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Mathematics teachers' awareness of effective teaching practices: A comparative study

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Abstract

This study aimed to explore mathematics teachers' awareness of effective teaching practices issued by the United States National Council of Teachers of Mathematics (NCTM, 2014a) in the Kingdom of Saudi Arabia and the Arab Republic of Egypt and to compare the results using the comparative descriptive method. The Saudi sample comprised 651 teachers, and the Egyptian sample included 620 teachers. Data were collected through an awareness scale of eight dimensions of effective teaching practices. The study found that mathematics teachers in the Kingdom of Saudi Arabia and the Arab Republic of Egypt had high awareness of effective teaching practices. In addition, no differences were found in Saudi teachers' awareness of potentially differentiating variables. However, there were differences attributable to the gender variable in favor of the female group. For Egyptian teachers, the results showed no statistically significant differences in awareness levels concerning gender and school stage. However, those with higher qualifications (master's and doctoral degrees) showed significantly higher awareness than those with an average teaching experience of five-nine years. We identified areas to support high-quality mathematics teaching and learning for future professional development by highlighting and examining mathematics teachers' awareness of effective practices. These findings have important implications for mathematics instruction specialists, coaches, and stakeholders in both countries.

Keywords: awareness, teaching practices, mathematics, effective teaching

INTRODUCTION

Many factors influence the teaching-learning process, which is hoped to be reflected in the level of students, including classroom teaching practices in the classroom environment. Teaching quality is one of the most important factors affecting student progress in all educational settings (Akiba et al., 2007; Hattie, 2012; Hattie & Yates, 2014; Hattie & Zierer, 2017). Mathematics teachers are responsible for teaching students how to control and improve their learning in the classroom and for teaching and learning mathematics, which entails outlining their teaching materials and planning daily lessons effectively (Noraini, 2006). Many researchers have used the term "practice" in different ways. The most common usage refers to actions during the teaching and learning process. This paper uses the term effective teaching practices, emphasizing the teacher's role in these practices (NCTM, 2014b).

"Good" or "effective" teaching is a controversial concept in educational research literature (Fenstermacher & Richardson, 2005). Morris and Hiebert (2011) argue that good teaching is associated with specific goals and that the better students achieve those goals, the more effective the teaching. The National Research Council (NRC) has indicated that effective teaching practices must address multiple approaches to mathematics instruction, such as conceptual understanding, fluency, problem-solving, logical thinking, and productive desire.

An essential role of the teacher is to provide students with a range of challenges and opportunities that meet their needs and abilities because all students need some time to think and work quietly on their own, away from

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Contribution to the literature

- This study examined one of the most prominent recent trends in mathematics education, including the eight practices for effective mathematics teaching released by the National Council of Teachers of Mathematics (NCTM, 204b).
- This study provided a reliable measure to assess mathematics teachers' awareness of teaching practices in eight dimensions. Each domain consists of indicators based on previous research (NCTM, 204b). In addition, this measure has been adopted by some experts in mathematics teaching and learning for use in new studies and different contexts.
- The study assessed the reality of awareness of effective teaching practices in Saudi Arabia and Egypt and presented additional details on the differences in variables related to awareness, such as gender, qualification, teaching, and experience.

the diverse and conflicting viewpoints of others (Sfard & Keiran, 2001). Another example of these good practices is providing classmates with a collaborative and participatory work environment. Working with peers or in groups provides a context for sharing ideas and learning with and from others. Collective and participatory actions encourage participation, sharing, and testing of ideas and lead to higher levels of thinking (Ding et al., 2007). Teachers' good teaching practices play an essential and effective role in activating class discussion and dialog by directing students' attention and encouraging them to listen to and respect each other's solutions and to evaluate different points of view (Anthony & Walshaw, 2009).

Rich dialog in the classroom requires a high level of teacher knowledge and understanding of student responses, thinking, misconceptions, and content (Boston & Smith, 2009; Feiman-Nemser, 2001). In addition, teachers must organize productive dialog that reveals mistakes, stimulates various student solutions and ideas, and facilitates productive competition among students that leads to appropriate solutions (Hattie & Zierer, 2017; Smith & Stein, 2011). Smith and Stein (2011) identified five practices for developing dialog in the classroom. These practices include anticipating student solutions, observing student responses to tasks, selecting specific students to present their ideas, sequencing answers, asking questions, and linking different responses. Thus, these teaching practices can provide teachers with a systematic approach to questioning the value of instruction by planning, implementing, and evaluating teaching and assessing the learning process.

Good planning is an essential teaching practice in learning and teaching mathematics. Anthony and Walshaw (2009) argued that effective teaching practice is experiential planning that allows students to build on their current mathematical competencies, interests, and experiences. They added that effective learning planning involves teachers placing students' current knowledge and interests at the heart of educational decision-making process by continuously assessing competencies.

Buser (2018) identified a set of effective teaching practices that helped students achieve the required competency, such as asking significant questions, building conceptual understanding before focusing on procedural fluency, making connections between mathematical ideas, linking mathematical concepts to real-world situations, using multiple illustrations of mathematics, encouraging students to speak and write, and diversifying lessons to meet students' diverse needs. This practice can include focusing on student thinking rather than direct guidance, allowing students to see different ways of solving the same problem, and making connections between them.

The interest in providing mathematics teachers with effective teaching practices is necessary because it significantly impacts their students' mathematical achievement (Gningue et al., 2013). Students' poor performances on international tests and weak mathematics achievement are due to ineffective teaching practices. Mathematics teachers have inadequate knowledge of mathematics content and the methods to teach and communicate it to students. The latter requires teachers to employ many strategies, such as gamification, cooperative learning, and technological innovations. These technological inventions help develop deep critical thinking and enable students to construct mathematical concepts independently through reasoning, investigation, comparison, synthesis, interpretation, inquiry, problem-solving, communication, and argument-building through student-centered learning rather than traditional methods. Roberts (2013) stated that teachers' teaching methods play an essential role in student learning and achievement because mathematics is still complicated for many learners. Teaching methods significantly impact students' understanding of what they are learning. Walkowiak et al. (2014) found that students' low mathematics achievements are due to teachers' practices. Their study examined the relationship between student achievement and teacher practices. The findings indicate a divergence between the visions of the National Council of Teachers of Mathematics (NCTM) regarding mathematics education and the nature of actual teaching in mathematics classrooms. Al-Harbi (2020, 2021) pointed out that one reason for the low

mathematical achievement of students is that teachers still adhere to their traditional practices that focus on lower thinking skills and do not link mathematics to the reality of students, which leads them to have a negative attitude towards it. Al-Saeed (2018) added that ineffective classroom teaching practices lead to a lack of cognitive understanding of mathematics and increased mathematical mistakes among students. Al-Shammari & Al-Arini (2019) confirmed that this finding indicates that the effect of teachers' teaching performance on students' education accounts for 60% of the educational process, suggesting that one of the elements for the success of any reform project begins in the hands of teachers in the first phase.

Teachers must acquire knowledge to teach effectively and access appropriate classroom environments, including educational knowledge, content knowledge, and technology (Mishra & Koehler, 2006). Awareness of effective teaching practices is among the pedagogical knowledge that should be provided to mathematics teachers through training, workshops, and various meetings. This awareness is a prerequisite for teachers to possess these practices and endeavor to develop themselves and acquire competencies. Mathematics teachers play an essential role in teaching students mathematical skills and providing instruction to students. This role requires teachers to be aware of their expected current and future roles and to be able to assume their responsibilities to meet the demands of the twenty-first century, which requires a radical change in teachers' teaching practices. Contemporary education considers the teacher as an organizer, facilitator, and guide on the student's steps towards achieving educational goals consistent with their needs and inclinations. It requires the teacher to be aware of effective teaching practices.

Therefore, many studies have emphasized the importance of providing mathematics teachers with effective teaching skills. For example, Diletti (2017) pointed out that an effective teacher must possess many teaching practices, namely, facilitating dialog and discussion among students so that they have multiple opportunities to express their ideas, enhancing students' expression in solving mathematical problems, teaching students to appreciate the ideas of their colleagues, and helping students think and infer through realistic learning. Courtney and Caniglia's (2021) study recommended the importance of training mathematics teachers before and during service on effective teaching practices in practical, applied ways to improve their students' mathematical concepts, skills, and thinking habits.

Although it was argued above how important it is for mathematics teachers to have effective teaching practices as they have an incredible impact on student achievement, many studies have shown that these practices are weak among teachers in Saudi Arabia and Egypt. For example, Al-Otaibi and Al-Ruwais (2022) pointed out that the performance level of female teachers in teaching practices that contribute to the development of engineering thinking skills in middle school students needs to match the expected level of mathematics teachers. Al-Salahi (2019) confirmed the weak performance of mathematics teachers in teaching practices that support conceptual understanding. Al-Shehri (2021) pointed out that middle school mathematics teachers are poor in selecting and presenting tasks that help with reasoning and problem-solving. Al-Qurashi (2021) stated that mathematics teachers' teaching practices to promote conceptual understanding and procedural fluency are decreasing. Al-Otaibi and Al-Omari (2022) referred to the effects of teaching with NCTM mathematics teaching practices on the development of conceptual understanding and procedural fluency in second-grade middle school students in the Kingdom of Saudi Arabia. Al-Harbi and Al-Ruwais (2022) showed that middle school female mathematics teachers' beliefs about and implementation of the mathematics teaching guidelines defined in the document of principles for the procedures issued by NCTM are low and that there is a correlation between teachers' beliefs and their effective teaching practices.

Given what previous studies have suggested about mathematics teachers' weaknesses in effective teaching practices, it is critical to determine the level of teachers' awareness of effective teaching practices as described by NCTM (2014b) in mathematics education. Teachers' poor awareness of effective teaching practices may result in inadequate use. In addition, interest in developing mathematics teachers' awareness of effective teaching practices is a prerequisite for preparing competent students.

Many studies have shown that teachers' awareness of certain teaching practices is reflected in their performance. For example, Abdioglu et al. (2021) showed that academics' awareness of the STEM approach is strongly reflected in their academic work. Al-Hajri (2020) pointed out that mathematics teachers' lack of awareness of teaching strategies and their correct application leads to teachers' inability to achieve the goals of teaching mathematics, especially in terms of promoting students' ability to think mathematically.

Because of this reason, it is necessary to measure the awareness of mathematics teachers in Saudi Arabia and Egypt of effective teaching practices, as this is a prerequisite for enhancing these practices among them.

LITERATURE REVIEW

Ensuring mathematics teachers employ effective teaching practices is necessary due to the significant impact of these practices on students' mathematical achievements, as shown by many studies (e.g., Roberts, 2013; Serigne et al., 2013; Walkowiak et al., 2014). As

indicated by Roberts (2013), teachers' practices play a considerable role in students' learning and achievements, and the teaching method strongly impacts students' understanding of what they learn. Walkowiak et al. (2014) identified the decline in students' mathematical achievements due to teachers' practices.

Haciomeroglu (2013) has pointed to the importance of cooperation between teachers and universities in assisting teachers in developing effective teaching practices, specifically the need for training programs to improve teachers' performances Teachers need to start developing the skills of effective teaching in pre-service programs. It was also suggested to rethink the partnership between teaching staff and the school to select cooperative teachers and develop them professionally. Courtney and Caniglia (2021) also highlight the importance of giving mathematics teachers training in effective teaching practices both pre- and during service in a practical way to enable them to develop and enhance their students' mathematics skills and habits of mind.

Given the importance of effective teaching practices and their impact on students' learning, several studies have developed models for building such practices. For example, Anthony and Walshaw (2009) proposed many characteristics of effective teaching for mathematics teachers, including teachers' knowledge, the use of presentation tools, mathematical coherence, facilitating mathematical discourse, the use of appropriate mathematics language, the selection of worthy tasks, the selection of appropriate tools to support students' thinking, assessment for the sake of learning, and mathematical communication. Hull et al. (2014) pointed out that an effective teacher must master many teaching practices that facilitate dialogue and discussions between students so that they have multiple opportunities to express their ideas, enhance students' explanations of their thinking through mathematical problems, teach students to appreciate the ideas of their colleagues, and help them think and reason through real learning. A joint paper published by the NCTM and NCSM (2020) also emphasized the importance of effective teaching and improving student learning in the time of the coronavirus pandemic, focusing on the decisions that must be taken to attain high-quality mathematics education and learning and considering the needs of both the teacher and the learner. This document highlights various ways of enhancing teaching, such as establishing mathematics objectives to focus on learning, performing tasks that enhance reasoning and problem solving, using and linking mathematical representations, facilitating purposeful mathematical discourse, posing purposeful questions, building procedural fluency from conceptual understanding, supporting productive struggle in mathematics learning, and eliciting and using evidence for students' reasoning. These practices require various teaching methods or educational practices that many teachers may not know or understand (Buser, 2018).

The studies cited above indicate the significance of teachers' practices in the classroom and their role in improving students' learning, as well as the need to establish a specific framework to implement such practices and make them feasible and beneficial for learners. Teachers first need to be aware of such practices so that they can be reflected in the classroom. As Chapman (2014) pointed out, mathematics teachers' awareness can be developed through professional development and continuous reflection. Hart and Memnun (2015) explored awareness and its role in influencing beliefs concerning mathematics teaching. Their study found a relationship between teachers' meta-knowledge and their beliefs about teaching mathematics and pointed to the contribution awareness makes to developing effective teachers.

Olson et al. (2014) sought teachers' perceptions of the extent to which they planned and implemented mathematics lessons in light of effective teaching practices; the predominant feeling among the respondents was that they had insufficient knowledge of effective teaching practices before the survey. Thus, their "familiarity" with effective teaching practices was categorized primarily as "unread." This finding was further emphasized by the study of Bartell et al. (2017), which showed that it is essential for mathematics teachers to understand common core state standards for mathematics and standards for mathematical practice to achieve educational reform and bring about a much-needed change in students' learning of mathematical content. The study also clarified that focusing on mathematics teaching practices is essential to success. It recommended that effective and equitable pedagogical practices supporting students' learning of mathematics be identified and that teachers be trained to teach content to different types of students. The study devised a framework for linking equitable mathematics and effective teaching practices (Bartell et al., 2017).

Many studies have sought to establish the reality of the teaching practices employed by mathematics teachers in terms of effectiveness. Al-Maliki et al. (2020) examined the teaching practices of mathematics teachers through the lens of the cognitive domains in trends in international mathematics and science study, i.e., knowledge, application, and inference, and found they varied between average and high. Khalil's (2016) study categorized the level of mathematics teachers' practices related to mathematical inference to be average. Bayoumi and Al-Jindi (2019) aimed to identify the classroom practices employed by primary school teachers in their classrooms in light of contemporary professional standards for teaching and learning mathematics. The study specified three standards: classroom teaching practices are related to the selection

of tasks that have mathematics values; teaching practices are related to preparing a classroom environment that supports learning and challenges students' abilities; classroom teaching practices are related to the activation of discussion and mathematical classroom dialogue. The study showed a weak implementation of these practices among teachers. It recommended that teacher preparation programs be developed in Egyptian universities based on contemporary professional standards for teaching and learning mathematics. Zalami (2020) examined mathematics teachers' classroom practices by drawing on Marzano's learning dimensions model. The study identified teaching practices in three main areas:

(1) acquiring knowledge and integrating it with what is stored in memory,
(2) deepening, refining, and expanding knowledge, and
(3) meaningful use of knowledge.

The study indicated that teachers' teaching practices based on these dimensions were low. Al-Qurashi (2021) sought to evaluate the teaching practices of mathematics teachers in light of the requirements for developing the mental dimensions of mathematical proficiency among middle school students in the Kingdom of Saudi Arabia. The study found that teachers' practices in this regard were low. In terms of mathematical knowledge (conceptual and procedural), Al-Halessi and As-Saluli's (2016) and Ibrahim's (2013) studies conducted in the Kingdom of Saudi Arabia and the Arab Republic of Egypt, respectively, reached similar conclusions and found that mathematics teachers in the two countries tend to focus predominantly on procedural knowledge. Russo and Hopkins (2019) also emphasized the importance of classroom support for productive struggle.

After reviewing studies that indicate the importance of effective teaching practices in mathematics classes and evaluating the reality of teaching from the perspective of effective teaching practices according to NCTM (2019), this study aims to assess awareness of effective practices as a necessary precursor to improving teaching performance. This study assesses teachers' awareness of using effective teaching practices in an integrated manner. It includes variables such as gender, stage, qualifications, and teaching experience to provide a detailed picture of reality. The study also compares two countries selected for converging educational systems and their common interest in evaluating and improving mathematics teachers' and students' performances at different levels. They are similar in their assessment of the international test, TIMSS. They also share, to some extent, the same culture, language, and social aspects.

Research Questions

The study sought to answer the following questions:

1. What is the level of mathematics teachers' awareness of effective teaching practices in the Kingdom of Saudi Arabia and the Arab Republic of Egypt?
2. Are there any differences in the level of awareness of the dimensions of effective teaching practice between teachers in the Kingdom of Saudi Arabia and the Arab Republic of Egypt?

Study Hypothesis

This study hypothesizes that there are no statistically significant differences ($\alpha \leq 0.05$) in the level of mathematics teachers' awareness of effective teaching practices between teachers in the Kingdom of Saudi Arabia and those in the Arab Republic of Egypt attributable to the variables of gender, qualification, teaching experience, and school stage.

METHODS AND SAMPLE

The study employed a quantitative approach, likely to provide excellent reliability, validity, objectivity, and generalizability to findings. A questionnaire can be distributed to a large number of participants. Moreover, as has been previously argued, if researchers collect data from a representative sample of the population using a quantitative approach, they will be more able to generalize statements regarding the topic under consideration (Fraenkel & Wallen, 2009). The study population also consists of mathematics teachers in the Kingdom of Saudi Arabia and the Arab Republic of Egypt who were in service during the period spent conducting the research (in 2022).

The study sample comprised 1,271 male and female mathematics teachers, 651 from the Kingdom of Saudi Arabia and 620 from the Arab Republic of Egypt. The participants were randomly chosen using an online questionnaire on the two countries' stimulants.

Table 1 presents the distribution of the study sample members according to the study variables.

Data Collection–Questionnaire

Data were collected using an online questionnaire (questionnaire of mathematics teachers' awareness of effective teaching practices) divided into eight dimensions, each representing one of the eight effective teaching practices specified by the NCTM (2014a). There were 39 items comprising positive and negative statements to which respondents were asked to express the extent of their agreement. The items were scored using a five-point Likert scale (strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1), and negative items were reverse coded. **Table 2** presents the distribution of scores for the items related to the levels of awareness.

The questionnaire was constructed in several stages:

Table 1. Distribution of the study sample members according to study variables

Variable		Saudi sample		Egyptian sample	
		n	%	n	%
Gender	Male	292	44.85	226	36.50
	Female	359	54.69	394	63.50
Qualification	Bachelor's degree	597	91.71	516	83.20
	Master's or doctoral degree	54	8.29	104	16.80
Teaching experience	< five years	39	5.99	132	21.30
	Five-nine years	112	17.20	110	17.70
	≥10 years	500	76.80	378	61.00
School stage	Primary	327	50.23	280	45.20
	Intermediate	167	25.65	201	32.40
	Secondary	157	24.12	139	22.40
Total		651	100.00	620	100.00

Table 2. Distribution of scores for each level of awareness

No	Score distribution	Level of awareness
1	1.00-1.80	Very low
2	1.81-2.40	Low
3	2.41-3.20	Neutral
4	3.21-4.20	High
5	4.21-5.00	Very high

Table 3. Relationship between scores for dimensions of mathematics teachers' awareness of effective teaching practices & total score of questionnaire

No	Items	Relationship with total score of questionnaire
1.	Establishing mathematics goals that focus on learning	0.713**
2.	Performing tasks that enhance reasoning and problem solving	0.772**
3.	Using and linking mathematical representations	0.767**
4.	Facilitating meaningful mathematical dialogue	0.731**
5.	Posing meaningful questions	0.823**
6.	Building procedural fluency from conceptual comprehension	0.607**
7.	Supporting productive struggle in learning mathematics	0.722**
8.	Deriving and using clues about students' thinking	0.757**

Note: **Significance at 0.01

1. Consulting key references (NCTM, 2014a).
2. Consulting previous studies that dealt with the subject, including Al-Aidi (2021) and Al-Ofi (2021).
3. Devising a list of statements related to effective teaching practices.
4. Obtaining the opinions of a group of experts in the field of teaching mathematics on constructing and amending items according to their suggestions.

Examples of positive statements included: "I see the importance of the teacher's use of various methods of assessment to ensure that students acquire mathematical knowledge" and "I have sufficient knowledge of appropriate intervention strategies for students (assignment scaffolding, differentiated learning, peer support, ...)." Examples of negative statements included: "I see no need to support students' involvements in learning new mathematical knowledge and relationships" and "I do not think it is important to review previous knowledge related to new knowledge and link it to reality."

The questionnaire was piloted with a sample of 30 teachers before administration in the main study to verify its validity for application. In addition, the internal consistency of the questionnaire was calculated using Pearson's correlation coefficient, estimating the correlation of each item with the dimension to which it belongs. The coefficients were in the range of 0.42-0.883, which means that the internal consistency of the questionnaire is acceptable. The correlation between the scores for each item and the total score of the questionnaire was also calculated, and the coefficients are presented in **Table 3**.

As can be seen, the correlation coefficients are significant at the level of .01, showing that the questionnaire presents a high degree of validity and is an appropriate measure of the constructs.

Reliability was first calculated using Cronbach's alpha, estimating coefficients for the individual dimensions and the questionnaire. The results are presented in **Table 4**, which shows good reliability for the dimensions.

Table 4. Cronbach's alpha coefficients for the questionnaire dimensions & questionnaire as a whole

No	Dimensions	Cronbach's alpha
1.	Establishing mathematics goals that focus on learning	0.717
2.	Performing tasks that enhance reasoning and problem solving	0.723
3.	Using and linking mathematical representations	0.720
4.	Facilitating meaningful mathematical dialogue	0.722
5.	Posing meaningful questions	0.717
6.	Building procedural fluency from conceptual comprehension	0.723
7.	Supporting productive struggle in learning mathematics	0.718
8.	Deriving and using clues about students' thinking	0.721
9.	Questionnaire as a whole	0.723

Table 5. Level of awareness of effective teaching practices among Saudi & Egyptian mathematics teachers

No.	Effective teaching practices	Saudi sample			Egyptian sample		
	Dimension	M	SD	Level	M	SD	Level
1.	Establishing mathematics goals that focus on learning	4.22	0.650	Very high	4.15	0.350	High
2.	Performing tasks that enhance reasoning & problem solving	3.73	1.113	High	4.01	0.390	High
3.	Using and linking mathematical representations	4.27	0.760	Very high	4.15	0.470	High
4.	Facilitating meaningful mathematical dialogue	4.02	0.765	High	3.96	0.390	High
5.	Posing meaningful questions	4.07	0.703	High	4.03	0.400	High
6.	Building procedural fluency from conceptual comprehension	3.69	1.185	High	3.84	0.420	High
7.	Supporting productive struggle in learning mathematics	4.00	0.777	High	3.97	0.420	High
8.	Deriving and using clues about students' thinking	3.97	0.769	High	3.94	0.420	High
Overall		4.00	0.840	High	4.01	0.310	High

In addition, the questionnaire was administered to the pilot sample twice, with an interval of two weeks in between, and the correlation between the scores for the two applications was calculated. This correlation gave a coefficient of 0.814, considered high, and indicates strong reliability and validity. In addition, content validity was measured for all items in the questionnaire, and that found for the item (I-CVI) was between 0.82 and 1, and for S-CVI, it was 0.94 for the whole scale. The S-CVI was computed for each item on the scale and then calculated the average I-CVI across items, as Polit et al. (2007, p. 461) suggested, "Another approach for the S-CVI is to compute the I-CVI for each item on the scale, and then calculate the average I-CVI across items." For example, the number of experts who agreed to item one is ten from 12, so the CVI for this item is 10/12, which equals 0.82. The same operation was done with the rest of the items, and the average was calculated.

Data Analysis

The data were analyzed using descriptive statistics (mean [M] and standard deviation [SD]). The results for the two samples (Saudi and Egyptian) were then compared to identify any potential differences using t-tests for the variables gender and qualifications and using one-way analysis of variance (ANOVA) for the variables teaching experience and school stage.

RESULTS

To answer the study questions and identify the level of mathematics teachers' awareness of effective teaching practices in the Kingdom of Saudi Arabia and the Arab Republic of Egypt and then compare the results, M and SD were calculated for each dimension, as well as overall. **Table 5** presents the results.

Table 5 shows a high level of awareness of effective teaching practices among mathematics teachers in the Kingdom of Saudi Arabia and the Arab Republic of Egypt overall. The levels of awareness of mathematics teachers in Saudi Arabia ranged between high (M=3.69) for the dimension "Building procedural fluency from conceptual comprehension" and very high (M=4.22) for the dimension "Establishing mathematics goals that focus on learning." The levels of awareness of effective teaching practices among mathematics teachers in the Arab Republic of Egypt were also high, ranging between M=3.84 for the dimension "Building procedural fluency from conceptual comprehension" and M=4.15 for the dimensions "Establishing mathematics goals that focus on learning" and "Using and linking mathematical representations."

Table 6 shows no statistically significant differences ($\alpha \leq .05$) in the level of awareness of effective teaching practices among mathematics teachers in the Kingdom of Saudi Arabia attributable to the qualification variable. However, there were differences attributed to the gender variable in favor of the female group. In the Egyptian sample, it is clear that there is no statistically significant difference in mathematics teachers' awareness of effective teaching practices attributable to gender. However, there is a statistically significant difference between the average mathematics teachers' assessment scores of their awareness of effective teaching practices attributable to qualification in favor of holders of master's and doctoral degrees.

Table 6. Differences in levels of awareness among Saudi & Egyptian mathematics teachers on gender & qualifications

Sample	Variable	Category	n	M	SD	t-value	p-value
Kingdom of Saudi Arabia	Gender	Male	292	154.57	14.90	2.786	0.005**
		Female	359	157.79	14.40		
	Qualification	Bachelor's	597	156.36	14.73	0.084	0.933
		Master's or doctorate	54	156.19	14.79		
Arab Republic of Egypt	Gender	Male	226	157.75	10.66	1.756	0.080
		Female	394	155.96	13.01		
	Qualification	Bachelor's	516	156.02	11.57	2.698	0.007**
		Master's or doctorate	104	159.55	14.80		

Note: **Significance at <0.05

Table 7. Results of one-way ANOVA testing differences in awareness of effective teaching practices among Saudi & Egyptian mathematics teachers on teaching experience & school stage

Sample	Variables	Disparity source	SS	df	Mean square	F-value	p-value
Kingdom of Saudi Arabia	Teaching experience	Inter-group	672.063	2	336.031	1.552	0.214
		Intra-group	140,263.172	648	216.456		
		Total	140,935.240	650			
	School stage	Inter-group	1,229.722	2	614.861	2.852	0.058
		Intra-group	139,705.513	648	215.595		
		Total	140,935.235	650			
Arab Republic of Egypt	Teaching experience	Inter-group	2,436.240	2	1,218.120	8.340	0.000**
		Intra-group	90,113.080	617	146.050		
		Total	92,549.320	619			
	School stage	Inter-group	133.010	2	66.510	0.444	0.642
		Intra-group	92,416.310	617	149.780		
		Total	92,549.320	619			

Note: **Significance at the .05 level; SS: Sum of squares

Table 7 shows no statistically significant differences at $\alpha \leq 0.05$ in the awareness of effective teaching practices among Saudi mathematics teachers attributable to the two variables of teaching experience and school stage. In contrast, there are statistically significant differences between the average scores of Egyptian mathematics teachers attributable to experience in favor of those with medium experience (five-nine years) compared to those with high experience (>10 years), and both these groups present higher levels of awareness than those with < five years of experience. As for the Saudi teachers, there are no statistically significant differences in levels of awareness among the Egyptian mathematics teachers attributable to the school stage.

DISCUSSION

The study used a questionnaire to collect data, determine awareness of effective teaching practices among Saudi and Egyptian mathematics teachers, and then compare the results. The results were generally as follows: Awareness of effective teaching practices was high in the two samples, consistent with Hull et al. (2014), who highlighted the importance of effective teaching practices for mathematics teachers. In addition, these results support Hart and Memnun's (2015) findings on the importance of awareness for teaching improvement.

Looking at the results, there appears to be agreement on several dimensions in the Saudi Arabian and Egyptian samples concerning the level of awareness. "Using and linking mathematical representations" had the highest mean score for both samples. This result is consistent with Al-Maliki's (2022) study, which highlighted the importance of the role of middle school mathematics teachers in creating interactive learning environments using the professional standards of the Education and Training Evaluation Commission in the Kingdom of Saudi Arabia. In addition, the study of Abu Sirah et al. (2021) confirmed the importance of focusing on mathematics teachers' teaching practices and mathematical representations, as this helps to support students' thinking and understanding of more abstract concepts to clarify their mathematical understanding through different mathematical representations. This result can be attributed to teachers' recognition of the importance of representing mathematical content with multiple mathematical representations and linking them to deepen and improve students' understanding of mathematical knowledge in different forms.

In contrast, the item "building procedural fluency from conceptual comprehension" received the lowest recognition. This finding is consistent with research by Al-Halisi and Al-Saluli (2016) and Ibrahim (2013), who indicate that mathematics teachers in the Kingdom of Saudi Arabia and the Republic of Egypt focus more on procedural knowledge and fail to balance conceptual

comprehension and procedural fluency to develop a deep enough understanding of mathematical knowledge and its related contexts. This result is also in line with a study by Al-Salahi (2019) that shows the level of practice of mathematics teachers. The promotion of understanding of mathematical concepts can be achieved to a medium degree in three areas: preface, presentation, and evaluation. This result is because most teachers focus on teaching students the correct solution steps based on the data without focusing on achieving a conceptual understanding of these steps.

There was a disparity in the results for two dimensions, "establishing mathematics goals that focus on learning" and "using and linking mathematical representations," with Saudi mathematics teachers indicating a very high level of awareness. In contrast, Egyptian mathematics teachers indicated a high level. This result can be attributed to the extensive and continuous training of Saudi teachers in applying technological innovations in the classroom, as more technologies and technological resources are available in schools than in the Arab Republic of Egypt. Regarding the other dimensions, both samples indicated high levels of awareness. The high awareness was about "performing tasks that enhance reasoning and problem-solving." This result may be due to teachers' awareness of the importance of developing students' problem-solving skills and the validity of their solutions as essential skills for learning mathematics. This result differs from the findings of Khalil's (2016) study, which classified teachers' level of practice in mathematical inference to be average, and from those of Bayoumi and Al-Jindi's (2019) study, which indicated weak practices related to mathematical tasks. However, it is consistent with the findings of the study by Al-Maliki et al. (2020). In addition, awareness of the practice of "supporting productive struggle" was high, consistent with Russo and Hopkins (2019) and Sayed (2022), who argued for the importance of a culture of supporting productive struggle in the classroom to deepen students' understanding of the mathematical structure of problems and the relationships between mathematical ideas, rather than just searching for the correct solution. They also helped raise teachers' awareness of the importance of stimulating the productive struggle in their students. The two samples also showed a high awareness of "deriving and using clues about students' thinking." This result is due to teachers' awareness of the importance of promoting student thinking and mathematical achievement and providing feedback and support based on evidence of their performance collected in an achievement file for each student.

Regarding the study variables-gender, qualifications, school stage, and teaching experience-the study found statistically significant differences in awareness of effective teaching practices at $\alpha \leq 0.05$ in the Saudi sample because all teachers are offered the same programs. This result is consistent with Al-Maliki et al. (2020), who found gender differences, favoring females and in teaching experience, favoring those with ten years or more experience. In contrast, in the Egyptian sample, there were differences in qualifications in favor of teachers with the highest qualifications and teaching experience in favor of those with an intermediate length of teaching experience (five-nine years). However, there were no differences in gender or school stage among Egyptian mathematics teachers.

CONCLUSION

This study has addressed the awareness of effective teaching practices identified by US NCTM (2014a) in light of the growing interest in the development of mathematics teaching and learning in the Kingdom of Saudi Arabia and the Arab Republic of Egypt. These two countries also strive to improve their rankings in the TIMSS assessment. To this end, they have initiated numerous efforts and development programs to improve mathematics education and promote good teaching practices. The results of this study confirm mathematics teachers' keenness and interest of mathematics teachers to develop their practices.

No gender differences in awareness of effective teaching practices were found among Saudi or Egyptian teachers, which is likely because all teachers are subject to the same teaching development programs and evaluation criteria in their respective countries. The study also found no differences based on school stage in either group, reflecting that the development and improvement activities encompassed all school stages and that some teachers would teach several stages. Regarding academic qualifications, there were differences in the Egyptian sample in favor of those with higher qualifications. This result may be because mathematics teachers with master's and doctoral degrees are aware of modern trends in effective mathematics teaching practices through their postgraduate studies. The results also showed differences in the level of awareness according to teaching experience in the Egyptian sample, which might be logical since new teachers in the transition to applied practice will have many questions about the most effective teaching practices. However, it may also be due to the lack of professional development programs for new teachers. As for the sample of teachers with ten or more years of experience, some need to be more motivated to develop their teaching practices in line with modern trends and instead tend to use traditional teaching methods.

In contrast, teachers with 5-10 years of experience are more likely to know how to teach their students effectively. They may also be more motivated to develop their teaching methods because they know more about teaching practices, are aware of their students' levels,

and have experience with peer support and self or professional development programs. There were no differences in the Saudi sample, which is most likely because the emerging interest in effective teaching practices in recent years has resulted in all teachers, regardless of experience, being subject to the same guidelines and training programs, which include presenting the latest trends.

Recommendations for Future Studies

In this study, mathematics teachers' awareness of effective teaching practices as defined by US NCTM (2014a) was assessed using a questionnaire, i.e., a self-report measure. Future studies could use alternative methods, both quantitative and qualitative. They could also measure the reality (level) of effective teaching practices and address the relationship between awareness level and actual teaching performance. Finally, developing teaching models and strategies based on effective teaching practices would be valuable.

Limitations

The study was limited to measuring the awareness of mathematics teachers using the awareness scale created by the researchers and then comparing the study results in the two countries (the Kingdom of Saudi Arabia and the Arab Republic of Egypt) (**Appendix A**). A quantitative electronic questionnaire and its items were measured on a five-point Likert scale. In terms of differentiation, the study focused on the following variables: gender, teaching experience, school stage, and qualifications.

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APPENDIX A: THE SCALE OF AWARENESS OF EFFECTIVE TEACHING PRACTICES

Table A1. Scale of awareness of effective teaching practices

No	Statement	Response SA	A	N	D	SD
	First dimension of awareness: Establishing mathematics goals that focus on learning					
1	I realize the importance of clarifying lesson objectives to students at the beginning of the class to make them aware of what they must learn from the mathematical content.					
2	I am aware of the importance of linking the objectives of the new lesson with previous and subsequent objectives to consider the vertical interconnection of the mathematical structure.					
3	I think that the gradual setting of lesson objectives contributes to the deepening of students' mathematical knowledge.					
4	I do not think it is necessary to link lesson objectives to daily life of the students or to other subjects.					
5	I realize the importance of alerting students to the extent to which learning objectives have been achieved while the lesson is in progress.					
6	I see that accurate identification of the objectives of the new lesson contributes to making appropriate decisions during the course of the educational process.					
	Second dimension of awareness: Performing tasks that enhance reasoning and problem solving					
7	I realize that it is important to design mathematical tasks & activities that enhance students' problem-solving skills.					
8	I realize the importance of helping students acquire the ability to model real-life problems using mathematical knowledge.					
9	I see no importance in designing mathematical tasks and activities that link mathematical content to scientific and technical situations and issues.					
10	I am aware of the importance of training students to choose the appropriate strategy to solve a mathematical problem (forward working, backward working, guessing, checking, using tables, simplifying the problem, logical arguments, ...).					
11	I am aware of the importance of tasks that stimulate mathematical reasoning in developing students' problem-solving abilities.					
	Third dimension of awareness: Using & linking mathematical representations					
12	I realize the importance of designing applied mathematical activities and situations that require students to use various mathematical representations to solve them.					
13	I realize the importance of highlighting the integration and interrelatedness of mathematical knowledge through conceptual maps and the use of various visual and electronic models.					
14	I realize the importance of assessing students' ability to meaningfully use a variety of mathematical representations to solve real-life problems and organize their mathematical thinking.					
15	I realize the importance of encouraging students to infer mathematical knowledge from multiple representations and link them to infer new combinations.					
16	I consider that diversifying contexts in which mathematics applications appear in all fields distracts students' attention.					
	Fourth dimension of awareness: Facilitating meaningful mathematical dialogue					
17	To have effective and meaningful dialogue and discussion in the mathematics class requires good management on the part of the teacher.					
18	I realize the importance of encouraging students to use the language of mathematics to present and explain their thinking and the various methods and strategies of solution.					
19	I realize the importance of encouraging students to derive common mathematical concepts and multiple solutions procedures resulting from meaningful dialogue among them.					
20	I am of the view that there is no point in getting students to discuss, debate and exchange opinions with each other and with the teacher about mathematical tasks or problems.					
	Fifth dimension of awareness: Posing meaningful questions					
21	I am aware of the importance of posing good questions that guide and support students' thinking.					
22	I am familiar with the ways of posing classroom questions to build meaning for diverse mathematical knowledge and relationships.					
23	I realize importance of posing meaningful questions that make mathematics lessons more meaningful.					
24	I do not think it necessary to give students the opportunity for discussion and dialogue between themselves and the teacher.					
25	I am aware of the importance of posing classroom questions that enable students to research and discuss.					
	Sixth dimension of awareness: Building procedural fluency from conceptual comprehension					
26	I have sufficient knowledge of how to design educational activities that will enhance students' building of meaning related to important mathematical ideas and relationships.					
27	I do not consider it important to revisit previous mathematical knowledge related to the new knowledge and link it to reality.					

Table A1 (Continued). Scale of awareness of effective teaching practices

No	Statement	Response				
		SA	A	N	D	SD
28	I see that it is important to give students time to think about different ways to solve mathematics problems.					
29	I realize the importance of encouraging students to use a variety of techniques to solve mathematics tasks and problems and justify their choices.					
Seventh dimension of awareness: Supporting productive struggle in learning mathematics						
30	I realize the importance of giving students enough time to work hard and try to find a solution while solving mathematics tasks.					
31	I have sufficient knowledge of appropriate intervention strategies for students (assignment scaffolding, differentiated learning, peer support, etc.).					
32	I understand the importance of supporting my students to overcome the educational challenges they face and anticipate what might hinder their learning of mathematical content.					
33	I see no need to support students' involvement in learning new mathematical knowledge and relationships.					
34	I am aware of the importance of allowing students to try to gain mathematical knowledge and persist in thinking to solve problems on their own.					
Eighth dimension of awareness: Deriving & using clues about students' thinking						
35	I have knowledge of how to identify indicators by which students' progress towards learning goals can be judged.					
36	I realize the importance of collecting evidence about students' understanding of mathematical content during learning in order to plan the next educational steps.					
37	I realize the importance of getting to know the level of students and evaluating their thinking to make appropriate future decisions.					
38	I understand how important it is for the teacher to use a variety of methods of assessment to ensure that students acquire mathematical knowledge.					
39	I see no need to take students' progress into account when planning subsequent mathematical knowledge content.					

Note. SA: Strongly agree; A: Agree; N: Neutral; D: Disagree; & SD: Strongly disagree