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Exploring the Teachers Beliefs and Perceptions on Mathematics Teaching: Empirical Evidences from High Schools in Kampong Thom Province, Cambodia

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ABSTRACT

Teacher beliefs and self-efficacy play essential roles in shaping mathematics instruction and students' learning experiences. However, limited evidence has explained how mathematics self-efficacy relates to mathematics teaching self-efficacy among Cambodian teachers. This study aimed to examine the relationship between these two forms of self-efficacy and teachers' preferences for conceptual or procedural teaching approaches. A quantitative research design was employed involving 85 high school teachers who taught Grades 7–12 in Kampong Thom Province, Cambodia, selected through convenience sampling. Data were collected using the Mathematics Teaching and Mathematics Self-Efficacy (MTMSE) survey and analyzed using Cronbach's alpha, Pearson product–moment correlation, and chi-square tests in SPSS. The MTMSE demonstrated excellent overall reliability, with a Cronbach's alpha coefficient of 0.95, while the conceptual–procedural teaching subscale showed lower reliability, with a coefficient of 0.55. Teachers reported higher mathematics self-efficacy (M = 158.9) than mathematics teaching self-efficacy (M = 134.8). A strong and statistically significant correlation was found between the two variables ($r = 0.77$, $p < 0.01$). The relationship also tended to become stronger with increased teaching experience. These findings indicated that mathematical confidence supported instructional confidence, although mastery of mathematical content did not automatically ensure equivalent teaching confidence. Professional development should therefore integrate mathematical knowledge, pedagogical competence, and conceptual teaching strategies to strengthen mathematics instruction.

INTRODUCTION

Researchers have demonstrated the importance of teacher self-efficacy and its influence on different types of classroom learning environments. Few would dispute that teachers' beliefs affect their perceptions and judgments, which subsequently influence their classroom behaviors, or that understanding the belief systems of teachers and teacher candidates is essential for improving professional development and instructional strategies (Pajares, 1992). According to Bandura (1993), teachers' perceptions of their own ability to inspire and facilitate learning influence the types of learning environments they create and the level of academic achievement their students attain. Teacher self-efficacy has also been shown to influence student self-efficacy. Siegle and McCoach (2007) suggested that teachers can enhance students' self-efficacy by modifying instructional strategies with appropriate training and effort. The present study was based on the premise that students' learning outcomes and self-efficacy are influenced by teachers' instructional strategy choices and classroom environments.

The National Research Council (NRC) (2001) described mathematical proficiency as consisting of five components: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. These five interrelated and interdependent constructs influence how students develop mathematical competence, how teachers promote mathematical proficiency, and how teachers are prepared to achieve the goal of mathematical proficiency. Conceptual understanding refers to comprehending mathematical concepts, operations, and relationships (Chhun, 2025). In addition, educational researchers and theorists have proposed various definitions of procedural and conceptual knowledge. Procedural knowledge includes the "formal language, or symbol representation system, of mathematics" (Hiebert, 1986, p. 6), the "rules, algorithms, or procedures used to solve mathematical tasks" (Hiebert, 1986, p. 6), and the "ability to execute action sequences to solve problems" (Rittle-Johnson, Siegler, & Alibali, 2001, p. 346). Conceptual knowledge has been defined as either flexible "implicit or explicit understanding of the principles that govern a domain and of the interrelations between units of knowledge in a domain" (Rittle-Johnson, Siegler, & Alibali, 2001, pp. 346–347) or "knowledge that is rich in relationships" (Hiebert, 1986, p. 3). Skemp (1976) described two related categories of understanding: instrumental understanding, which involves applying rules without necessarily understanding their underlying logic, and relational understanding, which involves knowing both what to do and why it works. Although the present study focused on instructional strategies that promote different types of understanding, these concepts are relevant to categories of knowledge and student comprehension (Pol-Lim, 2018).

Teaching frequently provides professional flexibility for selecting appropriate instructional strategies within the required curriculum. The Curriculum Framework of the Ministry of Education, Youth and Sport (2018) has influenced current trends in mathematics education, emphasizing conceptual teaching of mathematics as a foundation for procedural skill development (Chhun, 2025). Teachers' instructional decisions are influenced by factors such as self-efficacy, interest, training, and resource availability (Raymond, 1997). Therefore, it is important to examine whether teachers prioritize conceptual foundations to support students' mathematical understanding or emphasize the application of algorithms, rules, and memorization.

The present study investigated the relationship between productive disposition, particularly self-efficacy, and instructional strategies that promote procedural fluency and conceptual knowledge. This study contributed to understanding how teachers' mathematics self-efficacy and mathematics teaching self-efficacy influence instructional behaviors, including the relationship between mathematics self-efficacy and mathematics teaching self-efficacy and teachers' preferences for procedural or conceptual teaching approaches. Specifically, this study addressed three research questions: (1) What is the relationship between mathematics teaching self-efficacy and mathematics self-efficacy? (2) What is the relationship between teachers' preferences for conceptual or procedural teaching approaches and their mathematics self-efficacy? and (3) What is the relationship between teachers' mathematics teaching self-efficacy and their preferences for conceptual or procedural teaching approaches?

In this study, mathematics self-efficacy and mathematics teaching self-efficacy were treated as independent variables. Teachers' responses to questions regarding the mathematical subjects in which they felt most and least competent were used to assess their preferences for conceptual and procedural teaching approaches as dependent variables. It was expected that teachers would demonstrate varying levels of mathematics self-efficacy and mathematics teaching self-efficacy depending on the subject area and that their tendency to adopt conceptual or procedural teaching approaches would vary according to their levels of self-efficacy.

METHOD

This study employed a quantitative approach to examine the independent variables of mathematics self-efficacy and mathematics teaching self-efficacy and their relationship with dependent variables related to conceptually or procedurally focused teaching approaches. The analysis examined variations in self-efficacy levels and their association with instructional strategies.

The study involved 85 high school teachers who taught Grades 7–12 in Kampong Thom Province. Participants were selected using convenience sampling (Patton, 1990), and informed consent was obtained before data collection.

Data were collected using the Mathematics Teaching and Mathematics Self-Efficacy (MTMSE) survey, which was developed based on Pajares and Kranzler's (1995) Mathematics Self-Efficacy Scale Revised (MSES-R) and Enochs, Smith, and Huinker's (2000) Mathematics Teaching Efficacy Beliefs Instrument (MTEBI). The instrument measured mathematics self-efficacy, mathematics teaching self-efficacy, and teachers' preferences for conceptual or procedural teaching approaches.

The mathematics self-efficacy scale was adapted from Pajares and Kranzler's (1995) MSES-R and modified for high school teachers based on the target population of the study. The mathematics teaching self-efficacy scale assessed teachers' confidence in teaching various mathematics content areas aligned with National Council of Teachers of Mathematics (NCTM) content standards. The conceptual and procedural teaching scale consisted of 12 items adapted from Hiebert et al. (1992) and Skemp (1987) to evaluate teachers' instructional preferences.

The readability, validity, and reliability of the MTMSE instrument were evaluated. The readability of each subscale was assessed using the Gunning fog index (Gunning, 1952), and the average readability score was calculated for the overall instrument.

The MTMSE data were analyzed using SPSS. Reliability analysis was conducted using Cronbach's alpha to evaluate the consistency of the instrument and its subscales. Pearson product–moment correlation analysis was performed to examine the relationships between independent and dependent variables. Chi-square tests were used to analyze associations between categorical variables, including teachers' preferences for conceptual or procedural approaches when teaching mathematics topics in which they felt most or least confident.

RESULTS AND DISCUSSION

Results of Reliability of Research Instrument

The National Council of Teachers of Mathematics (NCTM) Standards (2000), the Mathematics Self-Efficacy Survey – Revised (MSES-R) (Kranzler & Pajares, 1997), the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs, Smith, & Huinker, 2000), and other recent research on mathematics education served as the foundation for the development of the Mathematics Teaching and Mathematics Self-Efficacy (MTMSE) survey.

Table 1. Cronbach's Alpha Coefficient for Each Part of the MTMSE (n=85)

Part	Purpose	Source	Source Reliability	Study Reliability
1.	Mathematics Self-Efficacy Problems	MSES-R (Kranzler & Pajares, 1997) Problems Subscale	0.90	0.90
2.	Mathematics Teaching Self-Efficacy	MTEBI (Enochs, Smith, & Huinker, 2000) Personal Efficacy Subscale	0.88	0.85
3.	Mathematics Self-Efficacy Tasks	MSES-R (Kranzler & Pajares, 1997) Tasks Subscale and NCTM (2000) Content Standards	0.91	0.86
4.	Mathematics Teaching Self-Efficacy Content	NCTM (2000) Content Standards	N/A	0.88
5.	Conceptually or Procedurally Oriented Teaching Methods	N/A	N/A	0.55
6.	Demographic Questions	N/A	N/A	N/A
1-5.	Full Instrument	N/A	N/A	0.95

For each component of the MTMSE, Table 1 above displays reliability using Cronbach's alpha coefficient of internal consistency in comparison to the reliability from the unrevised source instrument, if appropriate. These findings clearly show that the MTMSE is a very reliable tool overall, with an alpha level of 0.95. It is also very reliable for the portions on mathematics self-efficacy and mathematics teaching self-efficacy, all of which have alpha levels greater than 0.85. With an alpha level of 0.55, the conceptual/procedural portion of the survey has lower reliability, which could be attributed to the questions' breadth as opposed to the other sections' more focused mathematics themes. During the study's qualitative interview phase, teachers' preferences for procedural or conceptual instruction were made clear. The use of quantitative measurements to evaluate conceptually and procedurally oriented teaching methods should be investigated further.

The samples used in earlier research using the MSES-R or MTEBI instruments were different from those used in this investigation. A sample of college students took the MSES-R (Kranzler & Pajares, 1997). A sample of preservice primary teachers participated in the MTEBI (Enochs, Smith, & Huinker, 2000). There is a lot of research on self-efficacy for these two groups, but there aren't many studies on self-efficacy in math or math education that utilize practicing primary teachers as their sample, and none that employ the MSES or MTEBI. The MSES-R has been used with college students (Pajares & Kranzler, 1997), high school freshmen (Nielsen & Moore, 2003), and practicing elementary teachers in the current study, among other studies. Nielsen and Moore (2003) validated that the MSES-R could be reliably administered in various contexts. Overall, the consistent reliability results when compared to the reliabilities of the source studies indicate that MTMSE results are trustworthy for the population of active elementary teachers in the current investigation.

Results of Descriptive Statistics

The statistical analysis program SPSS was used to enter the survey and interview data. Part 2 survey items measuring self-efficacy in teaching mathematics were phrased in both positive and negative ways. For data analysis, negatively phrased statements were directionally recoded to match positively expressed statements. The six Likert-scaled responses were converted to numbers 1 through 6 in order to obtain the totals for mathematics self-efficacy and mathematics teaching self-efficacy. All 31 items measuring mathematics teaching self-efficacy (parts 2 and 4) and all 31 items measuring mathematics self-efficacy (parts 1 and 3) have sums. A score ranging from 31 to 186 points was obtained for each set of 31 questions.

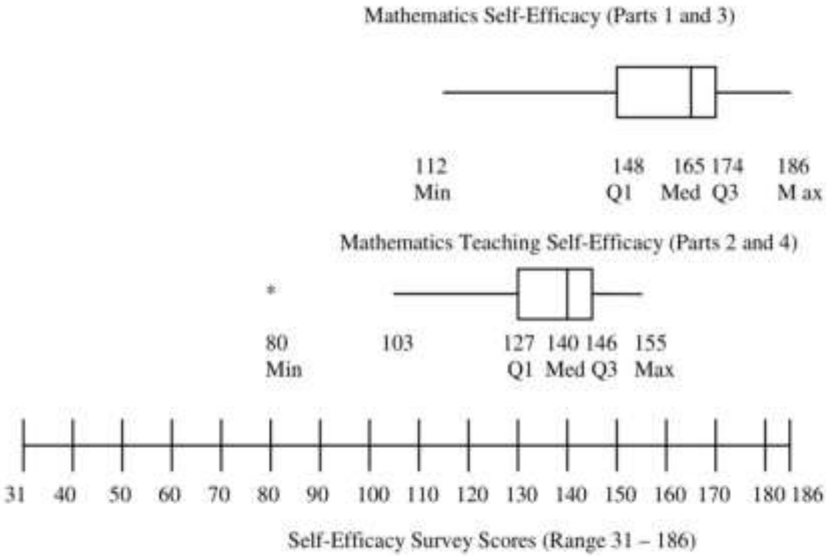

Figure 1. Results of Box-and-Whisker Charts for Mathematics and Mathematics Teaching Self-Efficacies

When comparing the two variables directly, care should be taken because the two sets of questions differed. However, as shown in Figure 2 above, box-and-whisker charts are useful for viewing each variable. The teachers' answers to the mathematics teaching self-efficacy questions were more similar than those to the mathematics self-efficacy questions, as seen by the slightly smaller range for mathematics teaching self-efficacy. Additionally, note that there is one outlier at the bottom end of the mathematics teaching self-efficacy data. Values that were greater than 1.5 times the inner quartile range above the third quartile or below the first quartile were considered outliers. This indicates that compared to the rest of the sample, one teacher's self-efficacy rating for teaching mathematics was substantially lower. She was categorized as having low self-efficacy for both teaching and math. This teacher, who teaches third grade in a conventional classroom, participated in both the study's survey and interview phases.

Lastly, the box-and-whisker plots demonstrate that teachers answered the mathematics self-efficacy questions more frequently overall than the mathematics teaching self-efficacy questions. Comparing the means of mathematics self-efficacy (158.9) and mathematics teaching self-efficacy (134.8) reveals this once more. In actuality, more than half of the sample provided answers for mathematics self-efficacy that were higher than the highest response for mathematics teaching self-efficacy, and 75% of the teachers provided answers for mathematics self-efficacy that were higher than the third quartile mark.

Those who think that instructors are more at ease teaching the mathematical ideas of their specific grade than doing math problems and tasks outside of the classroom in general may find these descriptive statistics startling. The distinction between mathematics self-efficacy and mathematics teaching self-efficacy could be explained by the fact that whereas teaching methods in the field of mathematics education are dynamic, mathematical concepts and skills are generally static. Teaching strategies are always evolving and, ideally, getting better as math teachers try to figure out how to teach a wide range of mathematical concepts and abilities to classrooms of individual students. However, a greater set of mathematics self-efficacy responses than mathematics teaching self-efficacy scores is consistent with Ma's (1999) research, which found that before a teacher could promote debate among students, she had to be confident in her own comprehension. Therefore, it may be necessary to have a high level of mathematics self-efficacy before developing a high level of mathematics teaching self-efficacy.

Only three teachers had lower maths self-efficacy scores than maths teaching self-efficacy scores, and one teacher had equal maths and maths teaching self-efficacy scores when comparing each teacher's maths self-efficacy total with her maths teaching self-efficacy total. The mathematics self-efficacy total and the mathematics teaching self-efficacy total differed by a mean of 24.45 points, with a minimum difference of minus 10 points and a maximum difference of 47 points. These descriptive statistics, along with the box-and-whisker plots in Figure 2 above, revealed that the majority of elementary teachers' self-efficacy in mathematics was higher than their self-efficacy in mathematics instruction.

Then, utilizing natural breaks in the scores for each variable, the participants were divided into about thirds and ranked from lowest to highest, first by sum for mathematics self-efficacy and second by sum for mathematics teaching self-efficacy. Teachers were divided into three categories based on their level of self-efficacy: low, medium, and high. "The natural breaks method is based on the assumption that data fall naturally into meaningful groups which are separated by breaks" (Smith, 1986, p. 64). It has been used to group participants for data analysis in attitudinal studies, including those by Parrott and Hewitt (1978) and Solomon et al.

(1997). Figure 3 below presents the scatterplot comparing between Mathematics Teaching Self-Efficacy (MTSE) and Mathematics Self-Efficacy (MSE).

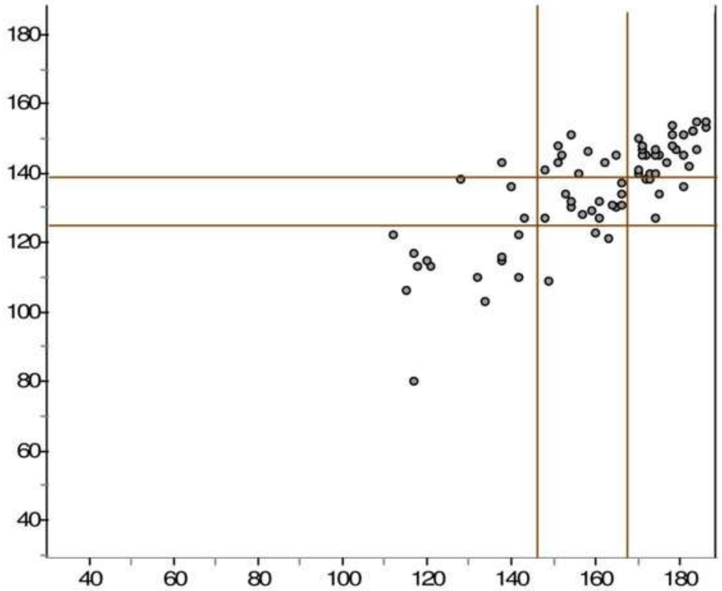

Figure 2. Results of Scatterplot Comparing Between MTSE and MSE

Each participant's location within low, medium, or high self-efficacy categories for each variable is displayed in the scatterplot in Figure 3 above.

Table 2. Results of Frequencies of Surveyed Teachers by Self-Efficacy (n=85)

		MSE		
		High	**Moderate**	**Low**
MTSE	High	29	10	2
	Moderate	6	14	5
	Low	0	5	15

Table 2 displays the categories' frequencies. With 29 teachers, the most prevalent category was strong mathematics self-efficacy and high mathematics teaching self-efficacy. Fifteen (15) instructors were classified as having poor self-efficacy in mathematics and low self-efficacy in teaching mathematics.

Results of Pearson's Product Moment Correlation

Pearson's Product Moment Correlation was used to evaluate the survey data's total mathematics teaching self-efficacy and total mathematics self-efficacy variables. There is a substantial ($p < 0.01$) correlation between the variables of mathematics teaching self-efficacy and mathematics self-efficacy, as indicated by the correlation level of 0.77. The correlation between mathematics self-efficacy and mathematics teaching self-efficacy was 0.83. Additionally, interview data revealed a substantial link between mathematics self-efficacy and mathematics teaching self-efficacy. This is an important finding for the current study because no other studies that compare the variables of mathematics self-efficacy and mathematics teaching self-efficacy were discovered in the literature on mathematics education.

Part 1 of the MTMSE survey, which measures self-efficacy on math problems, and Part 3, which measures self-efficacy on math tasks, showed a correlation of 0.74. This indicates that the scores on the survey's first and third sections had a rather good correlation. A comparison of the MTMSE survey's part 2, which assesses self-efficacy in teaching mathematics generally, and part 4, which assesses self-efficacy in teaching particular mathematics topics, showed a correlation of 0.76, demonstrating yet another substantial correlation between the survey's scores on parts 2 and 4. In the survey, participants were asked which of the following subjects they would most like to teach: Language Arts, Reading, Math, Science, and Social Studies.

Table 3. Results of Correlation of Mathematics and Mathematics Teaching Self-Efficacies by Subject

No.	Subject	The preferred subject to teach	The least preferred subject to teach
1.	Mathematics	0.80 (n=50)	0.56 (n=8)
2.	Not Mathematics	0.64 (n=24)	0.74 (n=61)

Table 3 above shows that 50 teachers said mathematics was their favorite topic to teach, while eight said it was their least favorite. There was a significant difference between teachers who selected mathematics as their favorite subject and those who did not, according to a Pearson correlation analysis of mathematics self-efficacy and mathematics teaching self-efficacy. As anticipated, the connection between mathematics and mathematics teaching self-efficacy was highest among instructors whose favorite subject was mathematics (0.80) and lowest among those whose least favorite subject was mathematics (0.56).

Additionally, NCTM subject strand was also used to compare mathematics self-efficacy and mathematics teaching self-efficacy. Instructors were asked to list the mathematical subjects they felt most and least comfortable instructing. One of five NCTM content strands—number and operation, algebra, geometry, measurement, or data analysis and probability—was assigned to topics from part 4 of the survey. Table 4 below presents the correlation between mathematics self-efficacy and mathematics teaching self-efficacy by most and least confident topic grouped by mathematics content strand.

Table 4. Results of Correlation Between MSE and MTSE by Most and Least Confident

No.	Strand of NCTM	Topic of Most Confidence	Topic of Least Confidence
1.	Atraumatic	0.71 (n=24)	0.89 (n=18)
2.	Algebra	0.87 (n=17)	* (n=8)
3.	Geometry	* (n=8)	* (n=6)
4.	Measurement	0.81 (n=12)	0.69 (n=31)
5.	Data Analysis and Probability	0.80 (n=16)	0.81 (n=18)
6.	No topic selected	* (n=8)	* (n=4)

Note: * it means there is no correlation was calculated for n <10.

All of the computed correlations were quite strong, with r > 0.69, as shown in Table 4 above. For n < 10, correlations were not computed. Although it varies slightly each mathematics strand, there is generally a substantial association between mathematics self-efficacy and mathematics teaching self-efficacy.

In term of correlation with demographic data, a number of demographic factors, such as undergraduate major, school district type, gender, whether or not the teacher was a parent, and years of teaching experience, were associated with mathematics self-efficacy and mathematics teaching self-efficacy. These computations showed no significant relationships, with the exception of the number of years of teaching experience.

Table 5. Results of Correlation Between MSE and MTSE by Years Teaching Experience

Years Teaching Experience		**Correlation**
From 3-5 Years	(n=5)	*
From 6-10 Years	(n=31)	0.76
From 11-15 Years	(n=15)	0.75
From 16-20 Years	(n=17)	0.84
From 21-30 Years	(n=12)	0.83
From 30 Years or More	(n=5)	0.93

Table 5 above shows that the link between mathematics and mathematics teaching self-efficacy increases with the number of years of teaching experience. This finding implies that self-efficacy increases with time. Additionally, this outcome tends to support the idea that higher levels of mathematics self-efficacy are associated with higher levels of mathematics teaching self-efficacy if teachers' content knowledge develops via experience.

CONCLUSION

The study concluded that mathematics self-efficacy was closely associated with mathematics teaching self-efficacy among 85 high school teachers in Kampong Thom Province, Cambodia. The Mathematics Teaching and Mathematics Self-Efficacy (MTMSE) instrument demonstrated excellent overall reliability (Cronbach's alpha = 0.95), although the conceptual–procedural teaching subscale showed comparatively low reliability (Cronbach's alpha = 0.55). Teachers reported higher mathematics self-efficacy ($M = 158.9$) than mathematics teaching self-efficacy ($M = 134.8$), indicating that confidence in understanding and solving mathematical problems did not necessarily translate into equivalent confidence in teaching mathematics. A strong and statistically significant correlation was found between the two forms of self-efficacy ($r = 0.77$, $p < 0.01$). Moreover, the relationship generally became stronger with increased teaching experience, suggesting that sustained classroom practice may help teachers integrate mathematical knowledge with instructional competence. These findings emphasized the importance of strengthening both subject-matter knowledge and pedagogical confidence in mathematics teacher development programs.

Future research should involve larger and more representative samples from multiple provinces in Cambodia and employ probability sampling techniques to improve the generalizability of findings. Longitudinal or experimental designs are also recommended to determine whether targeted professional development programs can enhance mathematics teaching self-efficacy and promote a balanced use of conceptual and procedural teaching approaches. The conceptual–procedural teaching subscale should be refined and revalidated due to its relatively low internal consistency. Future studies could also combine survey data with classroom observations, teacher interviews, and student achievement data to examine whether teachers' reported beliefs correspond with their actual instructional practices and students' learning outcomes. Investigating other potentially influential factors, including professional training, school resources, curriculum support, and institutional contexts, would provide a more comprehensive understanding of mathematics teaching practices in Cambodia.

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