallels the "learner-focused" view.

According to Arikan (2016), one of the most critical factors determining the teacher and student's relationship is the teachers' beliefs. These beliefs affect how teachers deliver instruction and their pedagogical approach. While teachers generate thoughts on their students, content areas, roles, and responsibilities, Hoy and Miskel (2001) contended that teachers' beliefs affect their perceptions and judgments. Then, their opinions and experiences affected their behaviors in the classroom, especially when teaching students problem-solving. Similarly, Wilkins (2008) examined teachers' level of mathematical content knowledge, attitudes toward mathematics, and beliefs of 481 third through fifth-grade elementary students. In the third through fifth grades, upper elementary teachers had more excellent content knowledge and positive attitudes toward mathematics than primary teachers in kindergarten through second grades. There was no difference in teachers' beliefs about effective instruction, but primary-level teachers used instruction more frequently than upper elementary teachers. Wilkins found that teachers' beliefs were the most significant predictor of teaching practices, among other factors. However, there is a gap in research about these teacher beliefs of those serving students in urban contexts or large numbers participating in NSLP.

Methods

We used a mixed-methods two-phase design with quantitative and qualitative components to examine teachers' beliefs in two urban Title I districts in Alabama to explore the general research question of beliefs about mathematical problem-solving strategies. According to Creswell (2012), mixed-methods designs allow for the acquisition of more detailed and specific information to understand the problem better when neither quantitative nor qualitative inquiry is robust enough to address the general research question. In this two-phase design type, we captured quantitative survey data and then used the qualitative component to explain the initial results further. Specifically, we administered a survey in the first phase of this study when participants indicated their agreement with belief statements about mathematical evidence-based problem-solving instructional strategies. In phase two, qualitative data was gathered from interviews and used to take a deeper dive to explore Title I elementary teachers' beliefs about these instructional strategies.

We addressed the following specific research questions:

1. What are all teachers' belief*s* in urban Title I elementary schools educating students in grades 3-5 in these two urban districts regarding effective mathematics problem-solving strategies to enhance performance?
2. In *high-performing* urban Title I schools, what are the teachers' beliefs about effective problem-solving strategies?
3. In *low-performing* urban Title I schools, what are the teachers' beliefs about effective problem-solving strategies?
4. Are there differences in the teachers' beliefs of those who educate *high versus low-performing* Title I schools regarding effective problem-solving strategies to enhance mathematics performance?
5. From teachers' perspective in *high-performing* Title I schools, how are problem-solving strategies used in their classrooms, and what support systems allow for professional growth in these instructional strategies (schema-based instruction, modeling, manipulatives, and communication)?

Setting/Population/Sampling

We used two adjacent Alabama urban school systems for this study. These communities, referred to as Districts 1 and 2, educate 59%-65% of students on NSLP, higher than the state average of 51%. These two districts serve over 40,000 P-12 students educated in about 40 schools. Both systems target the use of Title I allocated funds at the elementary school level. The districts have 26 Title I elementary schools operating for at least one year and participated in the ALSEE Assessment Program. Across the two districts, they26 Title I elementary schools enrolled nearly

12,750 students and 790 teachers (ALSDE, 2020). Scantron's mathematics achievement was about 22% compared to the State average of 46.78% in the same period.

The population for this study was 194 teachers of grades 3-5 in these 26 Title I elementary schools. Given this population, 129 was the number of survey responses needed for 95% confidence to generalize results to the entire population. The population included regular education teachers but not special education teachers—the overall majority of the teachers are females and white. All 194 teachers were asked to complete the survey in phase I of the study. To address specific research questions two through four, rank-ordered each of the 26 Title I schools based on their mathematics achievement scores from the 2017-2019 ALSDE Scantron Achievement Series mathematics assessment. The top and bottom one-third of schools were classified as "high" and "low" performing, respectively. The subsamples were teachers from nine high-performing and nine low-performing schools. Additionally, we used convenience sampling for phase II. We did this by requesting the nine high-performing school principals nominate two volunteers who teach in grades 3-5. If one or both volunteers declined to participate in interviews, we requested that the school principal select alternates.

Instrumentation

The Indiana Mathematics Belief Scale (IMBS) was utilized for phase I of this study. The IMBS is a survey designed by Stage and Kloosterman (1992) to provide insight into teachers' beliefs on mathematics problem-solving and how it affects mathematics instruction. Each respondent rated their beliefs on 36 mathematics problem-solving items on a response scale ranging from "1" (strongly disagree) to "5" (strongly agree). In addition to an overall score, the researchers obtained a sub-score for each of six constructs (*perseverance, procedural, conceptual, importance, effort,* and *usefulness*).

Data Analysis

After researchers received the responses to the survey, data analysis began. We used descriptive statistics to address the first specific question examining elementary students' teachers' beliefs regarding effective mathematical problem-solving strategies for student achievement. The statistics included frequency distributions, central tendency (i.e., mean), and dispersion (i.e., standard deviation) on the survey's overall score, construct, and item. Similarly, we used frequency distributions, central tendency, and dispersion on the survey's overall score construct and item to address the second and third specific questions examining teachers' beliefs from high and low-performing schools. The fourth specific research question compared the two subgroups of teachers representing high and low-'-performing schools. We used the parametric independent *t*-test to conduct inferential statistical analysis. Since the study's participant size was larger than 30, the independent *t*-test used as an inferential technique helped determine a statistically significant difference between the means in two unrelated groups (Laerd Statistics, 2020). The null hypothesis for the independent *t*-test was that the population means from the two unrelated groups are equal. A pre-established significance level (alpha) allowed the researchers to reject or accept the alternative hypothesis. We tested at the significance level of $p > .05$. The participants involved in addressing specific research question five were a thematic analysis of interview protocols.

Results

The total number of grade 3-5 teachers responding was 181 out of 194, a 93% response rate, thereby attaining the target rate to confidently generalize results. Of participants, 52 (27%) were from high-performing schools, and 79 (41%) represented low-performing schools. Additionally, 11 teachers participated in the qualitative semi-structured interviews representing eight of the 9 high-performing schools.

Beliefs of All Teachers

Teacher survey results from all 26 schools on the IMBS produced an overall mean of 2.92 (SD = .90) on a scale from "1" (strongly disagree) to "5" (strongly agree), indicating a middle-of-the-road response. The construct means ranged from 2.11 for an *effort* to 3.46 for *importance*. The statement that received the highest score was #36: *Studying mathematics is a waste of time.* The lowest item score was #33: *Mathematics is a worthwhile and necessary subject.*

The *perseverance* construct had a 3.00 (SD = .92), with item means ranging from 2.04 to 3.94 (SD = 0.80 to 1.02). For these statements, the highest mean (3.94) was item #5: *If I can't solve a math problem quickly, I quit trying*. The survey item with the lowest mean (2.04) was #3; *I find I can do hard math problems if I just hang in there*. The *procedural* construct had 2.83 (SD = .93), with item means ranging from 2.45 to 3.29 (SD = 0.85 to 1.01). For these statements, the highest mean (3.29) was item #9: *Memorizing steps is not useful for learning to solve word problems*. The item with the lowest mean (2.15) was #11: *Most word problems can be solved using the correct step-by-step procedure*. The third construct, *conceptual,* had a mean of 2.97 (SD = .90), with item means ranging from 1.80 to 3.85 (SD = 0.78 to 0.98). The highest mean (3.86) for these statements was item #16: *It's not important to understand why the mathematical procedure works if it gives a correct answer.* The lowest mean (1.80) was #15: *In addition to getting the right answer in mathematics, it is important to understand why the answer is correct.* The *importance* construct had a mean of 3.46 (SD = .94), with item means ranged from 2.71 to 3.89 SD = 0.81 to 1.05). The highest mean (3.24) for these statements was item #24: *Word problems are not an important part of mathematics.* The lowest mean (2.71) was #21: *Computational skills are useless if you can't apply them to real-life situations.* For e*ffort*, the fifth construct had a mean of 2.11 (SD = .83), with item means ranging from 2.06 to 2.17 (SD = 0.78 to 0.88); the highest mean (2.17) was item #25: *One can become smarter in math,* and the lowest mean (2.06) was #26: *Working can improve one's mathematics ability.* And finally, the *usefulness* construct had a mean of 3.06 (SD = .92), with item means ranging from 1.67 to 4.36 (SD = 0.77 to 1.17the highest mean (4.36) was item #36: *Studying mathematics is a waste of time* and the lowest mean (1.67) was #33: *Mathematics is worthwhile and necessary.*

Descriptive findings gathered from all Title I teachers resulted in middle-of-the-road findings with a mean close to "3" on a scale from "1" (strongly disagree) to "5" (strongly agree) and construct means ranging from a high of 3.46 (*importance*) to a low of 2.11 (*effort).* All teachers are relatively high on believing in word problems and the skills needed to solve problems instead of the other computational skills. However, a relatively lower belief in the extent of effort and study makes individuals smarter in mathematics. Overall descriptive findings from all Title I teachers resulted in a spread of 1.35 among the construct means on this five-point scale, but little difference across variability (.11).

Similarities and Differences

Inferential statistics addressed the fourth specific research question comparing two subgroups of teachers (those from high- and low-performing Title I urban schools) concerning each construct's general beliefs. First, the high performing schools (n = 58, M = 2.92) was compared to those from low performing schools (n = 73, M = 2.89). A *t*-score of .97 was obtained and tested at the pre-established $p \leq .05$ as the actual probability level was .42, so the researchers' failed to reject the null hypothesis. There were no statistical differences between these two means (i.e., 2.92 vs. 2.89). Second, we tested each of the six constructs. The *t*-values ranged from .06 to 1.01, with the corresponding *p*-values of .06 to .89. We failed to reject the corresponding null hypothesis in all situations, as no statistical differences were found. However, *useful* came close (e.g., .06). While not statistically significant, it may be of practical significance that teachers in high-performing schools generally believed mathematics is useful in daily life. Third, we tested each statement. Only one item within the importance construct showed a statistical difference between high and low-performing schools. An independent *t*-test showed that the high-performing schools' (M = 2.88) belief of #21, *Computational skills are useless if you can't apply them to real-life situations*, was statistically significantly higher than the low-performing schools (M = 2.73), p = .001.

To complement and further dive into quantitative results, we sought emerging themes from teachers' perspectives in high-performing Title I schools. The themes showed how problem-solving strategies are used in their classrooms and what support systems allow for professional growth in these instructional strategies (schema-based instruction, modeling, manipulatives, and communication). We coded transcripts to determine the common trends among participants' responses to evidence-based strategies in mathematical problem-solving discussed in the literature review. We also found trends in responses of teachers with certain levels of teaching experience, challenges, and barriers each participant shared as it relates to trying new strategies to support diverse learning needs, providing opportunities for their students to have meaningful discourse and productive struggle through problem-solving, and how to authentically support teachers professionally in implementing best practices for teaching students how to problem-solve.

System-level Support

All 11 participants discussed system support from the district or school level. Participants discuss the importance of having instructional support from professional development inside and outside the school district. Participant seven stated, "I always learn a lot from my colleagues...I talk to [them] and observe…. That is where I get a lot of knowledge from…my colleagues and mentor teacher...I have a mentor teacher." Participants discussed the importance of learning a lot from their colleagues within their school buildings. Participant seven also shared, "I wish I could sit in a couple of teachers' classes to learn the instructional strategies they use." Participant six stated, "My principal has been messaging me about different PDs that the district has offered and wondered if I had attended them because he knows I am a newer teacher. Last year, I was at a different school. So, he asked if I had been to any of those and encouraged me to sign up for those if I have not."

Responses from the teachers indicated that using the best mathematics instruction practices is key to promoting student achievement in mathematics. They communicated numerous methods of teaching problem-solving to their students. For example, P8 articulated, "It is being able to analyze and look at a math problem and not just regurgitate facts but working through the problem.

P3 explained how they like to see students communicate during math. P1 stated, “I like them communicating with each other, and in my class if you can do it, you can explain it.” P5 contended that modeling problems for the students are essential as well. “Understanding not just how to get an answer, but understanding the why and, you know, have examples and non-examples the correct or incorrect answer.” P11 shared, “So I use that (communication) frequently, and I use discourse because it is important for students to communicate and talk about and talk through problems.”

Participants described the obstacles and barriers to teaching mathematics problem-solving by explaining that language usage, student background knowledge, and reading below grade level were issues in students' problem-solving achievement. P8 stated, “Students not understanding the language of math and children’s general overall vocabulary seems to have gotten weak over the years...I would say it’s just a language barrier I have noticed over the years.” P7 offered: “Many of my students have expressed that they are scared of solving word problems...They looked at them as intimidating.” And P1 shared, “Challenges I encounter would be trying to teach a fifth-grade skill to someone with a first-grade background knowledge.”

Teachers identified students’ perception of mathematics and viewed their ability to solve word problems as challenging. For example, P11 stated, “Number one challenge is having to work through trying to show and demonstrate to kids…Yes, you can. It’s okay not to like anything that’s perfectly human, and that is your opinion, but I think a lot of times that may not necessarily come straight from the students, but it may be the family’s kind of pushing on…. Oh, I was bad in math, so you’re going to be bad at math.” Participants also expressed that using mathematical language and breaking down those language barriers is the challenge of achieving problem-solving.

Those interviewed stated that observing students had a breakthrough when complex solving problems was rewarding. Some participants indicated that it is difficult sometimes to refrain from giving their students the answers quickly. For instance, P9 responded: “I am very okay with watching my kids struggle for a little bit, and once they get it, it's just a lot more exciting and fun for them.” P7 expressed, “I am finding different ways to explain to students that they struggle in a different area or a particular area.”

Furthermore, participants expressed that teacher experiences have enhanced their knowledge of teaching problem-solving to their students over the years.; participants with more teaching experience revealed more knowledge of best practices and their ability to grow their expertise in particular methods. P10 expressed: “I believe having more time for discourse and not feeling pressured to keep up with the pacing guide is first and foremost; I feel we are doing a disservice to our students where we just keep going on to stay on schedule versus mastering a skill before moving on.” P8 stated: “I have so many resources in my head, and it makes it hard to decipher which way I can solve the problem...this way, or this way or this way...I sometimes wish I could go back to my 8th year of teaching when I wasn’t as knowledgeable and the way I was doing. If I had five things I could use, I could use it well.”

Data Triangulation

We used triangulation to compare the results of two quantitative and qualitative phases in high-performing schools. Survey responses were compared with interviews to understand better the general research question exploring mathematical problem-solving and teachers' beliefs in urban Title I elementary schools. As illustrated below, a significant agreement was found among participants' quantitative and qualitative responses.

Table 1

Summary of Quantitative and Qualitative Data Triangulation

Construct	Quantitative Result	Qualitative Result	Example Quote
Conceptual	Participants did not believe the right answer in math is more important than understanding why the solution works.	Participants described using strategies that help students solve various problems in various ways.	"It is not about using any particular strategy at any given time; it's just about using the strategy that works for you and this particular problem."
Importance	Participants expressed disagreement that math classes should not emphasize word problems.	Participants spoke about allowing students to develop their word problems to relate mathematics to their worldly perspectives.	"I like to connect word problems to their (students) world and require them to tell how they will use this in the real world instead of giving them a problem to solve."

Discussion, Implications, and Future Research

There have been few studies that intentionally focused on teachers' beliefs regarding using evidence-based problem-solving strategies to support the development of the conceptual understanding of mathematics, particularly in urban Title I schools (e.g., Arikan, 2016; Arabeyyat, 2017). This study aimed to gather the teachers' beliefs on problem-solving strategies (e.g., schema-based instruction, reasoning, modeling, manipulatives, and communication) to enhance student mathematics performance in urban Title I elementary schools. To further inform *Alabama Achieve* strategic plan, educational leaders can best meet the needs of students by gaining more insight into teachers' beliefs that affect Alabama's student mathematics achievement results, particularly those in urban districts and large numbers participating in NSLP.

Our guiding research question was: *What are elementary students' teachers' beliefs regarding effective instructional strategies for mathematical problem-solving? Are there differences between teacher beliefs in high and low-performing urban Title I schools? If so, what factors might explain the differences?* We found it essential understand to understand how these beliefs impact student performance. We found that all elementary teachers within these two districts across all domains displayed very positive beliefs about problem-solving. The most significant finding we detected was no difference between teacher beliefs in high- and low-performing schools. Perhaps these results may be attributed to high- and low-performing school teachers receiving the same preservice mathematics pedagogy and district-mandated professional development. This we deemed as a positive finding. Findings are aligned with Beswick (2012), who suggested that attention should focus on teachers' beliefs due to the cumulative experience of learning mathematics in primary and secondary schools and universities and experienced teachers from years of involvement in the profession.

This study's findings offer several implications for teachers in low- and high-performing Title I schools. Based on the survey findings, 57% of the participants state that most word problems can be solved using the correct step-by-step procedure. However, 81% of teachers believe that getting the right answer in mathematics is important to understand why the answer is correct. Therefore, teachers who emphasize solving mathematical problems should also find the best teaching practices for conceptual understanding. It is the idea that teachers' beliefs affect teaching and learning and ultimately affect student achievement in mathematics (e.g., Arikan, 2016; Correa et al., 2008). Therefore, it is important to investigate teachers' beliefs since they are expected to reflect instructional strategies for mathematics problem-solving. Teachers should be aware of their own beliefs about problem-solving strategies to strengthen their knowledge base in problem-solving instructional strategies.

This study suggests that further research needs to be conducted on educators' beliefs about problem-solving in urban school districts. This research may enlighten educators that teachers' ideas about mathematical problem-solving will influence their classroom instructional practices. Since this research focuses on elementary students in grades 3-5, future research is extended to grades K-2, 6-8, and 9-12 to understand the various grade span and needs. Also, further investigation of teachers' experience levels, levels of training, and post-secondary degree levels. Further research is necessary to address professional development's effectiveness in supporting evidence-based problem-solving instructional strategies in mathematics. Although teachers receive professional development support in teaching mathematics problem-solving strategies, further research can determine their effectiveness. This research might benefit all school districts, especially school leaders, concerning teachers' beliefs and professional development content and format for all grade levels' most effective practices. The qualitative findings further suggest that research is needed to address the challenges in breaking barriers to problem-solving (i.e., using the language of the discipline to explain mathematical expressions and concepts, perception of math from home and school, students reading below grade level and cannot decode word problems, and students' prior knowledge). Qualitative data suggest future research needs to address students' needs in various sub-groups within urban Title I schools (i.e., exceptional education students and English language learners). Several high-performing school teachers stated the need to identify the most effective mathematical problem-solving instructional strategies to enhance English language learners, students with reading deficiencies, and students with disabilities problem-solving skills.

Conclusions

In closing, our study's results contribute to the research on mathematics problem-solving in urban Title I schools. The findings are a revelation to teachers' overall beliefs about mathematical problem-solving. While there were no statistical differences in their prevailing beliefs regarding whether the teacher was in a high or low-performing school, each teacher strives to find and learn the best ways to present mathematical problem-solving strategies to students. As encouraged by NCTM, the focus of mathematics in schools has shifted from rules, procedures, and rote memorization to reasoning, problem-solving, and meaning. Teachers must plan student activities that recognize the importance of ambiguity in the instructional strategies and embed them in students' planned experiences.

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