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The teacher's perspective on effective of mathematic teaching at primary school in Cambodia

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Abstract

The research paper examines mathematics teaching and learning outcomes in primary schools in Cambodia. It highlights the importance of quality education in fostering student development and addresses challenges such as academic performance disparities and learning loss. The study emphasizes the need for effective teaching strategies, formative assessment, and differentiated instruction to enhance mathematical proficiency and overall educational achievement. The fieldwork occurred from June to July 2023 in four districts of Kampong Chhnang province. A sample size of 278 teachers from 4 study districts were selected, and individual face-to-face interviews were conducted using a structured questionnaire. The research employed a mixed-methods approach, combining quantitative methods such as the Weighted Average Index (WAI), t-tests, and chi-squared tests with qualitative methods like desk reviews and interviews with stakeholders in the education sector. The WAI assessed teachers' perceptions of mathematics education and students' learning outcomes. T-tests were used to explore gender differences in perceptions, and chi-squared tests were used to examine associations between respondent gender and teaching practices. The study highlights that primary school teachers' evolving perceptions towards teaching mathematics emphasizes the need for support to enhance teaching and learning outcomes. Teachers employed alternative strategies, prioritized conceptual understanding, and tailored lessons to individual proficiency levels. They promoted active student participation through collaborative activities and provided avenues for student choice despite curriculum constraints. By integrating abstract and concrete ideas in teaching, teachers facilitated connections between mathematics and real-life scenarios. Moreover, significant differences were observed in how male and female teachers engaged with student involvement. Encouraging the use of manipulatives was recommended to aid in concept comprehension. Policymakers should implement professional development for teachers and allocate resources to the school level to enhance mathematics education. Promoting active student participation involves student-centered learning to engage the students' voice and participation in mathematics learning. Achieving gender equality in math education requires

providing professional development opportunities for teachers focused on gender equity in mathematics education.

Key Word: Mathematic, Cambodia, Primary School, Teaching Methodology

Background

Education equips people with the knowledge and skills necessary to comprehend and utilize resources to exist fully. To help students reach their full potential, education should be a focused, well-organized endeavor that actively involves them in learning. For pupils to develop their unique qualities and take responsibility for the country's development, Pancasila-based education aims to strengthen pupils' character, intelligence, talents, and piety toward God (Tohir & Mashari, 2020). Mathematical proficiency is required to develop a scientific and technologically oriented-society (Veloo et al., 2015). Mathematics has a role in human activities derived from the thought process rather than experimental results (Damayanti & Mawardi, 2018). Many pupils hesitate to ask questions when they do not comprehend a concept, therefore, their learning outcomes are poor (Fadila et al., 2014). Repanta and colleagues identified that effective teaching material can help pupils to improve their mathematics learning outcome (Rapanta, et al., 2020) and improves pupils' mathematical dispositions (NCTM, 2015; Dina et al., 2019 & Haji et al., 2019). Clear instructional method that enhances students' academic performance qualifies as successful (Ma, 2009 & Ali et al., 2021). Skilled mathematics teachers used various teaching techniques, approaches, and instruments to make the teaching-learning process more fruitful (Akhtar et al., 2020 & Enrquez et al., 2018). There is always a gap between a teacher's expectations and a spupil's knowledge (Eckert, et al., 1997; Lakshmi & Majid, 2021). Teachers must identify students' learning needs to modify their instruction, and utilize this information to make informed decisions about instructional adaptations. One way to determine the learning needs of students is to get data from them and then assess and analyze it (Feldman & Capobianco, 2008; Gottheiner & Siegel, 2012; Gulikers & Baartman, 2017; Eysink & Schildkamp, 2021). Or, to put it another way, formative assessment and differentiation activities are essential for teachers to carry out when utilizing data to tailor instruction to students' needs (Visscher & Ehren, 2011; Sluijsmans et al., 2013; Schildkamp et al., 2014; Gulikers & Baartman, 2017). Formative assessment provides teachers with information on their students' progress. The results of these assessments are subsequently used as the foundation for teacher accountability and control systems (Alzen et al., 2017).

Cambodia's education system divided into three parts of general education: lower secadry schools from grade 1 to 6, secondary school from grade 7 to 9, high schools from grade 10 to 12. And after complete grade 12 the pupils have to obtance with national exame before continues their higher education (Khut, 2012). And has undergone substantial changes in recent years, with a focus on decentralization and deconcentrating (Pellini, 2007). In line with the 1990 Jomtien World Conference on Education for All (WCEFA), the Royal Government of Cambodia (RGoC) has made significant efforts to improve primary education access across the country (Dy & Ninomiya, 2003). Since the 2000s, the Ministry of Education, Youth, and Sport (MoEYS) has prioritized expanding educational opportunities to ensure that all children, both boys and girls, receive a minimum of 9 years of basic education(Ayres, 1999). From 1980 to 2015, Cambodia successfully met the primary Universal Education-related Millennium Development Goal (MDG2) set by the United Nations, achieving a 94% net enrollment rate in primary schools (ASEAN report, 2017). Cambodia has embraced the Sustainable Development Goals (SDG4) to further progress in education, focusing on attaining quality education between 2015 and 2030 (CoM, 2018). The education-related targets of SDG4, which aim to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, align with Cambodia's Rectangular Strategy Phase IV (2019-2023) (MoP, 2018) and National Strategic Development Plan (NSDP) 2019-2023 (MoP, 2018). To enhance the quality of education, science, and technology, the Ministry of Education, Youth, and Sport (MoEYS) has also developed the Education Strategic Plan (2019-2023) (MoEYS, 2019). The Ministry of

Education, Youth, and Sport (MoEYS) in Cambodia has implemented policies and interventions to eliminate national illiteracy, resulting in an adult literacy rate (15 years and above) of 84.7% in 2022-2023 (MoEYS, 2023). Primary education has been a key focus for the MoEYS as it is essential for individual self-development. However, most primary schools struggle to provide high-quality educational outcomes for their pupils (UNICEF, 2023). In 2019, there were 13,300 public schools, with 11,529 primary schools (86.7%) and 1,771 lower and secondary level schools. The average pupil-teacher ratio was 34 pupils (MoEYS, 2018) . The enrollment rate in primary education has increased from 82.0% in 1997 to over 90.0% in 2022-2023, with girls accounting for 90.5% of the enrollment. The latest data indicates that 86.8% of students completed primary school in 2022-2023, including 89.4% of girls and 85.3% of boys (MoEYS, 2023). The MoEYS has significantly boosted enrollment by providing free education to all children. Between 1995 and 2000, only 33% of 12-year-old children were able to complete their primary education (Dy, 2005).

Despite efforts to improve primary education, there are still concerns regarding students' academic performance, as indicated by national assessments (MoEYS, 2017). Some students require grade repetition, indicating the need for additional support (UNISCO, 2017). Access to early childhood education remains limited, and Cambodia faces challenges in achieving Goal 4 of the education-related targets by 2030 (MoEYS, 2018). In December 2017, Cambodia conducted the PISA-D (International Student Assessment) with over 5,000 15-year-old students in grade 7 or above, assessing their proficiency in science, mathematics, and reading through a 2-hour test. The assessment revealed a significant percentage of students performing below the baseline level of proficiency in reading, mathematics, and science (MoEYS, 2018). Moreover, there is evidence of substantial learning loss among grade six students, with average achievement levels in 2021 being 0.30-0.75 standard deviations lower than the 2016 averages. The decline in learning outcomes is more notable in mathematics compared to the Khmer language (UNICEF, 2023).This research paper was conducted to capture the mathematics teaching and learning outcomes at primary school.

Research Study Area and Methodology

Researcher conducted the research as doctor of philosophy in educational administration. The fieldwork was conducted from June to July, 2023 in four districts of Kampong Chhnang province, including Boribo, Kampong Chhnang, Kampong Trolach, and Rolia Pa-ir district. A sample size of 278 teachers in 4 study districts were selected based on a desired degree of precision of 10%. Individual face-to-face interviews were conducted with 2 to 3 teachers per study school in the classroom to avoid influence from the school director. A structured questionnaire was used for the interviews. The selected teachers in the study schools were randomly sampled using the teacher list provided by the school director. Kampong Chhnang province, located west of the Tonle Sap River, is in Cambodia's central region. It is approximately 91 km away from the capital city, Phnom Penh. The province shares its borders with Kampong Thom to the north, Kampong Cham to the east, Kampong Speu to the south, and Pursat to the west. According to the Ministry of Planning (MoP) data from 2019, the province's total population was 527,027 people (MoP, 2019). In Kampong Chhnang province, there are 279 primary schools spread across eight districts. These schools have a total of 1,776 teachers and a student population of 73,750 pupils. In 2023 education provincial report there was 88.9% as completion rate at primary education, with an annual enrolment rate at primary school 95.6%, and the adult literacy rate in this province 98% (KCH, provincial education report, 2023).

The study employed a mixed-methods approach, incorporating quantitative and qualitative methods to examine mathematics teaching and learning outcomes in the study

schools. A structured questionnaire was developed for data collection, drawing upon previous research and tools published in academic journals. The questionnaire was translated into Khmer language for training purposes and provided to data collectors in May 2023, before the commencement of fieldwork. A pilot test was conducted in five schools after the questionnaire training. The data collected during the pilot test were entered into SPSS (Statistical Package for the Social Sciences) for reliability testing and to identify any areas that required correction based on the pilot test findings. And semi-structured questionnaire was designed based on the primary findings to collect the qualitative data to back up the survey findings. The relevant stakeholders in the education sector included the School director, DoEYS, and PoEYS, who were contacted for interviews.

Desk review, problem analysis, and situation analysis methods were employed for qualitative analysis. Desk review involved collecting, organizing, and synthesizing available reports, previous assessments, and raw data related to mathematics teaching and learning in primary schools. Quantitative analysis was performed using the Weighted Average Index (WAI), t-tests, and chi-squared tests based on survey data. WAI, measured on a five-point scale, was used to assess teachers' perceptions regarding mathematic education for their pupils and pupils' learning outcome. The five-point scale included the following categories: Strongly Disagree (SD) = 0–0.20; Disagree (D) = 0.21–0.40; Moderate (M) = 0.41–0.60; Agree (A) = 0.61–0.80; Strongly Agree (SA) = 0.81–1.00. T-tests were utilized to explore the differences in teachers' perceptions of male and female. Additionally, the chi-squared test was used to examine associations among gender of respondents and practice of mathematic teaching.

Table 1: Sample size copulation

No.	District	Teachers	
		Total population	**Sample Size**
1.	Baribo	203	67
2.	Kampong Chhnang	131	57
3.	Kampong Tralach	255	72
4.	Rolea Pa-ir	441	82
Total:		**1,030**	**278**

Result and Finding

Teachers' Beliefs about Mathematic Teaching

The teacher involved in the research requested to rate capacity on mathematic teaching ***"to what degree on beliefs about mathematic teaching in class"*** with 10 indicators from 1 to 10 as illustrated in (**Table 2**). And Weight Average Index (WAI) with five-point-scale with rang 1 "**very low**" to 5 "**very low**". In overall, teachers rated their capacity in teaching mathematics highly, with similar ratings among female and male teachers. Furthermore, teachers rated indicators 5, 7, 9, and 10 very highly (WAI > 0.80), reflecting their beliefs about teaching mathematics. Additionally, teachers gave high ratings (WAI ≥ 0.61; ≤ 0.80) for indicators 1 to 4, 6, and 8, indicating a strong belief in their capacity to teach mathematics effectively. A T-test analysis was conducted to compare the levels of capacity in teaching mathematics between male and female teachers. Overall, both male and female teachers rated their beliefs about teaching mathematics similarly. However, the analysis revealed that male teachers rated their capacity very highly (WAI = 0.81), which was significantly (p-value = 0.047) higher than the rated by female teachers (WAI = 0.79) for indicator 2, "Understand mathematics concepts well enough to be effective in teaching mathematics." Both male and female teachers rated indicators 1, "know how to teach mathematics concepts effectively," 3, "usually help the student understand mathematics better when a student has difficulty

understanding a mathematical concept," 4, "know what to do to turn students on to mathematics," and 8, "foster student creativity," at a high capacity level (WAI ≥ 0.61; ≤ 0.80). Female teachers rated indicators 5, "control disruptive behavior in the classroom," 6, "get students to believe they can do well in class work," and 9, "adjust teaching lessons to the proper level of individual students," at a very high capacity level (WAI > 0.80) compared to the high capacity ratings given by male teachers (WAI ≥ 0.61; ≤ 0.80), but there was no significant difference between the two gender groups of teachers. Furthermore, both male and female teachers rated indicators 7 and 10 very highly (WAI > 0.80) with similar scores. The research suggested that both male and female teachers have a high capacity in teaching mathematics, with some nuanced differences in the perception of specific indicators, particularly in understanding mathematics concepts well enough for effective teaching.

Table 2: *The assessment of Teachers' Beliefs about Mathematic Teaching*

Attributes	**Male (n=110)**		**Female (n=168)**		**Overall (278)**		**P-value**
	WAI	**OA**	**WAI**	**OA**	**WAI**	**OA**	
1-I know how to teach mathematics concepts effectively.	0.79	H	0.77	H	0.78	H	0.074
2-I understand mathematics concepts well enough to be effective in teaching mathematics.	0.81	VH	0.79	H	0.80	H	**0.047**
3-When a student has difficulty understanding a mathematics concept, I will usually help the student understand it better.	0.80	H	0.78	H	0.79	H	0.136
4-I do know what to do to turn students on to mathematics.	0.79	H	0.79	H	0.79	H	0.607
5-I control disruptive behavior in the classroom.	0.82	VH	0.80	H	0.81	VH	0.236
6-I get student to belief they can do well in class work.	0.82	VH	0.80	H	0.80	H	0.080
7-I-gauge student comprehension of what I have taught.	0.84	VH	0.82	VH	0.83	VH	0.105
8-I foster student creativity.	0.78	H	0.77	H	0.77	H	0.636
9-I adjust my lesson to the proper level of individual students.	0.82	VH	0.80	H	0.81	VH	0.199
10-I assist families in helping their children do well in school.	0.82	VH	0.84	VH	0.83	VH	0.423
Overall	0.81	VH	0.80	H	0.80	H	0.117

Note: WAI=Weight Average Index, OA=Overall Assessment, five-point scale; 0-0.20 = Very Low (VL), 0.21-0.40 = Low (L), 0.41-0.60 = Moderate (M), 0.61 – 0.80 = High (H), 0.81 – 1 = Very High (VH); Significant at p-value< or = 0.05

Although male and female teachers demonstrated a high capacity in teaching mathematics overall, nuanced differences emerged in the perception of specific indicators. The study highlights the significance of understanding mathematics concepts well enough for effective teaching, where male teachers notably rated their capacity significantly higher than female teachers. The Ministry of Education, Youth, and Sport has emphasized capacity building for teachers through the national program for primary educators call teacher upgrading program, ensuring that all teachers have completed at least an undergraduate degree to meet the necessary qualifications. [KII-1].

Through personal communication with a teacher, it was noted that access to the Ministry of Education, Youth, and Sport's online platform, 'Sala Digital App,' has facilitated easy and comprehensive learning opportunities for mathematics lessons and teaching methods. This accessibility has empowered educators like him to enhance their capacity in mathematics teaching effectively [Per-Communication-1].

Teachers' Confidence of Mathematic Topic

Table 3 reveals that overall, teachers assess their confidence in mathematical topics at a high degree (WAI=0.78). Male teachers rate their confidence even higher (WAI=0.80) than female teachers, who assess their confidence at a high degree (WAI=0.77), with a significant difference (p-value=0.050). Additionally, teachers assess their confidence at a very high degree (WAI ≥0.81) for attributes 1 to 4 and 12. They rate their confidence at a high degree (WAI ≥0.61 to ≤0.80) for attributes 5 to 11 and 13 to 16, as illustrated in (**Table 3**). The analysis suggests that while overall confidence levels in mathematical topics are high among teachers, there are notable differences in confidence levels between male and female teachers for specific mathematical attributes.

A t-test was used to analyze the different levels of confidence in mathematical topics between male and female teachers. The t-test revealed that male and female teachers have similar confidence levels in mathematical topics related to attributes 1 to 7, 9, 11 to 13, and 16. These results indicate that while male and female teachers generally have similar confidence levels in most mathematical topics, there are specific areas where significant differences in confidence exist between the two groups. For example, male teachers rate their confidence at a high degree (WAI ≥0.61 to ≤0.80) significantly higher than female teachers (p-value = 0.05) for attribute 8, involving decimal numbers (the four operations of decimals, Word Problems...) and attribute 10, covering Average and Rate. In contrast, female teachers assess their confidence at a high degree (WAI ≥0.61 to ≤0.80) higher than male teachers significantly (p-value=0.05) for attribute 14, which includes Geometries (area and perimeter, angles, triangles, quadrilaterals, volume of solids and liquids...), and attribute 15, involving Speed (distance and speed, average speed). These findings indicate that there are specific areas within the realm of mathematics where male and female teachers exhibit differing levels of confidence. Male teachers demonstrate higher confidence in dealing with Decimal Numbers and concepts related to Average and Rate, while female teachers showcase higher confidence in Geometries and Speed-related topics.

Table 3: *the assessment of Teachers' Confidence of Mathematic Topic*

Attributes	**Male (n=110)**		**Female (n=168)**		**Overall (278)**		**P-value**
	WAI	**OA**	**WAI**	**OA**	**WAI**	**OA**	
1- Whole numbers (numbers to 10 million)	0.81	VH	0.80	H	0.81	VH	0.735
2- Addition and subtraction	0.87	VH	0.85	VH	0.85	VH	0.171
3- Word problems: addition and subtraction	0.83	VH	0.82	VH	0.83	VH	0.275
4- Multiplication and division	0.83	VH	0.81	VH	0.82	VH	0.097
5- Word problems: multiplication and division	0.81	VH	0.79	H	0.80	H	0.157
6- Fraction (adding, subtracting like and unlike fractions, product and dividing, word problems…)	0.78	H	0.76	H	0.77	H	0.287

7- Ratio (find ratio, equivalent ratios, word problems…)	0.77	H	0.74	H	0.76	H	0.056
8- Decimal numbers (the four operations of decimals, Word Problems…)	0.79	H	0.75	H	0.77	H	**0.044**
9- Percentage (percent, percentages as fractions and decimals and reverse, percentage of quantity, solving word problems)	0.77	H	0.74	H	0.75	H	0.175
10- Average and rate	0.76	H	0.71	H	0.73	H	**0.010**
11- Measurements (length, time, wight and capacity)	0.80	H	0.79	H	0.80	H	0.391
12- Currencies	0.83	VH	0.82	VH	0.83	VH	0.495
13- Statistics (picture and line graph, pie Charts…)	0.77	H	0.75	H	0.76	H	0.180
14- Geometries (area and perimeter, angles, triangles, quadrilaterals, volume of solids and liquids...)	0.77	H	0.73	H	0.75	H	**0.011**
15- Speed (distance and speed, average speed)	0.77	H	0.73	H	0.75	H	**0.043**
16- Algebras	0.79	H	0.77	H	0.78	H	0.435
Overall	**0.80**	**H**	**0.77**	**H**	**0.78**	**H**	**0.050**

Note: WAI=Weight Average Index, OA=Overall Assessment, five-point scale; 0-0.20 = Very Low (VL), 0.21-0.40 = Low (L), 0.41-0.60 = Moderate (M), 0.61 – 0.80 = High (H), 0.81 – 1 = Very High (VH); Significant at p-value< or = 0.05

Teachers' Confidence in Mathematic Teaching

Overall, teacher rated the high degree (WAI = 0.80) of confidence in mathematic teaching similar between male and female teacher. The attribute 3.) *I put more emphasis on getting the correct answer than on the process followed*, teacher rated in overall high degree (WAI= 0.77) while group of male teachers rated high degree (WAI = 0.80) higher than female teacher rated high degree (WAI = 0.75) significant at (p-value = 0.013). Attribute 1.) *Developing speed and accuracy of math skills improves understanding*, teacher rated overall at high degree (WAI = 0.78) similar between male and female teacher. Likely, the attribute 7.) *I frequently ask my students to explain why something works. And attribute 8.) Formulas and rules should be presented first when introducing new topics,* teacher rated high degree (WAI ≥0.61 to ≤0.80) similar between male and female teacher. As well as, overall teacher rated very high (WAI= 0.82) for attribute 2.) *I encourage students to use manipulative to explain their mathematical ideas to other students,* and both teacher male and female rated similarity at very high degree. Attribute 4.) *When introducing math topics which I am confident teaching, it is important to first build understanding of a concept before focusing on algorithms* teacher rated high degree (WAI=0.79) while male teacher rated very high degree (WAI=0.81) similar to female teacher rated at high degree (WAI=0.79). In addition, the attribute 5.) *I like my students to master basic mathematical operations before they tackle complex problems,* teacher rated very high (WAI= 0.83) in overall, while similar between male and female teacher. Likely the attribute 9.) *A lot of things about mathematics must simply be accepted as true and remembered*, and attribute 6.) *When two students solve the same problem correctly using two different strategies I have them share the steps they went through with each other,* teacher also rated very high degree in overall, and similarity between male and female teacher.

The result of analysis suggested that teacher confidence in mathematic teaching to their pupils, the teacher both male and female rated the similar on their confidence in mathematic teaching. As well as, only the attribute 3.) put more emphasis on getting the correct answer than on the process followed, that significant deferent between male and female teacher.

Table 4: *teacher's perception on mathematic teaching*

Attributes	**Male (n=110)**		**Female (n=168)**		**Overall (278)**		**P-value**
	WAI	**OA**	**WAI**	**OA**	**WAI**	**OA**	
1-Developing speed and accuracy of math skills improves understanding.	0.79	H	0.77	H	0.78	H	0.251
2-I encourage students to use manipulative to explain their mathematical ideas to other students.	0.83	VH	0.82	VH	0.82	VH	0.499
3-I put more emphasis on getting the correct answer than on the process followed,	0.80	H	0.75	H	0.77	H	**0.013**
4-When introducing math topics which I am confident teaching, it is important to first build understanding of a concept before focusing on algorithms.	0.81	VH	0.79	H	0.79	H	0.289
5-I like my students to master basic mathematical operations before they tackle complex problems.	0.84	VH	0.83	VH	0.83	VH	0.299
6-When two students solve the same problem correctly using two different strategies I have them share the steps they went through with each other.	0.84	VH	0.84	VH	0.84	VH	0.992
7-I frequently ask my students to explain why something works.	0.76	H	0.78	H	0.77	H	0.315
8-Formulas and rules should be presented first when introducing new topics.	0.73	H	0.74	H	0.74	H	0.602
9-A lot of things about mathematics must simply be accepted as true and remembered.	0.81	VH	0.81	VH	0.81	VH	0.932
10-When introducing math topics which I am confident teaching, it is important to first build understanding of a concept before focusing on algorithms.	0.81	VH	0.79	H	0.80	H	0.155
Overall	**0.80**	**H**	**0.79**	**H**	**0.80**	**H**	**0.321**

Note: WAI=Weight Average Index, OA=Overall Assessment, five-point scale; 0-0.20 = Very Low (VL), 0.21-0.40 = Low (L), 0.41-0.60 = Moderate (M), 0.61 – 0.80 = High (H), 0.81 – 1 = Very High (VH); Significant at p-value< or = 0.05

The relationship of male and female Teachers' Practice of Mathematic Teaching

The teacher requested respond to question ***"which the following mathematic practice method did you applied?"*** And 6 questions from 1 to 6 illustrated in (**Table 5**) with answer "Yes" and "No". A Chi-square test was applied to analyze the relationship between male and female teachers in the practice of teaching mathematics in class, with a significance level of

p-value ≤ 0.05. The Chi-square test examined the relationship between different teaching practices and the gender of the respondents. The results of the analysis suggest that there is no significant association between integrating abstract and concrete ideas in teaching mathematics and the gender of the respondents, whether male or female. Similarly, there is no significant relationship for attributes 2) helping students see the relationship between mathematics and real-world experiences, knowledge, and events, and 3) linking previous topics with new topics in mathematical teaching. In these cases, there is no significant relationship between the gender of the respondents, as indicated by p-values greater than 0.05. This failure to reject the null hypothesis suggests that there is no significant relationship when the p-value is less than or equal to 0.05.

Table 5: *the associate relationship of gender of respondents on practice of mathematic teaching*

Attribute	**Gender**			**X^2**	**P-value**
	Male	**Female**	**Overall**		
1- I integrate abstract and concrete ideas in mathematic teaching.					
Yes	74	98	172	2.252	0.165
No	36	70	106		
Overall	110	168	278		
2- I help students see the relationship between mathematics and the real-world experience, knowledge, and event.					
Yes	67	84	151	3.188	0.085
No	43	84	127		
Overall	110	168	278		
3- I link between previous topic and new topic in mathematic teaching.					
Yes	72	104	176	0.361	0.611
No	38	64	102		
Overall	110	168	278		
4- I promote student voice in the mathematics classroom.					
Yes	93	120	213	6.384	**0.014**
No	17	48	65		
Overall	110	168	278		
5- Students participate in choosing learning content or activities in mathematics.					
Yes	61	68	129	5.997	**0.019**
No	49	100	149		
Overall	110	168	278		
6- Students collaborate and work together to actively learn in mathematics.					
Yes	87	112	199	5.044	**0.029**
No	23	56	79		
Overall	110	168	278		

Note: significant p-value = 0.05; X2 = Pearson Chi-Square

In contrast, the Chi-square test revealed an interesting significant result for attributes 4 and 5 between male and female teacher respondents, as the p-values were ≤ 0.05, leading to the acceptance of the null hypothesis. Attribute 4, which involves promoting student voice in the mathematics classroom, showed a significant relationship between the gender of respondents, with X^2 = 6.384 and a p-value of 0.014, thus accepting the null hypothesis. Similarly, attribute 5, where students participate in choosing learning content or activities in mathematics, also displayed a significant associated relationship with the gender of

respondents, accepting the null hypothesis with $X^2 = 5.997$ and a p-value of 0.019. Likewise, attribute 6, where students collaborate and work together to actively learn in mathematics, showed an associated relationship with the gender of respondents, with $X^2 = 5.044$ and a p-value of 0.029, leading to the acceptance of the null hypothesis. These findings suggest that there are significant differences in how male and female teacher respondents perceive and engage with these specific attributes related to student involvement in the mathematics classroom.

Conclusion and policy implication

According to the findings, primary school teachers in this study exhibited shifting mathematical perceptions. During their time in primary school, these teachers held beliefs about teaching mathematics. They consistently employed strategies in teaching, assessed students' understanding of what they were learning, helped students grasp mathematical concepts, and supported families in aiding their children's success in school. However, despite these efforts, students' test results still posed challenges in certain areas. This indicates that teachers require assistance to enhance their teaching and learning of mathematics at the primary level. The classroom environment has the potential to motivate individuals to learn mathematics [FGD-1]. Teachers' actions, including how they teach mathematics, their discourse, and their demeanor, have been demonstrated to impact how students learn mathematics and can instigate mathematics anxiety in students [KII-2]. The officer at Provincial Department of Education, Youth and Sport, recognizing the influence that evolving perceptions of mathematics can have on teachers and their students, school systems and administrators should offer support groups and external resources to assist instructors in discussing and reflecting on their thoughts and emotions regarding math and teaching arithmetic [KII-1]. Some teachers feel they lack the support necessary to address their mathematical beliefs and teaching experiences. Consequently, there is a pressing need to provide support for teachers [KII-SD2].

In terms of flexible teaching methodologies, this study reveals that teachers are inclined to explore alternative teaching strategies, particularly with topics they are confident in teaching. They prioritize building a solid understanding of a concept before delving into algorithms when introducing mathematical topics, they are comfortable with. They focus on enhancing the speed and accuracy of mathematical skills to deepen understanding and frequently prompt students to explain the reasoning behind their solutions. There is a greater emphasis on obtaining the correct answers rather than just on the process followed. Additionally, they initially present formulas and rules when introducing new topics, establish connections between previous and new topics in mathematics teaching, and tailor their lessons to suit the individual students' proficiency levels. School Director at Boribo district, highlights narratives of teachers who initially struggled with learning mathematics but later underwent transformative experiences that improved their attitudes towards mathematics and enhanced their abilities to learn and teach the subject [KII-SD1].

Teachers employ strategies and activities in their classrooms to promote active student participation and learning. Student engagement is facilitated through collaborative frameworks, opportunities for peer tutoring or teaching, and small group activities. Despite the constraints of a prescribed curriculum that limits student choice in content, teachers provide avenues for students to select content, methods, and mediums during review activities. These options may include practicing problems on individual whiteboards, utilizing software, completing worksheets, or using manipulatives. Creating a welcoming learning environment is paramount for teachers, where students are encouraged to voice their opinions and engage in group projects. The goal is to cultivate a space where students feel

empowered to express themselves. As one teacher noted, "even my quietest students are eager to contribute, feeling at ease sharing their thoughts on any given topic." This inclusive approach aims to ensure that all students feel valued and supported in their learning journey.

This study presented the teachers integrate the abstract and concrete ideas in mathematic teaching and assist students in seeing the connection between arithmetic and real-life situations, know ledge, and event. Additionally, they assess the students' understanding of what they have taught, help the students' families support their children's academic success, and manage disruptive behavior in the classroom. And the findings suggest that there are significant differences in how male and female teacher respondents perceive and engage with these specific attributes related to student involvement in the mathematics classroom. The teacher should also encourage their students to utilize manipulatives to help other students understand mathematical concepts [KII-3]

Recommendation for policy implication

To enhance teaching and learning outcomes in mathematics, it is recommended that educational policymakers consider.

Should consider to Implement comprehensive professional development programs focusing on mathematics pedagogy for primary school teachers. These programs should incorporate strategies to improve teaching methods, assessment practices, and support mechanisms for teachers. Considering school directors' preferences and how they determine that their mentoring is beneficial for the demands of the classroom, another useful suggestion for the future is teachers' openness to mentoring. Ensure adequate allocation of resources for the provision of teaching aids, educational materials, and technology that can enhance the teaching of mathematics in primary schools. Access to quality resources is crucial for effective teaching and learning. As well as, school should engage the students' parents in promoting learning of their children, particularity the mathematic learning which encourage parental involvement in their children's mathematical education. Providing resources and guidance for families to support their children's learning outside of school can have a positive impact on students' mathematical achievement. As well as, the provincial level and district level should ensure effective implementation of policies related to mathematics education in primary schools. Establish mechanisms for monitoring and evaluating the impact of these policies to make necessary adjustments based on feedback and outcomes.

Promoting active student's participation and fostering a learning environment in mathematics classrooms

The investigative learning approach should apply to encourage student-centered learning in mathematics education that prioritize active student participation and engagement. Policies should support teachers in creating classroom environments that empower students to take ownership of their learning process. Offer professional development opportunities for teachers to enhance their knowledge and skills in implementing active learning strategies in mathematics classrooms. Training sessions should focus on collaborative frameworks, peer tutoring, small group activities, and creating inclusive learning environments. Support the integration of technology tools and resources that facilitate active student participation and engagement in mathematics learning. Ensure that classrooms are equipped with technology that enables interactive learning experiences and provides opportunities for students to explore mathematical concepts in innovative ways. Emphasize the importance of student voice and choice in the learning process. Encourage teachers to design activities that allow students to select content, methods, and mediums based on their interests and preferences, fostering a sense of ownership and agency in their learning. Promote inclusive classroom practices that value and respect diverse perspectives and contributions from all students.

Encourage teachers to create a welcoming and supportive learning environment where students feel comfortable expressing their opinions and engaging in collaborative projects.

The promotion of equality among male and female teachers engaging in outcome of mathematics teaching

Provide professional development opportunities for teachers focused on gender equity in mathematics education. Training sessions should address the differences in how male and female teachers perceive and engage with student involvement in the mathematics classroom, promoting awareness and strategies for creating inclusive learning environments. Encourage teachers to actively involve students' families in supporting their academic success. Develop initiatives that facilitate communication between teachers and parents to enhance understanding of students' progress, provide resources for families to support learning at home, and strengthen the home-school partnership. The school should facilitate collaborative professional learning communities where male and female teachers can share best practices, collaborate on curriculum development, and support each other in addressing gender-related challenges in mathematics teaching.

Annex 1: Interview code,

No.	Interview	Code
1	Key Informant Interview with Provincial Department of Education, Youth and Sport	[KII-1]
2	Personal Communication with teacher	[Per-Communication-1]
3	Focus Group Discussion with Teacher	[FGD-1]
4	Key Informant Interview with District office of Education, Youth and Sport at Boribo district	[KII-2]
5	Key Informant Interview with District office of Education, Youth and Sport at Kampong Tralach district	[KII-3]
5	Key Informant Interview with School Director	[KII-SD1]
6	Key Informant Interview with School Director	[KII-SD2]

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