



# The Teacher's Perspective on Effective Mathematic Teaching at Primary Schools in Cambodia



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## សង្ខេប

ការអប់រំមានសារៈសំខាន់ជាពិសេសក្នុងការផ្តល់ជូនបុគ្គលទាំងឡាយនូវបំណិនចាំបាច់សម្រាប់ជីវិត និងសម្រាប់ការចូលរួមជួយសង្គមផងដែរ។ នៅប្រទេសកម្ពុជា ជាទូទៅ ការអប់រំដែលអនុវត្តតាមគោលការណ៍ Pancasila ជួយលើកកម្ពស់អត្ថប្រយោជន៍ ភាពឆ្លាតវៃ និងការគោរពប្រណិប័តន៍ផងដែរ។ ដោយឡែក សិស្សជាច្រើនមានការលំបាកក្នុងការរៀនគណិតវិទ្យា ដោយសារលោកគ្រូ-អ្នកគ្រូប្រើប្រាស់សំណួរមិនច្បាស់លាស់ និងប្រើវិធីសាស្ត្របង្រៀនគណិតវិទ្យាពុំមានប្រសិទ្ធភាព។ ទោះបីជាការអប់រំមានភាពជឿនលឿនក៏ដោយ បញ្ហាប្រឈមដូចជាចន្លោះប្រហោងក្នុងការការពារ និងលទ្ធផលសិក្សាមិនប្រសើរនៅតែមាន ជាពិសេស ផ្នែកគណិតវិទ្យា។ ការសិក្សានេះស្វែងយល់ពីទស្សនៈរបស់គ្រូបង្រៀនសិក្សាលើការបង្រៀនគណិតវិទ្យារបស់គ្រូបង្រៀនដោយផ្ដោតលើភាពខុសគ្នារវាងយេនឌ័រក្នុងការលើកកម្ពស់ការចូលរួមរបស់សិស្ស ដើម្បីពង្រឹងវិធីសាស្ត្របង្រៀន និងធ្វើឱ្យលទ្ធផលសិក្សានៅកម្ពុជាកាន់តែប្រសើរឡើង។ ក្នុងការសិក្សានេះ អ្នកស្រាវជ្រាវបានប្រើវិធីសាស្ត្រវិធីសាស្ត្របរិមាណវិស័យដូចជា សន្ទស្សន៍ទម្ងន់មធ្យម (WAI) ការធ្វើ t-test និងការធ្វើ chi-squared test ព្រមទាំងវិធីសាស្ត្រគុណវិស័យដូចជាការសិក្សាលើឯកសារពាក់ព័ន្ធ និងការសម្ភាសអ្នកពាក់ព័ន្ធក្នុងវិស័យអប់រំ។ ការស្រាវជ្រាវនៅខេត្តកំពង់ឆ្នាំង ក្នុងចន្លោះពីខែមិថុនា ដល់ខែកក្កដា ឆ្នាំ 2023 បានពិនិត្យលទ្ធផលនៃការបង្រៀនគណិតវិទ្យានៅតាមសាលាបឋមសិក្សាចំនួន 148 ក្នុងស្រុកចំនួន 4 ។ គំរូសំណាកនៃគ្រូបង្រៀនចំនួន 278 នាក់ ត្រូវបានសង្កេតមតិដោយប្រើកម្រងសំណួរ និងធ្វើទស្សនាវិស័យលទ្ធផលនៃការសិក្សាបានបង្ហាញថា (១) សមត្ថភាពគ្រូបង្រៀនក្នុងការលើកទឹកចិត្តសិស្សឱ្យចូលរួម និងរីករាយក្នុងការរៀនគណិតវិទ្យា និងជាពិសេស សមត្ថភាពយល់ដឹងរបស់គ្រូបង្រៀនអំពីបញ្ហាគណិតវិទ្យាឱ្យបានគ្រប់គ្រាន់ សម្រាប់ការបង្រៀន

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ប្រកបដោយប្រសិទ្ធភាព មានសារៈសំខាន់ខ្លាំងណាស់សម្រាប់ការបង្រៀនគណិតវិទ្យា, (២) ភាពបត់បែនរបស់គ្រូបង្រៀនគឺជាអាទិភាពសំខាន់សម្រាប់ការសម្រេចបាននូវលទ្ធផលសិក្សាគណិតវិទ្យាប្រកបដោយប្រសិទ្ធភាពក្នុងចំណោមសិស្ស និង (៣) គ្រូស្រីច្រើនតែពូកែជាងគ្រូប្រុសក្នុងការលើកទឹកចិត្តសិស្សឱ្យចូលរួមក្នុងការរៀនគណិតវិទ្យា។

**Abstract:**

Education is vital for equipping individuals with necessary life skills and societal contributions. In Cambodia, Pancasila-based education fosters character, intelligence, and piety. However, many pupils struggle with mathematics due to poor question-asking and ineffective teaching methods. Despite educational advances, challenges like learning loss and academic performance remain, especially in math. This study explores primary school teachers' perceptions of effective mathematics teaching, focusing on gender differences in promoting pupil engagement, aiming to enhance teaching strategies and learning outcomes in Cambodia. The study focused on teachers' perceptions of effective mathematics teaching, employing both quantitative and qualitative methods. 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 research, conducted in Kampong Chhnang province from June to July 2023, examined mathematics teaching outcomes in 148 primary schools across four districts. A sample of 278 teachers was surveyed using structured questionnaires and interviews. The paper revealed that, (1) the teacher capacity very crucial for teaching mathematics included abilities in encouraging pupils to participate and enjoy mathematics learning, particularly teacher's understanding of mathematical concepts well enough for effective teaching, (2) Teacher flexibility is a key priority for achieving effective mathematics learning outcomes among pupils, and (3) Female teacher significant greater than male teacher in encouraging pupil involve and participate in mathematics learning.

**Background**

Education equips people with the knowledge and skills necessary to comprehend and utilize resources to exist fully. To help pupils 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 could help pupils to improve their mathematics learning outcomes (Rapanta, et al., 2020) and improve pupils' mathematical dispositions (NCTM, 2015; Dina et al., 2019 & Haji et al., 2019).

A clear instructional method that enhances pupils' academic performance qualifies as successful (Ma, 2009 & Ali et al., 2021). Skilled mathematics teachers use 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 pupil's knowledge (Eckert, et al., 1997; Lakshmi & Majid, 2021). Teachers must identify pupils' 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 pupils 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 pupils' needs (Visscher & Ehren, 2011; Sluijsmans et al., 2013; Schildkamp et al., 2014; Gulikers & Baartman, 2017). Formative assessment provides teachers with information on their pupils' 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 is divided into three parts of general education: lower secondary schools from grades 1 to 6, secondary schools from grades 7 to 9, and high schools from grades 10 to 12. After completing grade 12, the pupils have to obtain with national exam before continuing 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). The RGoC prioritized education reform as a key part of national development, including free of charge for primary enrollment at primary schools (Kingdom of Cambodia, 1993; Moeys, 2003a, 2006) and the enrollment campaign in the community has led to Cambodia's success in achieving 94% net enrolment rate in primary school from 1980 to 2015 s (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 promote equitable quality education and lifelong learning for all, 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 ICT, 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).

In 2016, MoEYS adopted the policy for STEM and policy guidelines for new-generation schools to develop human resources for Cambodia. This included promoting science, technology, Engineering and Mathematics (MoEYS, 2016b & 2016a). The education strategic plan 2024 - 2028 has prioritized the Mathematics outcome to meet the standard of the Program for International Pupil Assessment of Development (PISA-D) (MoEYS, 2024). 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 pupils 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 pupils' academic performance, as indicated by national assessments (MoEYS, 2017). The learning loss report during the COVID-19 outbreak showed 250 days schools in Cambodia were closed in 2020 - 2021 and mathematics learning outcomes of students fall into worse results as mathematics learning requires more in-person support and learning than other subjects (UNICEF, 2022). Some pupils 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 Pupil Assessment) with over 5,000 15-year-old pupils 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 pupils 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 pupils, with average achievement levels in 2021 being 0.30 to 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.

Education has been prioritized as a key part of national development in Cambodia since after the Khmer Rouge era, and Mathematics is the forefront subject and skill to realize Cambodia's long-term vision 2050 and develop the human resources for global industrial development. Scholars and researchers have conducted many studies related to education in Cambodia. Sokha Om (2022), a study on school directorship in primary schools in Cambodia, found child-centric practices driven by the school director's values and leadership. In 2019, King, E. (2019) conducted a study on the implications for the child-friendly school policy within Cambodia's cultural and primary school context. He identified that child-friendly school policy not only fails to take into support the local cultural situation but is also a significant form of pedagogy. Research on basic education clusters in Cambodia found that school clusters improve education quality and foster collaboration identified by Pellingini and Bredenberg (2015).

Other research on primary education like Prigent, S. (2018) study on education for all in Cambodia, Ravet, J., & Mtika, P. (2021) education inclusion in primary schools and mental health in primary by Alfredsson

et al., (2017). Related to mathematics education, few scholars have conducted research in Cambodia. Courtney, J. (2007) assesses the teacher's trainer's perception of mathematics education. Stols & Rogan's (2015) analysis of teachers' perceptions of mathematics teaching. The existing study mostly assessed leadership and child-centric education for all and few research on mathematics teaching in general education. However, there is no specific research on mathematics teaching at primary school. This research paper aims to assess the perception of teachers on the effectiveness of mathematics teaching at primary schools in Cambodia which focuses on two research objectives (1) the effective mathematics teaching for pupils at primary school, and (2) the association between female and male teacher to promote the activity in mathematics learning.

## Study Area and Methodology

The researcher conducted the research as a 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. The selected study district that attached to the Tonle Sap River and connected to have district town along the national road No. 5. These districts mix urban, rural, and semi-rural settings, providing a broad spectrum of teaching and learning conditions. A sample size of 278 teachers in four study districts was selected based on a desired degree of precision of 10%. Individual face-to-face interviews were conducted with two to three 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 pupil population of 73,750 pupils. In the 2023 education provincial report, there was an 88.9% completion rate at primary education, with an annual enrolment rate at primary school at 95.6%, and the adult literacy rate in this province at 98% (KCH, provincial education report, 2023). According to the Kampong Chhnang Provincial Office of Education, Youth and Sports Report 2022, Baribo district is located in the north of Kampong Chhnang provincial town. The district

shares a border with Pursat province, contacted to Tonle Sap. The district covers 57 schools with a total student enrolment of 14,042 students and a repeater student rate of 5% in 2022.

There were 57.9% in primary school with a total enrollment of 8,708 students and a repeater rate of 0.07% among the students at primary schools. Kampong Chhnang district is the provincial town of Kampong Chhnang province, with a total of 17 public schools, with 47% as primary schools. The total student enrollment by 2022 for all public schools is 10,193 students, and 46.7% of students study at primary schools. The total repeater students are 3% and 6.2% at primary school. Kampong Trolach is a southeast district of a provincial town and the shared border with Kandal province along the Tonle Sap River runs through the district from north to south. The district covers a total of 77 schools, 62.3% as primary school. Total enrollment is 22,298 students, and 61.3% of students study at primary schools. The repeater rate is 7.1% across the district and 11% at primary school. Rolea Pair is the center of the province and also central Cambodia. The district shares a border with Tonle Sap as the northeast. The total number of schools in this district is 105 schools and 56.2% as primary schools, with a total of 13,784 students studying at primary school.

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 the SPSS program (Statistical Package for the Social Sciences) for reliability testing and to identify any areas that required correction based on the pilot test findings.

A 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 mathematics education for their pupils and

**Table 1:** Sample size copulation

No.	District	Teachers	
		Total of teacher	Sample size
1.	Baribo	203	67
2.	Kampong Chhnang	131	57
3.	Kampong Tralach	255	72
4.	Rolea Pa-ir	441	82
<b>Total</b>		<b>1,030</b>	<b>278</b>

pupils’ learning outcomes. 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 males and females. Additionally, the chi-squared test was used to examine associations between the gender of respondents and the practice of mathematics teaching.

The research study was conducted in 148 primary schools across four districts of Kampong Chhnang province (Baribo, Kampong Chhnang, Kampong Trolach and Rolea Pa-ir). The research covers only a small part of Kampong Chhnang province, so the finding may not fully provide as the whole picture of mathematics teaching in the whole country. The research focused exclusively on mathematics teaching and learning outcomes, so it may limit insights into other subjects or overall educational performance. According to the Yaman formulation, 278 teachers were selected as a sample size in the study on the perception of effective mathematics teaching at primary schools.

## Result and Finding

### Teachers’ Beliefs about Mathematics 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 ten variables from 1 to 10 as illustrated in (Table 2). Weight Average Index (WAI) with a five-point scale with rang 1 “very low,” to 5, “very low,” was applied. In overall, teachers rated their capacity to teach mathematics highly, with similar ratings among female and male teachers. Since 2019, Moeys has established the capacity building program for primary teachers called the Teacher Upgrading Program (TUP), hence both male and female teachers have the same opportunity to join the national capacity building at the national level, including the mathematics teaching method [Per-comm - Moeys staff]. Furthermore, teachers rated very highly (WAI > 0.80) for some indicators like a teacher can control disruptive behavior, understand what pupils need and support different needs of individual pupils and teacher contact to family for supporting their pupils5, reflecting their beliefs about teaching mathematics.

Additionally, teachers gave high ratings (WAI ≥ 0.61; ≤ 0.80) for the capacity to teach mathematics effectively, make a student interested in mathematics learning, self-confident and belief and pupils creative in learning. A statistical test 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. The female and male teachers mentioned that teaching

**Table 2:** The assessment of teachers’ beliefs about mathematics teaching

Variables	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	<b>0.047</b>
3-When a pupil has difficulty understanding a mathematics concept, I will usually help the pupil understand it better.	0.80	H	0.78	H	0.79	H	0.136
4-I do know what to do to turn pupils 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 pupil to belief they can do well in class work.	0.82	VH	0.80	H	0.80	H	0.080
7-I-gauge pupil comprehension of what I have taught.	0.84	VH	0.82	VH	0.83	VH	0.105
8-I foster pupil creativity.	0.78	H	0.77	H	0.77	H	0.636
9-I adjust my lesson to the proper level of individual pupils.	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.

mathematics is mostly based on the teaching lesson plan and guidance from mathematics teaching books [FGD1-teacher]. Teachers often received similar access to teaching materials and professional development opportunities, especially mathematics teaching programs to align with the national policy of STEM [Per-comm with Poey1].

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. Excepted the understanding of mathematics concepts well enough to be effective in teaching mathematics, 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). Through personal communication with a teacher, it was noted that access to the Ministry of Education, Youth and Sport’s online platform, the ‘Sala Digital App,’ has facilitated easy and comprehensive learning opportunities for mathematics lessons and teaching methods. This accessibility has empowered educators to enhance their capacity in mathematics teaching effectively [Per-Comm-

Poey1]. However, female teachers seem to lack time to access extra learning platforms and digital learning apps and online learning has some challenges for teachers with aging and teachers located at low internet service [Per-Comm-Doeys-1].

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 MoYES has emphasized capacity building for teachers through the national program for primary educators called the teacher upgrading program, ensuring that all teachers have completed at least an undergraduate degree to meet the necessary qualifications. [KII-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

Table 3: The assessment of teachers’ confidence of mathematic topic

Variables	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	<b>0.044</b>
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	<b>0.010</b>
11- Measurements (length, time, weight 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	<b>0.011</b>
15- Speed (distance and speed, average speed)	0.77	H	0.73	H	0.75	H	<b>0.043</b>
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

a significant difference ( $p\text{-value}=0.050$ ). Additionally, teachers assess their confidence at a very high degree ( $WAI \geq 0.81$ ) for teacher confidence for mathematic topics like mathematic numbers, additional subtraction, word problems and, multiplication and currencies. They rate their confidence at a high degree ( $WAI \geq 0.61\text{-}\leq 0.80$ ) for word problems related to multiplication and division, measurement and statistics, as illustrated. 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. The result of the finding suggested 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 ( $WAI \geq 0.61\text{-}\leq 0.80$ ) significantly higher than female teachers ( $p\text{-value} = 0.05$ ) for involving decimal numbers (the four operations of decimals, Word Problems...) and covering

Average and Rate. In contrast, female teachers assess their confidence at a high degree ( $WAI \geq 0.61\text{-}\leq 0.80$ ) higher than male teachers significantly ( $p\text{-value} = 0.05$ ), which includes Geometries (area and perimeter, angles, triangles, quadrilaterals, the volume of solids and liquids...), and number related the 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.

### Teachers' Confidence in Mathematics Teaching

Overall, teachers rated a high degree ( $WAI = 0.80$ ) of confidence in mathematics teaching, similar between male and female teachers (Table 4). The teacher rated in an overall high degree ( $WAI = 0.77$ ) on the pressure method to pupils to get the answers, while a group of male teachers rated a high degree ( $WAI = 0.80$ ) higher than female teachers rated a high degree ( $WAI = 0.75$ ) significant at ( $p\text{-value} = 0.013$ ). as well as, teacher-rated overall at high degree ( $WAI = 0.78$ ) Developing speed and accuracy of math skills improves understanding

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

Variables	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 pupils to use manipulative to explain their mathematical ideas to other pupils.	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	<b>0.013</b>
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 pupils to master basic mathematical operations before they tackle complex problems.	0.84	VH	0.83	VH	0.83	VH	0.299
6-When two pupils 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 pupils 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 that 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  $p\text{-value} < \text{or} = 0.05$

among pupils, this similar between male and female teacher. At the same, overall, teachers rated high degree (WAI  $\geq 0.61$ - $\leq 0.80$ ) requested pupils more time to explain the answer or why they saw that answer and the formulas and introduction to pupils when it is new. These findings are similar between male and female teachers. Moreover, overall, teachers rated very high (WAI= 0.82) for attribute teachers encourage pupils to use manipulatives to explain their mathematical ideas to other pupils, and both teacher male and female rated similarity at a very high degree. The teacher always introduces math topics that I am confident teaching. It is important to first build an understanding of a concept before focusing on algorithms. Teachers rated a high degree (WAI=0.79) while male teachers rated a very high degree (WAI=0.81), similar to female teachers rated a high degree (WAI=0.79). In addition, the teacher wants their pupils to master basic mathematical operations before they tackle complex problems. Teachers rated very high (WAI = 0.83) overall, while similar between male and female teachers. And the teacher has a lot of things about mathematics that must simply be accepted as true and remembered, and the teacher asks two pupils to solve the same problem correctly using two different strategies I have them share the steps they went through with each other, a teacher also rated very high degree in overall, and similarity between male and female teacher. The result of the analysis suggested that teacher's confidence in mathematics teaching to their pupils, the teacher both male and female, rated similarly on their confidence in mathematics teaching. Also, only attribute 3) puts more emphasis on getting the correct answer than on the process followed, that significant deferent between male and female teachers.

### The relationship of male and female teachers' practice of mathematics teaching

The teacher requested to respond to the question, "Which the following mathematic practice method did you apply?" And 6 questions in Table 5 with answers "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  $p\text{-value} \leq 0.05$ . 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 pupils 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  $p\text{-values}$  greater than 0.05. This failure to reject the null hypothesis suggests that there is no significant relationship when the  $p\text{-value}$  is less than or equal to 0.05.

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

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

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

Note: significant  $p\text{-value} = 0.05$ ;  $\chi^2$  = Pearson Chi-Square



the gender of respondents, accepting the null hypothesis with  $X^2 = 5.997$  and a  $p$ -value of 0.019. Likewise, attribute 6, where pupils 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 found that there were significant differences among male and female teacher respondents who perceive and engage with these specific attributes related to pupil involvement in the mathematics classroom.

## Discussion

### Effective of Mathematics Teaching

Mathematics education at the primary school level is essential for developing well-rounded, capable, and confident learners at a young age. The analysis of a research study on the perception of effective mathematics teaching for pupils at primary schools revealed that the teacher capacity is very crucial for teaching mathematics, included abilities to encourage pupils to participate and enjoy mathematics learning, particularly the teacher's understanding of mathematical concepts well enough for effective teaching. The education officer at the Kampong Trolach District Office of Education, Youth, and Sport highlighted that teachers' creativity has been demonstrated to impact pupils' ability to learn mathematics and can help reduce mathematics anxiety [Per-Comm Doeys-1]. Similarly, an officer at the Provincial Department of Education, Youth, and Sport recognized the influence that evolving perceptions of mathematics can have on teachers and their pupils. They emphasized that school systems and administrators should offer support groups and external resources to assist instructors in discussing and reflecting on their thoughts and emotions regarding mathematics and teaching arithmetic [Per-Comm-Poeys]. However, it was noted by NGO staff that the classroom environment also has the potential to motivate individual pupils to learn mathematics [Per-Comm-NGO]. In addition the research also found that teacher flexibility is a key priority for achieving effective mathematics learning outcomes among pupils. A female teacher noted that her pupils quickly understood mathematical concepts when she adapted her teaching approach, such as using physical objects to demonstrate calculations [IDI-teacher-1]. Meanwhile, a male teacher observed that his pupils made greater efforts to answer mathematics questions correctly when they were placed under pressure [IDI-teacher-2]. However, it was noted by NGO staff that some teachers still apply negative disciplinary practices, which can cause pupils to dislike mathematics learning [Per-Comm-NGO]. The school director at Baribo observed that pupils were happier and more engaged in mathematics

learning when their teacher asked them to learn outside the classroom. For example, they were tasked with measuring the height of eggplants in the vegetable garden and comparing the heights of each plant[KII-SD].

### Associate between male and female teacher in Encouraging Pupil Participation in Mathematics Learning

The study illustrated that female teachers are significantly greater than male teachers in encouraging pupils to get involved and participate in mathematics learning. The female teacher involves promoting pupil voice in learning mathematics greater than a male teacher with chi-square result ( $X^2 = 6.384$ ;  $p$ -value of 0.014). And female teachers made pupils participate in choosing learning content or activities in mathematics better than male teachers ( $X^2 = 5.997$ ;  $p$ -value of 0.019). Likely pupils collaborate and work together to actively learn in mathematics showed an associated relationship with the gender of respondents ( $X^2 = 5.044$ ;  $p$ -value of 0.029). Female teachers created a friendly environment in the classroom to encourage pupils to participate more willingly in-class activities. For example, they used classroom decorations and implemented positive disciplinary strategies tailored to individual pupils [KII-SD]. A female teacher in Kampong Chhnang District mentioned that she speaks very kindly to her pupils, especially those who are quiet or have low learning outcomes in class. She encourages them to answer questions, regardless of whether their responses are right or wrong, and then provides constructive feedback [IDI-teacher-1]. In contrast, a male teacher utilizes a quiet classroom culture to maintain pupils' attention and focus during lessons [IDI-teacher-3].

### Conclusion and Policy Implication

Education plays a crucial role in equipping individuals with the knowledge and skills necessary to navigate life and contribute to societal development. At the primary school level, education should be organized in a way that actively involves pupils, enabling them to reach their full potential. Pancasila-based education in Cambodia aims to develop pupils' character, intelligence, and piety, contributing to the nation's growth. Mathematical proficiency is particularly important for fostering a scientifically and technologically advanced society. However, many pupils struggle to ask questions when they do not understand, resulting in poor learning outcomes. Effective teaching materials and clear instructional methods can help improve these outcomes, particularly in mathematics, a subject that requires skilled teachers using diverse approaches to enhance learning. Cambodia's education system has undergone substantial changes in recent years, focusing on decentralization and accessibility. Efforts to increase primary education

access have led to a high enrollment rate, and significant progress has been made towards achieving the Sustainable Development Goal (SDG) of quality education for all. Despite these advances, challenges remain, such as learning loss due to the COVID-19 pandemic and concerns about academic performance, particularly in mathematics. This research aimed to explore the perceptions of primary school teachers in Cambodia regarding effective mathematics teaching, focusing on the differences between male and female teachers in promoting pupil engagement. By understanding these perceptions, the study aims to inform strategies that can improve mathematics teaching and learning outcomes for pupils in Cambodia. The research, conducted in Kampong Chhnang province from June to July 2023, examined mathematics teaching outcomes in 148 primary schools across four districts. A sample of 278 teachers was surveyed using structured questionnaires and interviews. The study focused on teachers' perceptions of effective mathematics teaching, employing both quantitative and qualitative methods. The study found that both male and female teachers rated their capacity and confidence in teaching mathematics highly, with slight differences between genders. Teachers highly rated their ability to control disruptive behavior, support diverse student needs, and engage with families. While male teachers rated their understanding of math concepts significantly higher than female teachers, both genders had similar confidence in most topics. Notably, male teachers were more confident in decimals, average, and rate, while female teachers showed greater confidence in geometry and speed-related topics. However, female teachers are significantly greater than male teachers in encouraging pupils to be involved and participate in mathematics learning.

The research provide the policy implementation as the following below:

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

Should consider implementing 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. Also, a school should

engage the pupils' parents in promoting the learning of their children, particularly mathematics learning, which encourages 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 pupils' mathematical achievement. As well as the provincial level and district levels should ensure the effective implementation of policies related to mathematics education in primary schools. Establish mechanisms for mentorship to ensure the impact is evident based on necessary adjustments based on feedback and outcomes.

**Promoting active pupil participation and fostering a learning environment in mathematics classrooms**

The investigative learning approach should apply to encourage pupil-centered learning in mathematics education that prioritizes active pupil participation and engagement. Policies should support teachers in creating classroom environments that empower pupils to take ownership of their learning process. Provide a frequency of professional development among male and female teachers to develop 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 pupil participation and engagement in mathematics learning. Ensure that classrooms are equipped with technology that enables interactive learning experiences and provides opportunities for pupils to explore mathematical concepts in innovative ways. Emphasize the importance of pupil voice and choice in the learning process. Encourage teachers to design activities that allow pupils 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 pupils. Encourage teachers to create a welcoming and supportive learning environment where pupils feel friendly and express their opinions and engage in group work and class activities.

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**Declaration of competing interest**

The author has no competing interests to declare.

## Credit authorship contribution statement

Md. Omar Faruk Bhuiyan: Research design, data collection, data analysis, writing- the original draft of the article, reviewing and editing.

## Data availability statement

Data for this research is based survey collected at schools in four districts of Kampong Chhnang province, including Boribo, Kampong Chhnang, Kampong Trolach, and Rolia Pa-ir district.

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Md. Omar Faruk Bhuiyan is currently working as an Assistant Professor (Finance and Banking) at the Open School, Bangladesh Open University. He joined as a Lecturer (Finance and Banking) in October 2018. Before that, he served as a Lecturer (Finance) at Notre Dame University Bangladesh (NDUB) and BGMEA University of Fashion and Technology (BUFT) since October 2016. He has already published five research articles, two conference papers, and two textbooks and also participated in many international conferences as a paper presenter. His research interests include open and distance education and technology-enabled learning, capital market, money market and agricultural finance. Currently, he is assigned to prepare finance and banking-related teaching materials (lectures, books, and radio-TV programs) for different formal academic programs (SSC, HSC, BBS, BBA-Bangla, MBA-Bangla) of Open School. He was the founder and Co-Coordinator of the MBA (Bangla) Program. He is working as a member of different committees, i.e., member of Curriculum Committee (Business), member of Curriculum Committee (Criminology and Criminal Justice), member of School Committee (Open School), member of finance Committee (BBA-Bangla), and member of the Examination Committee (SSC, HSC, BBS, BBA-Bangla, MBA-Bangla). He is working as the Media Coordinator (Open School).

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## Annexures

Annex 1: Interview code

<i>No.</i>	<i>Interview</i>	<i>Code</i>
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]
7	Indepth interview with female teacher Kampong Chhang disstrict	[IDI-teacher-1]
8	Indepth interview with female teacher Baribo district	[IDI-teacher-2]
9	Indepth interview with male teacher Kampong Chhang disstrict	[IDI-teacher-3]