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Unlocking numerical sense: An in-depth analysis of teaching practices among mathematics teachers in primary schools

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Abstract

Mathematics teachers face significant challenges in developing number sense among students. This study investigates the teaching practices of Saudi Arabian primary school mathematics teachers for fourth-grade female students. Using a descriptive-analytical approach and validated observation cards, the study sampled 20 teachers and analyzed data through statistical measures. Results revealed teaching practice levels as low in planning, moderate in implementation, and high in evaluation, with overall moderate effectiveness. No significant differences were found based on teaching experience, academic degree, class size, training programs, or teaching load. The study recommends the Saudi Ministry of Education enhance teaching practices via targeted professional development and suggests future research on instructional methods across different educational levels and the use of digital tools.

Keywords: teaching practices, number sense, mathematics female teachers, primary stage, Saudi Arabia

INTRODUCTION

The need for mathematics arose for humans through their interaction with their surroundings, driven by their necessity for counting and performing basic arithmetic operations. Humans developed the concept of numbers, embarking on their journey with various methods such as signals, pebbles, and fingers. Over time, civilizations developed counting systems, including the Egyptians, Greeks, Romans, and Babylonians. The Arabs, in particular, adopted a numbering system that surpassed all others and is still in use today (Afanah et al., 2012).

The evolution of mathematics usage across the ages has enabled mathematics to play a crucial and fundamental role in the scientific and technological advancement of humanity in this era. Many countries have begun improving and developing school mathematics curricula due to significant cognitive growth (Alkhawaja et al., 2013). Number sense, defined as the general understanding of numbers and operations, has remained one of the most important components of these curricula (Alharbawi, 2011). Akkaya (2016) indicated that children with strong number sense have the ability to solve problems in daily life situations, using their skills in mental arithmetic and estimation. They can flexibly apply arithmetic operations, devise suitable strategies and plans through mental operations to solve their problems, and verify the adequacy of their plans and the appropriateness of the results. Furthermore, Delaney (2020) pointed out that the importance of number sense lies in its connection to all fundamental branches of mathematics, and the future success of students in these branches depends on their mastery of number sense.

In this context, the Kingdom of Saudi Arabia, like other countries striving to foster distinguished generations in various life fields, showed concern over the low results of fourth-grade students in the program for international student assessment (PISA) test in 2018. Saudi Arabian students achieved a performance level of 47.00% in mathematics, which is lower than the average score for countries of the organization for economic co-operation and development (OECD, 2019). Additionally, the results of fourth-grade students in the mathematics branch of the trends in international mathematics and science study (TIMSS) in 2019 were low, with Saudi Arabia ranking 53rd out of 58 participating countries. The results indicated that 49.00% of students did not reach the low level, meaning they lacked the expected basic

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Contribution to the literature

- The study offers insights into teaching practices, professional development needs, and policy implications.
- This study underscores the practical implications of its findings for teacher training, such as enhancing instructional practices and addressing teachers' challenges within the educational system.
- This study contributes to the literature by highlighting the importance of developing teaching practices related to number sense and the value of tailored professional development for mathematics teachers to enhance student learning outcomes.

mathematical knowledge at their age. It is noteworthy that 89.00% of fourth-grade students discussed most of the TIMSS test topics in mathematics classes (Education & Training Evaluation Commission [ETEC], 2020).

ETEC (2020) indicated that of the main topics of TIMSS mathematics test in 2019 for fourth grade, 50.00% consisted of questions in the field of numbers, 30.00% in measurement and mathematical geometry, and 20.00% in data. It is noticeable that the largest part of the test included the numbers section, which requires high numerical skills from the students.

Despite extensive research on the importance of number sense in mathematics education and various teaching strategies to enhance it (Makhluf et al., 2018), there remains a significant research gap concerning the specific teaching practices of mathematics teachers in Saudi Arabia, especially at the fourth-grade level. Previous studies have often focused on general pedagogical approaches or interventions without delving deeply into the contextual factors that influence teaching effectiveness in developing number sense (Al-Hiti & Al-Hiti, 2017; Haroun, 2020). This gap is particularly evident in the lack of detailed examination of how variables such as teaching experience, academic qualifications, class size, training programs, and teaching load impact the efficacy of teaching practices in Saudi classrooms. Addressing this gap is urgent, as evidenced by the low performance of Saudi students in international assessments like PISA and TIMSS, which highlight deficiencies in numerical skills (ETEC, 2020; OECD, 2019).

The low number sense of students at various educational levels is a concern for researchers. Consequently, numerous studies have explored teaching strategies' efficacy in fostering number sense (e.g., Alturki, 2018; Alzubaidi, 2017; Al-Hiti & Al-Hiti, 2017; Haroun, 2020; Makhluf et al., 2018), reflecting the pivotal role of teachers. Given the importance of teachers' roles in building number sense among students through their teaching practices and the activities they choose within the classroom (Alharbi & Alnesyan, 2020), the current study aimed to investigate the reality of teaching practices among mathematics teachers in Saudi Arabia for developing number sense among fourth-grade female students. Understanding the factors that contribute to effective teaching practices is crucial for addressing the current gaps in student performance. This study is significant because it provides insights into how teaching practices can be improved, which is essential for enhancing students' mathematical abilities. By identifying effective strategies and addressing any deficiencies in current methods, the study aims to support mathematics teachers in fostering stronger numerical skills among their students. Improved teaching practices will not only benefit current students but also have a long-term positive impact on future generations, ultimately contributing to the advancement of mathematics education in Saudi Arabia. The following research questions were formulated for this purpose:

1. What is the level of teaching practices among mathematics teachers for developing number sense among fourth-grade female students?
2. Is there a statistically significant mean difference in the teaching practices of fourth-grade teachers to develop number sense with respect to the participants' teaching experience, academic degree, class size, training programs, and teaching load?

THEORETICAL FRAMEWORK & LITERATURE REVIEW

Number sense is the cornerstone of mathematics, enabling learners to interpret and represent things around them, in daily life situations, and in the problems they encounter. Therefore, there is a need to develop and enhance number sense. Number sense is one of the components of mathematical literacy, mathematical power, and mathematical proficiency needed by all students in the 21st century.

Dimensions of Number Sense

Researchers of the current study believe that there is difficulty in providing a clear definition of number sense. Attempts to define number sense have been divided into four main dimensions that reflect aspects of the educational context (see **Figure 1**).

1. **Mental process:** This aspect means that number sense is a mental ability in students that manifests in their understanding of the meaning and structure of numbers, operations on them, connecting previous experiences with new ones,

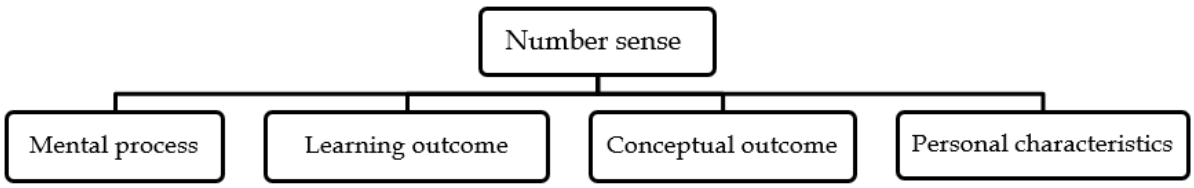

Figure 1. Dimensions of number sense definitions (Source: Authors' own elaboration)

and linking numbers to daily life (Alharithi & Alshahrani, 2020).

2. **Learning outcome:** This means that number sense includes the ability to reach mathematical judgments flexibly and to develop useful strategies for dealing with numbers and related operations. Number sense represents the ultimate goal of learning because students' mastery of numerical skills enables them to innovate various solutions (Alibrahim et al., 2022).
3. **Conceptual outcome:** This means students' ability to have a general understanding of numbers and operations, in addition to their ability to apply this understanding flexibly to make mathematical judgments and develop useful problem-solving strategies (Badawi, 2019).
4. **Personal characteristics:** The personal characteristics of students who possess number sense include their ability to deal and move easily between the real quantitative world and the world of numbers, as well as their ability to apply numerical operations easily and represent numbers in various ways according to the requirements of the situation (Ali, 2005).

Operational Definition

The researchers define number sense operationally as: a mathematical skill aimed at developing the fourth-grade students' sense of number, flexibility in dealing with numbers and different operations, understanding the magnitude of numbers and comparing them with other numbers, mastering mental calculation and approximate estimation, and ensuring the reasonableness of the answer.

Key Skills in Number Sense

Many studies (e.g., Abdulamir & Alkhazraji, 2017; Alharithi & Alshahrani, 2020; Alzubaidi, 2017; Al-Mehrez, 2018; Er & Artut, 2021) have indicated that number sense includes many skills that learners should be able to master, such as:

1. **Absolute and relative numerical perception skill (number value):** This refers to the student's perception of the value of the number as a quantity or magnitude as an independent unit and understanding the spatial value of the number. This understanding is evident in the ability to determine the relationship of the number to other numbers through comparison, arrangement, or finding equivalent representations of numbers.
2. **Perception skill of the relative effect of operations on numbers:** This means the student's ability to perceive the effect of each operation of the four operations (addition, subtraction, multiplication, division) on the result of the arithmetic operation, such as (the sum of two numbers increases with the increase of one and the stability of the other, the result of the division increases as the divisor decreases while the dividend is stable).
3. **Distinctive the symbols of comparing numbers and usage skill:** This is the student's perception of a number chosen to help him/her compare a set of numbers and outcomes. For example, the student realizes that the sum of two fractions, each less than half, is less than one.
4. **Mental calculation strategies skill:** Mental calculation strategies refer to the student's ability to use or employ many strategies that allow him/her to practice mental calculation for the outcomes of arithmetic operations without resorting to writing.
5. **Approximate estimation skill:** This means the student's ability to find an estimated value for the outcome of the arithmetic operation without performing it in usual manner using paper and pen like using rounding or compatible numbers.

Role of Teachers

Number sense is not an innate trait but rather a process that can be developed through experience and knowledge, focusing on number concepts and operations. Teachers play a crucial role in building number sense depending on the classroom environment, teaching practices, and activities they choose (Tsao & Lin, 2012). El-Seidy (2020) summarized the roles of teachers in developing number sense in their students by providing them with opportunities to innovate various solutions; presenting mathematical problems that help develop mental calculation and approximate estimation skills; knowing multiple ways of mental work and encouraging their use; developing important skills such as (place value, sets, order, counting, symmetry, relationships, concept); providing a knowledge-based educational environment with active interaction;

organizing content in the form of activities and problems that students encounter, and through which students' ability to make mental responses and correctly judge the results they reach is evident.

Strategies to Improve Number Sense

There are many strategies that can be applied to improve students' number sense, including: using different computational methods (Makhluf et al., 2018), getting students accustomed to mental calculation (Alharithi & Alshahrani, 2020), always relying on estimation (Alzubaidi, 2017), asking students about how to perform arithmetic operations, posing numerical problems with more than one possible answer (Mawaddah et al., 2021), and using critical thinking strategies (Haroun, 2020).

Due to the importance of developing number sense skills in elementary school students, many educational studies have attempted to test and identify the best teaching strategies that develop those skills. For example, the effectiveness of teaching using a visual approach (Ahmad, 2015), using a problem-solving-based strategy (Al-Yarbouh, 2016), using mathematical puzzles (Alzubaidi, 2017), using the Wheatley model (Haroun, 2020), using mind mapping strategy (Alturki, 2018), using games and electronic programs (Al-Etni & Alharbi, 2021; Al-Kathiri, 2021), using a cooperative inquiry strategy (Alharithi & Alshahrani, 2020), using a structure-based strategy (El-Seidy, 2020), and using a flipped classroom strategy (Al-Ward & Alshehri, 2022). Despite the attention given by many studies to identify the best strategies that develop number sense skills in elementary school students, their implementation in classrooms remains limited (Er & Artut, 2021).

Number Sense in Curricula

On the other hand, many other studies have sought to verify the availability of number sense in elementary mathematics curricula. Zaqqout (2016) conducted a study aimed at identifying the availability of number sense in the content of elementary mathematics curricula in Palestine, and the extent to which students acquire them. The results indicate that the curriculum content does not support the acquisition of number sense, and that teachers are not adequately trained, either before or during their service, to master number sense and teach it effectively to students. Al-Azamat (2016) revealed a significant interest in elementary mathematics textbooks in Jordan in developing number sense. Thus, some curricula do not adequately support number sense development, highlighting the need for curriculum enhancement.

Teaching Practices

Furthermore, some previous studies (e.g., Alibrahim et al., 2022; Alkhaldi & Al-Slouli, 2015; Tawhari, 2021) focused on measuring the level of teaching practices followed by teachers in the classroom, which help develop students' number sense. Alshamri (2019) defines teaching practices as the behaviors, actions, and methods used by teachers inside the classroom to deliver educational material for the purpose of inducing learning for students. The researchers define them operationally as the set of teaching activities performed by the fourth-grade mathematics teacher inside the classroom, which consist of setting teaching objectives, selecting methods and strategies, classroom management techniques, and assessment methods that affect students' acquisition of numerical sense skills. Alkhaldi and Al-Slouli (2015) indicate the low level of teaching practices and strategies that develop number sense among elementary teachers in Saudi Arabia. They highlight inconsistent training and professional development for teachers to effectively develop number sense in students. Also, their results confirmed that there were no statistically significant differences between the participants in the variables of years of experience and educational qualification.

Conversely, Tawhari (2021) showed that the level of mathematics teachers' practices in Saudi Arabia was moderate. In contrast, Alibrahim et al. (2022) indicated that the level of teaching practices that develop number sense among elementary teachers in Syria was high. Their results also confirmed the presence of statistically significant differences between the participants in the variable of years of experience in favor of longer years of experience, and for the variable of training courses in favor of teachers who followed one or more training courses.

Therefore, the research hypothesis has been formulated in the current study, indicating "there is a statistically significant difference at the (0.05) level between the mean scores of teaching practices among fourth-grade mathematics teachers aimed at developing number sense with respect to the participants' teaching experience, academic degree, class size, training programs, and teaching load."

METHODOLOGY

The current study employed a descriptive-analytical methodology, which is considered the most appropriate approach to achieve the study's objectives of monitoring the teaching practices of mathematics teachers inside the classroom. This design was selected because it facilitates a thorough comprehension of a phenomenon by utilizing various data sources (Gay & Airasian, 2000).

The choice of the descriptive-analytical methodology aligns well with the study's objectives of investigating the reality of teaching practices among mathematics teachers to develop number sense for fourth-grade female students in primary schools in Saudi Arabia. This approach allows for a detailed description and analysis

of the level of teaching practices among the sampled mathematics teachers in developing number sense for students. By employing this approach, the researchers are able to gather comprehensive data and analyze the teaching practices of the teachers in a structured and systematic manner to understand their effectiveness in developing number sense among students.

Population & Sample

The study population consisted of all mathematics teachers in primary schools in the Eastern Province, Saudi Arabia. 20 teachers were randomly selected to constitute the study sample, on whom the study tools were applied during the second semester of the academic year 2023-2024.

The decision to focus specifically on fourth-grade female students and teachers in this research study was driven by the aim to address gender-specific educational needs, improve teaching practices, and enhance mathematical skills among this particular group within the Saudi Arabian context.

Instrument

The observation card was selected to assess the level of teaching practices of mathematics teachers aimed at developing number sense among fourth-grade female students (**Appendix A**).

The choice of the observation card as a study instrument is attributed to the fact that the information collected through observation is deeper, more comprehensive, and more accurate, making it one of the most direct means of studying teaching practices (Qandilji, 2013). According to Attia (2009), the observation card is the optimal instrument for studying behavior, performance, and systematically collecting information about individuals' characteristics in performance-oriented situations.

Design & objective determination of instrument

The observation card was designed by referring to literature and some previous research and studies that used the observation card to study number sense, such as Alkhaldi and Al-Slouli (2015), Al-Mehrez (2018), and Tawhari (2021).

The observation card consisted of two parts: the first part contained general information about the teacher (teaching experience, academic degree, class size, training programs attended by the teacher during service, teaching load, observation location, and observation date). The second part included a list of teaching practices to be observed, divided into three dimensions: preparation (monitored and followed through the teacher's preparation on the "Madrasati" platform. Madrasati is a national electronic platform created by the Ministry of Education in Saudi Arabia for teachers, parents, and school students. The platform represents a virtual school with different services and features that were created during the COVID-19 pandemic and are still being used up to this moment), implementation, and evaluation (monitored and followed through direct observation during the class).

Table 1. Evaluation values of teaching practices

Practice level	Mean
Low	From 1.00 to 1.66
Medium	From 1.67 to 2.33
High	From 2.34 to 3.00

Validity

Face validity was used to verify the validity of the instrument, where the initial form of the instrument was presented to seven referees in the curriculum and instruction specialization to solicit their comments and suggestions. The observation card in its initial form consisted of 36 teaching practices distributed across the three dimensions (preparation, implementation, and evaluation). Some paragraphs were linguistically rephrased, and other paragraphs were modified and deleted based on the referees' comments and suggestions. The observation card, in its final form, consisted of 32 items distributed across the three dimensions (preparation=five practices, implementation=20 practices, and evaluation=seven practices). Each item corresponded to a three-point scale (high=three points, medium=two points, low=one point) to describe the level of practice.

Table 1 shows the mean score of teaching practices for teachers, where 1.00-1.66 indicates a low level, 1.67-2.33 indicates a medium level, and 2.34-3.00 indicates a high level of teaching practices for mathematics teachers aimed at developing number sense among fourth-grade students.

Item discrimination

Pearson correlation coefficients were calculated between each item and the total score of its dimension and between the scale dimensions and the total score to assess the ability of the items to discriminate.

Table 2 shows the item correlation coefficients for each dimension with its total score. **Table 2** indicates that all Pearson correlation coefficients for items with their sub-dimensions were significant at 0.05, supporting the items' ability to discriminate.

Additionally, Pearson correlation coefficients were calculated between the dimension score and the total score on the scale (see **Table 3**). **Table 3** shows that all correlation coefficients between the dimension and the total score for the three sub-dimensions of the scale were significant at (0.01), confirming the scale's ability to discriminate.

Table 2. Correlation coefficients results

Item	Correlation coefficient
Preparation	
1	0.759**
2	0.667**
3	0.840**
4	0.901**
5	0.739**
Implementation	
6	0.808**
7	0.736**
8	0.634**
9	0.858**
10	0.877**
11	0.750**
12	0.761**
13	0.802**
14	0.665**
15	0.714**
16	0.617**
17	0.660**
18	0.721**
19	0.538*
20	0.679**
21	0.678**
22	0.730**
23	0.805**
24	0.768**
25	0.721**
Evaluation	
26	0.577**
27	0.724**
28	0.902**
29	0.634**
30	0.602**
31	0.744**
32	0.746**

Note. *Correlation is significant at 0.05 level & **Correlation is significant at 0.01 level

Table 3. Pearson correlation coefficients for sub-dimensions of teaching practices

Dimension	Correlation coefficients
Preparation	0.712**
Implementation	0.982**
Evaluation	0.835**

Note: **Correlation is significant at 0.01 level

Reliability

The reliability of the observation card was ensured by calculating the inter-rater agreement coefficient using Cooper's formula, with the assistance of a mathematics subject supervisor participating in the observation process with the researchers. Five primary school mathematics teachers (not part of the sample) were visited to record each observation, and then the reliability coefficient was calculated.

Table 4. Reliability values

Item	Corrected item-total correlation	Alpha if item deleted
1	0.446	0.958
2	0.273	0.956
3	0.726	0.956
4	0.561	0.957
5	0.617	0.956
6	0.767	0.955
7	0.681	0.956
8	0.536	0.957
9	0.808	0.955
10	0.823	0.955
11	0.754	0.955
12	0.793	0.956
13	0.689	0.955
14	0.652	0.956
15	0.676	0.956
16	0.529	0.957
17	0.638	0.956
18	0.691	0.956
19	0.519	0.957
20	0.650	0.956
21	0.596	0.956
22	0.685	0.956
23	0.779	0.955
24	0.781	0.955
25	0.712	0.956
26	0.483	0.957
27	0.685	0.956
28	0.779	0.955
29	0.698	0.956
30	0.651	0.956
31	0.425	0.958
32	0.479	0.957

Note. Total reliability=0.957

$$R = \frac{Number\ of\ agreement \times 100}{Number\ of\ agreement + Number\ of\ disagreement}, \quad (1)$$

where R is reliability.

The inter-rater agreement ratio indicated that the average agreement among the observers on the performance of the five teachers in planning was (84.00%), in implementation (78.00%), and in evaluation (77.14%), with an average agreement of (81.18%), allowing us to accept the use of the observation card. Additionally, the homogeneity of observation card items was checked using Cronbach's alpha. The reliability coefficient was calculated in case of deleting the item (alpha if item deleted) to accurately assess the contribution of scale items to reliability. The corrected item-total correlation coefficient was calculated to detect item discrimination and internal consistency, which supposed to be not least 0.2 (Streiner, 2003).

Table 4 shows the reliability values in case of alpha if item deleted, the corrected item-total correlation, and the overall reliability of the observation card. **Table 4** shows that Cronbach's alpha reliability coefficient for the

Table 5. Reliability coefficients for study instrument & its dimensions

Dimension	Cronbach's alpha	Number of items
Preparation	0.840	5
Implementation	0.951	20
Evaluation	0.818	7
Total	0.957	32

observation card was (0.957). All reliability values in case of deleting the item were less than or very close to this coefficient, indicating the contribution and importance of these items to the observation card's reliability. The corrected correlation coefficient achieved the minimum required threshold for all items.

Table 5 shows the reliability coefficients for each dimension and the total score using Cronbach's alpha. **Table 5** shows that all dimensions of the practices scale enjoyed good Cronbach's alpha coefficients (preparation=0.840, implementation=0.951, and evaluation=0.818) exceeding 0.7. The overall score of the instrument also had a high reliability coefficient (0.957) (Streiner, 2003).

Statistical Analysis

After applying the study instrument, the data were analyzed using SPSS software utilizing the following statistical methods:

Mean and standard deviation and percentages were calculated to measure the level of teaching practices of mathematics teachers aimed at developing number sense among fourth-grade female students.

One-way ANOVA was conducted when data assumptions were met to determine the effect of teaching experience on the level of teaching practices of fourth-grade mathematics teachers aimed at developing number sense.

Mann-Whitney test was employed when data assumptions were violated to examine differences in estimations among the study sample based on their academic degree.

Kruskal-Wallis test was used when data assumptions were violated to test differences among different groups according to the training programs.

An independent samples t-test was conducted when data assumptions were met to investigate differences among study sample individuals based on teaching load and class size.

RESULTS & DISCUSSION

The current study aims to investigate the teaching practices of mathematics teachers in Saudi Arabia for developing number sense among fourth-grade elementary female students.

Table 6. Participants' teaching experience

Teaching experience	n	Percentage (%)
Less than five years	10	50
From five to 10 years	4	20
More than 10 years	6	30
Total	20	100

Table 7. Participants' academic degree

Academic degree	n	Percentage (%)
Bachelor's in mathematics education	16	80
Bachelor's in mathematics	4	20
Total	20	100

Table 8. Class size results

Class size	n	Percentage (%)
Less than 25 students	16	80
From 25 to 35 students	4	20
Total	20	100

Table 9. Participants' number of training programs

Number of training programs	n	Percentage (%)
Less than five programs	2	10
From five to 10 programs	4	20
From 11 to 15 programs	6	30
From 16 programs & more	8	40
Total	20	100

Descriptive Results

Demographic characteristics of participants indicate that 50.00% of them have teaching experience of less than five years, followed by teachers with more than ten years of experience at 30.00%, and finally, teachers with experience ranging from five to ten years at 20.00% (see **Table 6**).

Table 7 shows that the highest proportion of participants holds a bachelor's degree in mathematics education at 80.00%, while teachers with a bachelor's degree in mathematics account for 20.00%.

Table 8 indicates that 80.00% of teachers have fewer than 25 students in one class, while 20.00% of them have 25-35 students in a class.

Table 9 illustrates that the majority of teachers attended over 16 professional development programs during service, followed by teachers attending 11-15 professional programs, then five-10 professional programs, and finally, 10.00% of teachers attended fewer than five professional programs during service.

Table 10 presents teaching workload of participants, where 17 of them have between 16 to 23 teaching periods per week, accounting for 85.00%, while three of them have fewer than 15 teaching periods weekly.

Teaching Practice Results

To answer the first question regarding "What is the level of teaching practices among mathematics teachers

Table 10. Participants' teaching load

Teaching load	n	Percentage (%)
Less than 15 classes	3	15
From 16 to 23 classes	17	85
Total	20	100

Table 11. Level of teaching practices

Dimension	Mean	SD	Level	Ranking
Preparation	1.64	0.57	Low	3
Implementation	2.30	0.56	Medium	2
Evaluation	2.45	0.49	High	1
Total	2.23	0.50	Medium	

Note. SD: Standard deviation

for developing number sense among fourth-grade female students?", the mean and standard deviation were calculated to measure the level of teaching practices of mathematics teachers aimed at developing number sense among fourth-grade female students.

Table 11 presents the evaluation values of teaching practices (preparation, implementation, evaluation) in terms of three levels: low, medium, and high, based on mean scores.

Table 11 indicates that the level of participants' practice in preparation was low (*mean*=1.64; *standard deviation*=0.57). This result can be attributed to mathematics teachers' lack of interest in lesson planning and their reliance on prepared material on "Madrasati" platform. This low level of planning could also be attributed to their lack of motivation for planning, as some mentioned that it requires more effort and time in preparation. Additionally, some highly experienced teachers do not practice lesson planning, relying on their knowledge and teaching experience in the subject matter. Moreover, the high workload and job requirements take up most of the teachers' attention, leading to a lack of focus on lesson planning. This result aligns with Alkhaldi and Al-Slouli (2015), indicating the low practices and teaching methods used by teachers to develop number sense.

Table 11 also indicates that the level of teaching practices of mathematics teachers for developing number sense in implementation was medium (*mean*=2.30; *standard deviation*=0.56). This result may be attributed to the need for teachers to further training on number sense, and the importance of mental arithmetic and approximate estimation, as confirmed by Tawhari (2021). The moderate level of teaching practices (implementation dimension) of mathematics teachers for developing number sense may also be explained by teachers' somewhat inadequate understanding of the importance of reinforcement and encouragement for learning, according to Skinner's theory of learning, where supporting the emotional aspect of students is one of the main approaches to supporting the cognitive aspect (Qubad, 2009). Teachers need to focus more on mental arithmetic and approximate estimation, as they are the most commonly used skills in daily life (Matouq, 2020). Teachers also need to use software and technologies to overcome some of the difficulties faced by teachers and students, as well as provide opportunities for a deeper understanding of mathematical concepts and terms (Abdul-Sayed, 2022).

Additionally, **Table 11** shows that the level of teaching practices of mathematics teachers for developing number sense in evaluation is high (*mean*=2.45; *standard deviation*=0.49). This result may be due to the familiarity of teachers with various evaluation methods, the availability of sufficient exercises in school mathematics textbooks, and the teacher's desire to create a competitive environment among students. This result aligns with Alibrahim et al. (2022), indicating that the level of practices of third-grade elementary teachers for number sense in an evaluation aspect was high.

In general, the results of **Table 11** indicate that the level of teaching practices of mathematics teachers aimed at developing number sense among fourth-grade female students is moderate (*mean*=2.23, *standard deviation*=0.50). This suggests that there is room for improvement in the teaching practices to enhance the development of number sense skills. The medium level of teaching practices indicates that while efforts are being made to develop students' number sense, there is a need for teachers to enhance their strategies further to achieve a higher level of effectiveness in this area. This result differs from Alibrahim et al.'s (2022) finding, which suggests a high level of teaching practices, and it aligns with Tawhari's (2021) result indicating that the level of mathematics teachers' practices in Saudi Arabia is moderate. Perhaps this result is due to teachers' exhaustion from additional tasks and other job requirements, such as developing remedial plans for weak students, as well as enrichment plans for high achievers, addressing educational gaps, enhancing skills, analyzing results, preparing various types of tests (evaluative, diagnostic, summative, and formative), visiting professional communities, exchanging visits between teachers, preparing for school radio programs, participating in ministry programs, activating activity sessions, taking turns in waiting sessions, and correcting various tasks (assignments, tests, activities, and performance tasks). All these tasks divert the teacher's effort away from improving their teaching practices, which reduces their support for students' mastery and excellence in number sense.

To answer the second question, which states "Is there a statistically significant mean difference in the teaching practices of fourth-grade teachers to develop number sense with respect to the participants' teaching experience, academic degree, class size, training programs, and teaching load?", the validity of the following hypothesis was verified: "There is a statistically significant difference at the 0.05 level between the mean scores of teaching practices among

Table 12. Descriptive statistics for teaching experience variable

Teaching experience	n	Mean	Standard deviation	Levene's statistic	p
Less than five years	10	2.1219	0.52570	0.736	0.494
From five to 10 years	4	2.3906	0.69245		
More than 10 years	6	2.3073	0.33155		
Total	20	2.2313	0.49901		

Table 13. One-way ANOVA analysis table

Variance source	Sum of squares	df	Mean square	F	p
Between	0.256	2	0.128	0.486	0.623
Within	4.475	17	0.263		
Total	4.731	19			

Table 14. Mann-Whitney test for comparing different academic degree

Group	n	Mean rank	Sum of ranks	U	p
Bachelor's in mathematics education	16	10.69	171.00	29	0.820
Bachelor's in mathematics	4	9.75	39.00		

fourth-grade mathematics teachers aimed at developing number sense with respect to the participants' teaching experience, academic degree, class size, training programs, and teaching load."

One-way ANOVA analysis was conducted to determine the effect of years of experience (teaching experience) on the level of teaching practices of fourth-grade elementary mathematics teachers aimed at developing number sense. Initially, mean and standard deviation were calculated to estimate the practices for each level of experience, and the assumption of variance homogeneity was verified using Levene's test (refer to **Table 12**).

Table 12 indicates that variance homogeneity between groups was achieved ($p>0.05$). It also shows that teachers with experience ranging from five-10 years were the most practiced (*mean*=2.3906; *standard deviation*=0.69245).

To check for differences among participants based on teaching experience, a one-way ANOVA analysis was conducted (refer to **Table 13**).

Table 13 shows no statistically significant differences in the mean scores of teaching practices of fourth-grade elementary mathematics teachers aimed at developing number sense attributed to the teaching experience variable ($F=0.486$, $p>0.05$). This result indicates that teaching experience alone may not significantly impact the level of teaching practices aimed at developing number sense. This finding is consistent with Alkhaldi and Al-Slouli (2015) and Al-Motreb et al. (2017), which showed that teaching experience has no effect on the level of teaching practices aimed at developing number sense. It contradicts the result of Alibrahim et al. (2022), which affirmed that highly experienced teachers are more practiced in developing number sense among their students. Perhaps the reason for this result in the current study is the conceptual stability of teachers over time, emphasizing their need to join professional development programs and be updated with the latest developments in education and learning, as well as familiarizing themselves with the principles and standards underlying mathematics teaching. The current study's results suggest that factors beyond teaching experience, such as professional development programs and teachers' attitudes towards teaching, may play a more crucial role in influencing teaching practices.

Additionally, to test differences among participants based on academic degree, Mann-Whitney test was used (refer to **Table 14**).

Table 14 indicates no statistically significant differences in the teaching practices scores of fourth-grade elementary mathematics teachers aimed at developing number sense attributed to the academic degree variable ($p>0.05$). The non-significant results imply that there is no strong evidence to suggest that the academic degree of teachers significantly influences their teaching practices aimed at developing number sense in fourth-grade students. This result is consistent with Alkhaldi and Al-Slouli (2015), Alzahrani (2014), Al-Khuzaim and Albalawi (2020), and Al-Motreb et al. (2017), which found no significant impact of academic degrees on teaching practices. And this result contradicts the result of Alibrahim et al. (2022), which confirmed that teachers' academic degrees influenced their teaching practices to develop number sense among their students. Perhaps the reason for this result in the current study is that teaching practices are influenced by teachers' attitudes toward teaching and their inclinations, regardless of their educational qualifications. This finding reinforces the idea that effective teaching practices may not solely be dependent on formal education but also on teachers' personal dispositions and approaches to teaching.

Additionally, to examine the differences among sample individuals based on the variation in the number of students inside the classroom (class size) (refer to **Table 15**), an independent samples t-test was used since

Table 15. Independent t-test for comparison based on class size

Class size	Mean	Standard deviation	t	df	p
Less than 25 students	2.2090	0.52820	- 0.390	18	0.701
From 25 to 35 students	2.3203	0.41903			

Table 16. Kruskal-Wallis test values for number of training programs

Number of training programs	n	Mean rank	χ^2	p
Less than five programs	2	5.75	3.030	0.387
From five to 10 programs	4	9.00		
From 11 to 15 programs	6	13.42		
From 16 programs and more	8	10.25		

Table 17. Independent samples t-test for comparing based on teaching load

Teaching load	Mean	Standard deviation	t	df	p
Less than 15 classes	2.1979	0.33415	- 0.122	18	0.904
From 16 to 23 classes	2.2371	0.53057			

the grades were normally distributed for both groups, and the assumption of variance homogeneity was verified (Levene's test value=0.298, p=0.592).

Table 15 indicates no statistically significant differences in the teaching practices of fourth-grade elementary mathematics teachers aimed at developing number sense attributed to the difference in the class size (t=-0.390, p>0.05). The t-value being close to zero and the p-value being greater than 0.05 suggest that variations in class size do not influence teaching practices aimed at developing number sense. This result is consistent with Alzahrani (2014), suggesting that class size may not significantly impact teaching practices related to number sense development. Perhaps the reason for this result is that the number of elementary school students in Ras Tanura city (where the study was conducted) is somewhat equal in classrooms, with the number usually not exceeding 25 students per class except in exceptional cases.

Furthermore, to test differences among groups based on the number of training programs, Kruskal-Wallis test was used (refer to **Table 16**).

Table 16 indicates no statistically significant differences in the mean ranks of the four groups attributed to the difference in the number of training programs (p>0.05). The lack of significant differences suggests that the number of training programs undertaken by teachers may not directly impact the level of teaching practices aimed at developing number sense among fourth-grade students. This result is consistent with what was mentioned by Alshamri (2019), Al-Khuzaim and Albalawi (2020), and Al-Motreb et al. (2017), which showed no differences attributed to the number of training programs in the level of teaching practices for teachers. This result may be due to the focus of training programs on the theoretical aspect of knowledge only, without focusing on its application in the classroom. Many training programs focus on general educational activities and strategies, without specializing in teaching mathematics, and there are no specialized programs aimed at developing numerical skills for teachers according to the researchers. This indicates that the focus of training programs may need to be more tailored towards practical application in the classroom to enhance teaching practices effectively.

Moreover, to test differences in the estimates of study participants based on teaching load, an independent samples t-test was used (refer to **Table 17**), where grades were normally distributed for both groups, and the assumption of variance homogeneity was verified (Levene's test value=1.118; p=0.304).

Table 17 shows no statistically significant differences in the teaching practices of fourth-grade elementary mathematics teachers aimed at developing number sense attributed to differences in teaching load (t=-0.122, p>0.05). Perhaps reason for this result may be due to the large burden that falls on teachers in non-teaching work (such as preparing for school radio, participating in ministerial programs, activating activity classes, taking turns in waiting periods, correcting various tasks, etc.), which made teachers not focus on developing their required teaching skills.

Implications of Results

The results of this study have several important implications:

1. **Professional development focus:** Since the number of training programs attended did not significantly impact teaching practices, it indicates a need to reevaluate the content and delivery of these programs. Professional development should focus more on practical application and classroom strategies rather than just theoretical knowledge. Specialized training in number sense development and effective teaching methods should be prioritized.
2. **Support for teachers:** The lack of significant impact from teaching experience suggests that continuous support and resources for teachers at

all stages of their careers are crucial. This support could include mentorship programs, collaborative teaching communities, and regular workshops focused on innovative teaching practices.

3. **Holistic approach to teaching:** Since factors like academic degree and class size did not significantly influence teaching practices, it highlights the importance of a holistic approach to teaching that considers teacher attitudes, motivation, and overall teaching environment. Efforts should be made to create a supportive and motivating environment for teachers to enhance their teaching practices.
4. **Workload management:** The insignificant impact of teaching load on teaching practices suggests that the quality of teaching might not necessarily be affected by the number of teaching periods. However, the additional non-teaching responsibilities mentioned (such as preparing for school radio programs, participating in ministry programs, and correcting various tasks) might be diverting teachers' efforts. Schools should consider ways to manage these additional duties more effectively, perhaps by providing administrative support or redistributing responsibilities to ensure teachers can focus more on instructional practices.
5. **Innovative teaching strategies:** Given the moderate level of teaching practices overall, there is room for improvement. Emphasizing the use of innovative teaching strategies, such as incorporating technology and interactive methods, can help enhance the development of number sense. Encouraging teachers to adopt new teaching tools and methods could lead to more effective learning outcomes.
6. **Emphasis on mental arithmetic and estimation:** The medium level of teaching practices in implementation suggests that more emphasis should be placed on mental arithmetic and estimation skills. Training programs and classroom activities should focus on these areas to ensure students develop strong number sense skills that are applicable in real-life situations.

Overall, while the study did not find significant differences based on the tested variables, it highlights the importance of focusing on practical, supportive, and innovative teaching practices. By addressing these areas, schools can better support teachers in developing number sense among students, ultimately leading to improved mathematical proficiency and student outcomes.

CONCLUSIONS

The current study examined the teaching practices of mathematics teachers aimed at developing number sense among fourth-grade female students in Ras Tanura, Saudi Arabia. The findings revealed that overall teaching practices were average, with planning rated low, implementation medium, and evaluation high. Furthermore, there were no statistically significant differences in teaching practices based on variables such as teaching experience, academic degree, class size, training programs, or teaching load. These results highlight the need for targeted professional development to enhance teachers' skills in fostering number sense. It is recommended that schools implement specialized training courses and professional development programs to improve planning and implementation practices. Moreover, there is a need to innovate and reinforce teaching practices to create more engaging and effective learning experiences for students. Future research should investigate teaching practices at different educational stages, assess teachers' training needs, and explore other factors influencing the development of number sense. Additionally, studies should evaluate the effectiveness of electronic programs and other innovative methods in enhancing number sense among elementary school students.

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APPENDIX A: OBSERVATION CARD

Teaching Practices of 4th Grade Mathematics Teachers

Part 1: Information about observed teacher

1. **Years of experience in teaching elementary school (teaching experience)**

☐ Less than 5 years.
☐ From 5 to 10 years.
☐ More than 10 years.

2. **Qualifications (academic degree)**

☐ Bachelor's in mathematics education.
☐ Bachelor's in mathematics.
☐ Bachelor's in a different field.
☐ Postgraduate studies.

3. **Number of students in the class (class size)**

☐ Less than 25 students.
☐ From 25 to 35 students.
☐ More than 35 students.

4. **Number of professional development courses attended during service (number of training programs)**

☐ Less than 5 programs.
☐ From 5 to 10 programs.
☐ From 11 to 15 programs.
☐ 16 or more programs.

5. **Teaching load (weekly)**

☐ Less than 15 classes.
☐ from 16 to 23 classes.
☐ 24 classes.

Part 2: List of teaching practices

(A) Information to be filled out by observer

Table A1. Information to be filled out by observer

Observation location	School name: …….
	Class: ……...
Observation time	Date: ../../ 20..

(B) Level of teaching practices among mathematics teachers for developing number sense among fourth-grade female students

Table A2. Level of teaching practices among math teachers for developing number sense among 4th grade female students

Statement	Practice level		
	High	Medium	Low
Preparation			
1. Plans the lesson introduction considering number sense skills.			
2. Plans to use diverse strategies to accommodate individual student differences.			
3. Plans problems involving higher-order thinking skills.			
4. Plans activities that support understanding of mathematical operations.			
5. Identifies appropriate assessment methods.			
Total score			
Mean score			

Table A2 (Continued). Level of teaching practices among math teachers for developing number sense among 4th grade female students

Statement	Practice level		
	High	Medium	Low
Implementation			
6. Introduces the lesson in an engaging manner to capture attention.			
7. Connects previous learning experiences with new ones.			
8. Provides activities that allow students to use estimation.			
9. Implements estimation strategies.			
10. Implements mental math strategies.			
11. Asks open-ended questions to develop number sense.			
12. Encourages verbalizing mental math processes.			
13. Waits after posing a question to allow thinking time for the answer.			
14. Provides opportunities for students to choose appropriate numerical operation.			
15. Links numerical skills to real-life situations for students.			
16. Uses tangible tools to illustrate numerical concepts.			
17. Utilizes educational software, videos, and apps to support numerical concept understanding.			
18. Supports students in finding creative solutions.			
19. Allows multiple ways to express numbers (verbal, visual, symbolic).			
20. Encourages students to verify answers using estimation.			
21. Guides students to use various mental math strategies.			
22. Offers multiple solutions to problems with similar concepts.			
23. Provides classroom activities requiring application of learned concepts in new situations.			
24. Explains the differences between mathematical operations (addition, subtraction, multiplication, division).			
25. Encourages students to use correct mathematical terminology.			
Total score			
Mean score			
Evaluation			
26. Discusses students' solutions.			
27. Uses preliminary evaluation.			
28. Uses formative evaluation to achieve lesson objectives in number sense.			
29. Uses summative evaluation to achieve lesson objectives in number sense.			
30. Provides varied assessment methods like choices, observation, error detection, etc.			
31. Avoids making quick judgments on responses.			
32. Provides feedback to students on numerical and operational skills.			
Total score			
Mean score			
Total scores for the entire observation card			
Mean scores for the entire observation card			