

Level Of Teaching Practices To Promote The Mathematical Representation Skills Of Intermediate Schoolteachers In Accordance With The Standards Of The National Council Of Mathematics Teachers (NCTM)

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Abstract: The study aims to reveal the level of instructional practices supporting Mathematical representation skills of intermediate stage teachers, in accordance with NCTM standards and the impact of years of experience and academic qualification factors. The research followed the descriptive approach through a survey given to a random sample of (36) mathematics teachers in the Quawyah education department during the year 1440 -1441 AH. The results of the study found that all the instructional practices of the three mathematical representation standards ranged from 55.6-100.0%, except for two practices that are not available at a rate of 47.2% concerning the criteria for building and using mathematical representation to organize, record, and communicate mathematical ideas, seven instructional practices were at an average level, while four practices were at a low level and the standard level as a whole was low. Regarding the criterion of selecting, applying, and translating mathematical representations to resolve issues, six teaching practices supporting the mathematical representation skills of intermediate-level mathematics teachers were at an average level, while three practices achieved a low level. The standard as a whole was at an average level, and seven teaching practices under the standard of using representations to model and interpret mathematical, natural, and social phenomena achieved an average level as well, while three practices achieved a low level and the standard level as a whole was low. There are no statistical differences in the level of instructional practices in support of the mathematical representation skills of intermediate-level teachers with regard to NCTM standards. There are also statistical function differences among teachers according to years of experience, in the level of teaching practices supporting mathematical representation skills, in intermediate-level teachers considering NCTM standards for highly experienced teachers.

Index Terms: Teaching Practices- Mathematical Representations-Mathematics Teachers- National Council of Teachers of Mathematics (NCTM).

1 INTRODUCTION

Nowadays, communities seek to build a generation that through the content, expertise, experience, values, and skills given to them, can pursue their lives to employ them in the daily situations they face. This generation conducts its future tasks in the management of its community through sound education (Nimtz, J., 2009). That is why educational institutions prepare the vision and goals of society, which they aspire to, through educational curricula that ensure the achievement of the objectives of the educational learning process in compliance with the latest international standards to achieve success and progress in all fields, (Dewall, J. 2007 & Fennel, F. & Rowan, T.2001). Therefore, the content of the school curricula was of remarkable and widespread importance, as the content is the real manifestation and official representation of those objectives that society wants to accomplish. There has been a significant change in mathematics curricula around the world, in the stages of education, and growth has characterized this global trend. The expansion of mathematical material and processes has an influence and an important role in developing the generation's abilities and enhancing its abilities to help achieve the degree of mastery of certain mathematical activities (Gagatsis, A. & Elia, I., 2004).

Mathematics as a science is a quantitative approach to the study of natural and social phenomena, and school mathematics as a core topic seeks to create a thoughtful approach focused on the quantitative logic systematized by students. (Hwang, W. et al., 2007). With major advances in mathematics, there has been a clear change in the goals of mathematics education, so that achievement is no longer the primary goal. The goal is to prepare an individual who can apply mathematical knowledge to solve different life problems, requiring teachers to make reasonable decisions about the learning situation, mathematical knowledge, curriculum goals, classroom environment, and student needs. (Goldin G.A., 2008) Therefore, it is necessary to study and monitor the performance of the teachers and their teaching practices and analyze and evaluate them through systemized and studied standards (Asli, O., 2001). In the sense of major changes in the mathematics curriculum, Saudi Arabia's view of the teacher's role in the educational process has shifted as well. The teacher of today is expected to perform roles that involve skills and tasks that vary greatly from those practiced by the teacher of yesterday, as new roles were assigned to him, both of which seek to activate the role of the student in the classroom situation and His learning in general, in addition to enhancing the product of teaching, learning, and education as a whole. These need a teacher who possesses modern teaching competencies, and exercises them effectively, because focusing on developing courses cannot achieve the goals of the educational process unless this is accompanied by a teacher who is skilled in his subject matter and has the drive and desire to achieve its goals, and deliver them to the student easily and proficiently, which led to the emergence of mathematical representation as a vital topic in the teaching

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and learning of mathematics. Representation is the use of one thing to represent something else and representation is the use of items like words, graphs, sketches, physical materials, etc. in mathematics to express a mathematical idea or concept (Salkind, G., 2007). Mathematics education research indicates that the ability to convert between various representations of mathematical concepts, such as conversion from a drawing equation or vice versa, plays an important role in developing problem-solving abilities. Some researchers claim that a measure of deep mathematical thought is flexibility in transforming representations (Macmillan / McGraw-Hill, 2007 & Pape, S. & Tchoshanov, M., 2001). Mathematical representations are one of the most effective teaching techniques, in addition to consolidating knowledge in the minds of students, designing exercises that teachers need to teach the content of mathematics, making mathematical ideas more sensory. Moreover, communicating with others, restoring, and organizing their information, allowing students to create cognitive connections between concepts that make it enjoyable for the mathematics class. When the student engages and participates in the educational situation, he demonstrates the value of the mathematical subjects he is studying by using methods close to his life that help establish and learn positive tendencies towards mathematics, (Chen, C., 2014). In view of what was confirmed by the literature review, the performance of the teacher cannot be enhanced without certain criteria that define what should be met in his performance, so interest in professional standards emerged. Therefore, in the light of the standards of the National Council of Mathematics Teachers, the two researchers saw the value of conducting an evaluation study to identify the level of teaching practices that encourage the abilities of mathematical representation among middle school teachers (NCTM). Specialists in mathematics teaching were among the first to be involved in these criteria, as one of the most important documents on which specialists depended was the document "Professional Standards for Teaching Mathematics" released by the National Council of Teachers of Mathematics [NCTM] in 1991, as their studies continued to use it for evaluating the performance of a mathematics teacher or his professional development, then the council published the document "Principles and Standards of School Mathematics" in 2000. Then the previous professional standards updated document published in 1991 was with the issuance of the new standards document in 2007 under the heading "Teaching Mathematics Today: Improving Practice, Improving Student Learning" (NCTM, 2014). The School Mathematics Principles and Standards document released in 2000 AD by the American National Council of Mathematics Teachers affirmed that the use of mathematical representations helps students grasp, deepen, and solve mathematical problems with mathematical concepts. And that mathematical representations must be dealt with as basic elements in supporting students' learning of mathematical concepts and in communicating understanding to the student, with the need for mathematics teachers to understand what their students know and what they need to learn, and then create appropriate opportunities for effective learning. (NCTM, 2000). Several studies have addressed the teacher and student mathematical representations and identified the difficulties that teachers face in the classroom in solving mathematical problems using mathematical representations and the factors that affect the class teacher's use of these representations, such as Bal, 2014, 2010

Özmantar et al., Alshehri and Ali, 2016, Noto et al., 2016, Turner, 2016, 2016. Based on the above, in teaching and learning mathematics simply and interestingly, allowing students to perform mathematical representations has become an urgent need. This mastery does not take place without the assistance of a teacher who, subject to the requirements of the National Council of Mathematics Teachers, requires special skills to use mathematical representation, especially in middle school, since it is the stage of behavior development. therefore, the two researchers considered the importance of conducting an evaluation study, to identify the level of teaching practices supporting the skills of mathematical representation in intermediate school teachers in accordance with the standards of the National Council of Mathematics Teachers (NCTM).

2- THE STUDY PROBLEM

The lack of effective mathematical teaching and learning methods contribute to the unsatisfactory outcome of mathematics students. One of the factors influencing improving student learning in mathematics is the appropriate learning experiences that students have, focusing on the learner's activity and motivating learning, and the emotions and attitudes that accompany the learning situation with mathematics. Perhaps the use of mathematical representations in teaching mathematics and linking it to the life and realistic experiences of the student helps create this supportive environment that can contribute to the cognitive, emotional, and social improvement of learning outcomes (Blom, V., 2009). Because there is a lack of student achievement in mathematics, through the grades they receive in the monthly and final exams, which may be due to the difficulty of students' understanding of this material, the lack of teaching methods that help with learning, and the low levels of teachers' teaching practices, The content of mathematics textbooks in the light of the standards of the document (NCTM, 2000). The poor performance of students can be attributed to the low level of teaching practices for teachers, as the level of ability of mathematical representation for mathematics teachers can be weak with an apparent gap between the formal curriculum and the semester curriculum as implemented by teachers (Chandra, B. 2002).

The researchers considered it important to conduct an assessment study, to identify the level of instructional practices that support the mathematical representation skills of intermediate stage teachers following the NCTM standards, and the researcher formulated the following questions:

- What are teaching practices that support the mathematical representation skills required for mathematics teachers in intermediate school, in accordance with the standards of the National Council of Mathematics Teachers (NCTM)
- What is the level of teaching practices that support the mathematical representation skills required for mathematics teachers in intermediate school, in accordance with the standards of the National Council of Mathematics Teachers (NCTM)?
- With regard to the standards of the National Council of Mathematics Teachers (NCTM) relating to years of experience, are there statistically significant differences between the level of teaching practices that support the

mathematical representation skills required for mathematics teachers at intermediate school?

- With regard to the standards of the National Council of Mathematics Teachers (NCTM) relating to academic qualifications, are there statistically significant differences between the levels of teaching practices that support the mathematical representation skills required for mathematics teachers at intermediate school?

3. METHOD

The researchers followed the descriptive survey approach at the level of teaching practices that support the skills of mathematical representation among middle school teachers to describe the nature of the phenomenon.

3-1 SAMPLE OF THE STUDY

The study sample consisted of a random sample of intermediate-stage teachers in the Al-Quwaiyah governorate and its Al-Rawaida department in the academic year 1441 AH. The number of teachers reached (36) where the visits were developed in accordance with the schedule of the program of visits drawn up by the researcher.

3-2 TOOLS OF THE STUDY

The researchers composed an observation checklist for mathematics teachers in intermediate schools that consists of three axes: 1) the level of practices of mathematical teachers that support the skills of building and using mathematical representations to organize, record, and communicate mathematical ideas, 2) the level of practices of mathematical teachers that promote the skills of selecting and applying representations, 3) the level of mathematical teachers' practices supporting the skills of using representations to model and understand natural, social, and mathematical phenomena.

3-3 VALIDITY AND RELIABILITY OF THE TOOL (observation checklist).

3-4 CONTENT VALIDITY:

The checklist was presented in its preliminary form to several faculty members in Saudi universities who specialized in this field. The researcher made the necessary adjustments of deleting, adding, and modifying in the light of their proposals. The checklist in its final form included preliminary data covering two variables (scientific qualification, years of teaching experience). The items in the checklist included (30) statements distributed on three criteria in its final form, and each standard contains two axes of teaching practices that support the skills of mathematical representation (availability of practice, level of practice performance).

3-5 INTERNAL VALIDITY CONSISTENCY

The researchers calculated the internal consistency of the observation checklist on the study sample, by calculating the correlation coefficients between each item and the overall grade of its standard, as well as between each criterion. the overall score of the observation checklist, and all processes were statistically significant. This reflects the sincerity of the paragraphs and criteria of the observation checklist, as validity by the following:

Table (1)

Shows the correlation coefficients of each checklist item with the total value for each standard

| Standard of designing and using mathematical representations to organize, record, and communicate mathematical ideas | | | Standard of selecting, applying, and translating mathematical representations to solve problems | | | Standard of using representations to model and interpret mathematical, natural, and social phenomena | | |
|--|-------------|-------|---|-------------|-------|--|-------------|-------|
| Item | coefficient | Sig | Item | coefficient | Sig | Item | coefficient | Sig |
| 1 | 0.922 | 0.000 | 1 | 0.650 | 0.000 | 1 | 0.658 | 0.000 |
| 2 | 0.923 | 0.000 | 2 | 0.834 | 0.000 | 2 | 0.746 | 0.000 |
| 3 | 0.903 | 0.000 | 3 | 0.865 | 0.006 | 3 | 0.868 | 0.000 |
| 4 | 0.796 | 0.000 | 4 | 0.578 | 0.000 | 4 | 0.864 | 0.000 |
| 5 | 0.708 | 0.000 | 5 | 0.662 | 0.000 | 5 | 0.861 | 0.000 |
| 6 | 0.799 | 0.000 | 6 | 0.602 | 0.000 | 6 | 0.774 | 0.000 |
| 7 | 0.864 | 0.000 | 7 | 0.728 | 0.000 | 7 | 0.790 | 0.000 |
| 8 | 0.831 | 0.000 | 8 | 0.628 | 0.000 | 8 | 0.789 | 0.000 |
| 9 | 0.792 | 0.000 | 9 | 0.738 | 0.000 | 9 | 0.820 | 0.000 |
| 10 | 0.864 | 0.000 | | | | 10 | 0.524 | 0.001 |
| 11 | 0.878 | 0.000 | | | | | | |

Table (2)

Correlation coefficients between the grade of each standard and the observation checklist as a whole

| N | Standard | Correlation coefficients | Significance |
|---|--|--------------------------|--------------|
| 1 | Designing and using mathematical representations to organize, record, and communicate mathematical ideas | 0.919 | 0.000 |
| 2 | Selecting, applying, and translating mathematical representations to solve problems | 0.909 | 0.000 |
| 3 | Using representations to model and interpret mathematical, natural, and social phenomena | 0.973 | 0.000 |

The reliability of the checklist

The reliability values of Correlation coefficients of the observation checklist using the Cooper method are shown in the table below, which is a high value that shows the stability of the checklist.

Table (3)
Correlation coefficients of the observation checklist using the Cooper method

| No. | Standard | Cooper coefficient |
|-------|--|--------------------|
| 1 | Designing and using mathematical representations to organize, record, and communicate mathematical ideas | 0.712 |
| 2 | Selecting, applying, and translating mathematical representations to solve problems | 0.870 |
| 3 | Using representations to model and interpret mathematical, natural, and social phenomena | 0.716 |
| Total | | 0.761 |

RESULTS AND DISCUSSION

The first question:

Question 1 states, "What are teaching practices that support the mathematical representation skills required for mathematics teachers in intermediate school, with regard to the standards of the National Council of Mathematics Teachers (NCTM)?" To respond to this question, in the observation checklist, the frequencies and percentages of the estimates were calculated in relation to the degree of availability of teaching practices that promote mathematical representation skills among mathematics teachers in intermediate school, taking into account the standards of the National Council of Teachers of Mathematics (NCTM), and the teaching practice was considered available if the percentage of availability was considered.

Table (4)

Availability of instructional practices supporting mathematical representation skills, regarding the standard for designing and using mathematical representation to organize, record, and communicate mathematical ideas.

| No. | Teaching Practices | Availability | | | | |
|-----|---|--------------|----------|----|----------|---------------|
| | | Yes | | No | | |
| | | F | Per cent | F | Per cent | |
| 1 | The teacher uses representations in inferring mathematical laws and relationships. | 33 | 91.7 | 3 | 8.3 | Available |
| 2 | The teacher encourages students to create special representations to understand mathematical concepts and principles. | 33 | 91.7 | 3 | 8.3 | Available |
| 3 | The teacher shows mathematical concepts from concrete to abstract. | 33 | 91.7 | 3 | 8.3 | Not Available |
| 4 | The teacher uses the appropriate technique when presenting mathematical representations. | 17 | 47.2 | 19 | 52.8 | Available |
| 5 | The teacher uses codes (symbols) verbally or in writing. | 20 | 55.6 | 16 | 44.4 | Available |
| 6 | The teacher clearly and accurately displays | 36 | 100.0 | 0 | 0.0 | Available |

| | | | | | | |
|--|---|-------|-------|-------|------|-----------|
| | mathematical ideas in the provided representations. | | | | | |
| 7 | The teacher presents graphs correctly and completely in displaying mathematical ideas. | 33 | 91.7 | 3 | 8.3 | Available |
| 8 | The teacher interprets mathematical text as it explains with different representations (tables-words-shapes-symbols-relationships). | 33 | 91.7 | 3 | 8.3 | Available |
| 9 | The teacher uses representations to show relationships among mathematical ideas through conceptual or mind maps. | 31 | 86.1 | 5 | 13.9 | Available |
| 10 | The teacher allows students to express their ideas and represent them in different ways, such as drawings, writing, or symbols. | 36 | 100.0 | 0 | 0.0 | Available |
| 11 | The teacher uses models and material materials from the student's environment to illustrate mathematical ideas. | 26 | 72.2 | 10 | 27.8 | Available |
| The overall proportion of the availability of teaching practices | | %82.8 | | %17.2 | | Available |

2- Selecting, applying, and interpreting mathematical representations to solve problems.

Table (5)

Availability of teaching practices that support the skills of mathematical representation, in accordance with the standard for selecting, applying, and translating mathematical representations to answer questions.

| No. | Teaching Practices | Availability | | | | |
|-----|--|--------------|----------|----|----------|---------------|
| | | Yes | | No | | |
| | | F | Per cent | F | Per cent | |
| 1 | The teacher represents the concept or generalized it by using more than one image. | 24 | 66.7 | 12 | 33.3 | Available |
| 2 | The teacher makes transformations between mathematical representations from verbal to symbolic and vice versa. | 23 | 63.9 | 13 | 36.1 | Available |
| 3 | The teacher makes transformations between mathematical representations from tables to curves and vice versa. | 20 | 55.6 | 16 | 44.4 | Not Available |
| 4 | The teacher stands out the use of mathematical representations to show examples more clearly. | 33 | 91.7 | 3 | 8.3 | Available |
| 5 | The teacher makes the use of mathematical representations more comprehensible answer exercises. | 36 | 100.0 | 0 | 0.0 | Available |
| 6 | The teacher interprets with the | 36 | 100.0 | 0 | 0.0 | Avai |

| | | | | | | |
|--|--|-------|-------|-------|------|-----------|
| | students the problem in the lesson for appropriate representation. | | 0 | 0 | | label |
| 7 | The teacher allows students to choose the representation of a mathematical problem appropriate to their abilities. | 36 | 100.0 | 0 | 0.0 | Available |
| 8 | The teacher supports innovative representations by students. | 33 | 91.7 | 3 | 8.3 | Available |
| 9 | The teacher asks students to make mathematical drawings to explain and justify their logic. | 30 | 83.3 | 6 | 16.7 | Available |
| The overall proportion of the availability of teaching practices supporting the skills of mathematical representation in relation to the standard for selecting, applying, and translating mathematical representations to solve problems. | | %83.7 | | %16.3 | | Available |

| | | | |
|--|-------|-------|--|
| The overall proportion of the availability of teaching practices supporting the skills of mathematical representation in relation to the standard of using representations to model and interpret mathematical, natural, and social phenomena. | %83.9 | %16.1 | |
|--|-------|-------|--|

The second question:

Question 2 states: "What is the level of teaching practices that support the mathematical representation skills required for mathematics teachers in intermediate school, with regard to the standards of the National Council of Mathematics Teachers (NCTM)?"

To respond to this question, in the observation checklist, the frequencies and percentages of the averages and standard deviations of these scores were calculated to determine the level of each of these practices, and the results were as follows:

2- Standard for building and using mathematical representation to organize, record, and communicate mathematical ideas:

3) Using representations to model and interpret mathematical, natural, and social phenomena

Table (6)

The overall proportion of the availability of teaching practices supporting the skills of mathematical representation in relation to the standard for selecting, applying, and translating mathematical representations to solve problems.

Table (7)

The level of teaching practices supporting the skills of mathematical representation, in relation to the standard for building and using mathematical representation to organize, record, and communicate mathematical ideas.

| No | Teaching Practices | Availability | | | | |
|----|---|--------------|---------|----|---------|---------------|
| | | Yes | | No | | |
| | | F | Percent | F | Percent | |
| 1 | The teacher uses graphs to interpret relation between variables. | 20 | 55.6 | 16 | 44.4 | Available |
| 2 | The teacher connects mathematical ideas with the reality of the student through representations and models. | 36 | 100.0 | 0 | 0.0 | Available |
| 3 | The teacher formulates life situations according to mathematical models, i.e., turning them from a life problem to a mathematical model. | 33 | 91.7 | 3 | 8.3 | Available |
| 4 | The teacher translates mathematical models, which are in the form of a mathematical equation or graphs, into the corresponding life situations. | 30 | 83.3 | 6 | 16.7 | Available |
| 5 | The teacher explains to students the skill of using mathematical representations to model a specific life problem. | 33 | 91.7 | 3 | 8.3 | Available |
| 6 | The teacher employs technical tools to explore models of social and mathematical phenomena. | 17 | 47.2 | 19 | 52.8 | Not available |
| 7 | The teacher provides examples of issues that require the use of mathematical models. | 33 | 91.7 | 3 | 8.3 | Available |
| 8 | The teacher uses mathematical modeling to solve scientific and life issues in various sciences. | 32 | 88.9 | 4 | 11.1 | Available |
| 9 | The teacher uses modeling using a mathematical model to describe the actual position. | 33 | 91.7 | 3 | 8.3 | Available |
| 10 | The teacher uses questions and comments for students to facilitate mathematics' understanding. | 35 | 97.2 | 1 | | |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|---|--------|-----|---------|------|-----|------|-----|------|------|------|------------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 1 | The teacher uses representations in inferring mathematical laws and relationships. | 3 | 8.3 | 18 | 50.0 | 12 | 33.3 | 3 | 8.3 | 1.58 | 0.77 | 1 | Average |
| 2 | The teacher encourages students to create special representations to understand mathematical concepts and principles. | 3 | 8.3 | 17 | 47.2 | 13 | 36.1 | 3 | 8.3 | 1.56 | 0.77 | 5 | Average |
| 3 | Teacher shows mathematical concepts from concrete to abstract. | 3 | 8.3 | 18 | 50.0 | 12 | 33.3 | 3 | 8.3 | 1.58 | 0.77 | 1 repeated | Average |
| 4 | The teacher uses appropriate technique when presenting | 3 | 8.3 | 9 | 25.0 | 5 | 13.9 | 19 | 52.8 | 0.89 | 1.06 | 11 | Low |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|---|--------|------|---------|------|-----|------|-----|------|------|------|-------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| | mathematical representations. | | | | | | | | | | | | |
| 5 | The teacher uses codes (symbols) verbally or in writing. | 3 | 8.3 | 10 | 27.8 | 7 | 19.4 | 16 | 44.4 | 1.00 | 1.04 | 10 | Low |
| 6 | The teacher clearly and accurately displays mathematical ideas in the provided representations. | 1 | 2.8 | 16 | 44.4 | 19 | 52.8 | 0 | 0.0 | 1.50 | 0.56 | 6 | Average |
| 7 | The teacher presents graphs correctly and completely in displaying mathematical ideas. | 2 | 5.6 | 14 | 38.9 | 17 | 47.2 | 3 | 8.3 | 1.42 | 0.73 | 8 | Low |
| 8 | The teacher interprets mathematical text as it explains with different representations (tables-words-shapes-symbols-relationships). | 5 | 13.9 | 14 | 38.9 | 14 | 38.9 | 3 | 8.3 | 1.58 | 0.84 | 3 | Average |
| 9 | The teacher uses models and material materials from the student's environment to illustrate mathematical ideas. | 3 | 8.3 | 17 | 47.2 | 11 | 30.6 | 5 | 13.9 | 1.50 | 0.85 | 7 | Low |
| 10 | The teacher allows students to express their ideas and represent them in | 3 | 8.3 | 14 | 38.9 | 19 | 52.8 | 0 | 0.0 | 1.56 | 0.65 | 4 | Average |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|--|--------|-----|---------|------|-----|------|-----|------|------|------|-------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| | different ways, such as drawings, writing, or symbols. | | | | | | | | | | | | |
| 11 | The teacher uses representations to show relationships among mathematical ideas through conceptual or mind maps. | 2 | 5.6 | 13 | 36.1 | 11 | 30.6 | 10 | 27.8 | 1.19 | 0.92 | 9 | Average |
| | The overall average of teaching practices supporting the skills of mathematical representation, in relation to the standard for building and using mathematical representation to organize, record, and communicate mathematical ideas is low. | | | | | | | | | 1.40 | 0.82 | | Low |

2- Standard of Selecting, applying, and translating mathematical representations to solve problems

Table (8)

The level of availability of teaching practices that support the skills of mathematical representation, in accordance with the Standard of Selecting, applying, and translating mathematical representations to solve problems

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|--|--------|------|---------|------|-----|------|-----|------|------|------|-------|-------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 1 | The teacher represents the concept or generalized it by using more than one image. | 4 | 11.1 | 14 | 38.9 | 6 | 16.7 | 12 | 33.3 | 1.06 | 1.06 | 7 | Low |
| 2 | The teacher makes transformations between mathematical representations from verbal to symbolic and vice versa. | 3 | 8.3 | 11 | 30.6 | 9 | 25.0 | 13 | 36.1 | 1.01 | 1.01 | 8 | Low |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|--|--------|------|---------|------|-----|------|-----|------|------|------|-------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 3 | The teacher makes transformations between mathematical representations from tables to curves and vice versa. | 3 | 8.3 | 1 | 36.1 | 4 | 11.1 | 1 | 44.4 | 1.08 | 1.08 | 9 | Low |
| 4 | The teacher stands out the use of mathematical representations to show examples more clearly. | 3 | 8.3 | 1 | 41.7 | 1 | 41.7 | 3 | 8.3 | 0.77 | 0.77 | 6 | Average |
| 5 | The teacher makes the use of mathematical representations more comprehensible answer exercises. | 2 | 5.6 | 1 | 52.8 | 1 | 41.7 | 0 | 0.0 | 0.59 | 0.59 | 5 | Average |
| 6 | The teacher interprets with the students the problem in the lesson for appropriate representation. | 6 | 16.7 | 1 | 44.4 | 1 | 38.9 | 0 | 0.0 | 0.72 | 0.72 | 3 | Average |
| 7 | The teacher allows students to choose the representation of a mathematical problem appropriate to their abilities. | 4 | 11.1 | 2 | 63.9 | 9 | 25.0 | 0 | 0.0 | 0.59 | 0.59 | 2 | Average |
| 8 | The teacher supports innovative representations by students. | 6 | 16.7 | 2 | 63.9 | 4 | 11.1 | 3 | 8.3 | 0.78 | 0.78 | 1 | Average |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|---|---|--------|------|---------|------|-----|------|-----|------|------|------|-------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 9 | The teacher asks students to make mathematical drawings to explain and justify their logic. | 6 | 16.7 | 2 | 55.6 | 4 | 11.1 | 6 | 16.7 | 0.94 | 0.94 | 4 | Average |
| The overall average of teaching practices supporting the skills of mathematical representation, in accordance with the standard of selecting, applying, and translating mathematical representations to solve problems. | | | | | | | | | | 1.54 | 0.84 | | Average |

3- Standard of using representations to model and interpret mathematical, natural, and social phenomena

Table (9)

The level of availability of teaching practices that support the skills of mathematical representation, in accordance with using representations to model and interpret mathematical, natural, and social phenomena

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|--|--------|------|---------|------|-----|------|-----|------|------|------|-------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 1 | The teacher uses graphs to interpret relation between variables. | 2 | 5.6 | 1 | 38.9 | 4 | 11.1 | 1 | 44.4 | 1.06 | 1.04 | 9 | Low |
| 2 | The teacher connects mathematical ideas with the reality of the student through representations and models. | 3 | 8.3 | 2 | 61.1 | 1 | 30.6 | 0 | 0.0 | 1.78 | 0.59 | 1 | Average |
| 3 | The teacher formulates life situations according to mathematical models, i.e., turning them from a life problem to a mathematical model. | 4 | 11.1 | 1 | 41.7 | 1 | 38.9 | 3 | 8.3 | 1.56 | 0.81 | 6 | Low |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|----|---|--------|------|---------|------|-----|------|-----|------|------|------|--------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 4 | The teacher translates mathematical models, which are in the form of a mathematical equation or graphs, into the corresponding life situations. | 3 | 8.3 | 17 | 47.2 | 10 | 27.8 | 6 | 16.7 | 1.47 | 0.88 | 8 | Average |
| 5 | The teacher explains to students the skill of using mathematical representations to model a specific life problem. | 4 | 11.1 | 17 | 47.2 | 12 | 33.3 | 3 | 8.3 | 1.61 | 0.80 | 3 | Average |
| 6 | The teacher employs technical tools to explore models of social and mathematical phenomena. | 4 | 11.1 | 8 | 22.2 | 5 | 13.9 | 19 | 52.8 | 0.92 | 1.11 | 10 | Low |
| 7 | The teacher provides examples or issues that require the use of mathematical models. | 4 | 11.1 | 17 | 47.2 | 12 | 33.3 | 3 | 8.3 | 1.61 | 0.80 | 3 مكرر | Average |
| 8 | The teacher uses mathematical modeling to solve scientific and life issues in various sciences. | 4 | 11.1 | 14 | 38.9 | 14 | 38.9 | 4 | 11.1 | 1.50 | 0.85 | 7 | Average |
| 9 | The teacher uses modeling using a mathematical model to describe the actual position. | 5 | 13.9 | 15 | 41.7 | 13 | 36.1 | 3 | 8.3 | 1.61 | 0.84 | 5 | Average |

| No | Teaching Practices | Degree | | | | | | | | Mean | SD | Order | Level |
|---|--|--------|-----|---------|------|-----|------|-----|-----|------|------|-------|---------|
| | | High | | Average | | Low | | Nil | | | | | |
| | | F | P | F | P | F | P | F | P | | | | |
| 10 | The teacher uses questions and comments for students to facilitate mathematics' understanding. | 3 | 5.6 | 19 | 52.8 | 14 | 38.9 | 16 | 2.8 | 1.61 | 0.64 | 2 | Average |
| The overall average of teaching practices supporting the skills of mathematical representation, in relation to the standard of using representations to model and interpret mathematical, natural, and social phenomena | | | | | | | | | | 1.47 | 0.84 | | Low |

The third question:

With regard to the standards of the National Council of Mathematics Teachers (NCTM) relating to years of experience, are there statistically significant differences between the levels of teaching practices that support the mathematical representation skills required for intermediate school mathematics teachers? To respond to this question, in the observation checklist, the Man-Whitney U test was used for independent groups, and the results were as follows:

Table (10)

The significance of the differences in the level of teaching practices that support the skills of mathematical representation among intermediate school teachers, in accordance with the standards of the National Council of Mathematics Teachers, which are due to the different years of experience.

| Teaching Practices | Experience | Number of Ranks | Average ranks | Total ranks | Value "U" | Value "Z" | Sig. |
|---|--------------|-----------------|---------------|-------------|------------------|-----------|------|
| Standardizing and generalizing mathematical representations, and articulate mathematical models. | Less than 10 | 30 | 15.65 | 469.50 | 469.50 196.50 | 3.656 | 0.01 |
| | 10 and more | 6 | 32.75 | 196.50 | | | |
| Standardizing, generalizing, and articulating mathematical representations in various sciences. | Less than 10 | 30 | 15.85 | 475.50 | 475.50 190.50 | 3.401 | 0.01 |
| | 10 and more | 6 | 31.75 | 190.50 | | | |
| Standardizing mathematical and scientific representations, and articulating mathematical phenomena. | Less than 10 | 30 | 15.65 | 469.50 | 469.50 196.50 | 3.661 | 0.01 |
| | 10 and more | 6 | 32.75 | 196.50 | | | |
| All teaching practices | Less than 10 | 30 | 15.60 | 468.00 | 468.00 | 3.708 | 0.01 |
| | 10 and more | 6 | 33.00 | 198.00 | | | |

The fourth question

With regard to the standards of the National Council of Mathematics Teachers (NCTM) relating to academic qualifications, are there statistically significant differences between the levels of teaching practices that support the mathematical representation skills required for intermediate school mathematics teachers? To respond to this question, in the observation checklist, the Man-Whitney U test was used for independent groups, and the results were as follows:

Table (11)

| Standards | Academic Qualification | Number of Ranks | Average ranks | Total ranks | Value "U" | Value "Z" | Sig. |
|---|-------------------------------------|-----------------|---------------|-------------|-----------|-----------|---------------|
| Building and using mathematical representations to organize, record, and communicate mathematical | Non-educational (Bachelor's Degree) | 15 | 22.33 | 335.00 | 100.00 | 1.859 | 0.067 Non-sig |
| | B.A. Ed. | 21 | 15.76 | 331.00 | | | |
| Building, applying, and using mathematical representations to solve problems | Non-educational (Bachelor Degree) | 15 | 22.00 | 330.00 | 105.00 | 1.698 | 0.090 Non-sig |
| | B.A. Ed. | 21 | 16.00 | 336.00 | | | |
| Building mathematical representations to explain and use mathematical ideas and mathematical models | Non-educational (Bachelor Degree) | 15 | 22.00 | 330.00 | 105.00 | 1.699 | 0.089 Non-sig |
| | B.A. Ed. | 21 | 16.00 | 336.00 | | | |
| Using mathematical representations to solve problems | Non-educational (Bachelor Degree) | 15 | 22.27 | 334.00 | 101.00 | 1.820 | 0.069 Non-sig |
| | B.A. Ed. | 21 | 15.81 | 332.00 | | | |

6- RESULTS DISCUSSION

The results of question 1 showed that the three standards of mathematical representation (building and using mathematical representation to organize, record, and communicate mathematical ideas, selecting, applying and translating mathematical ideas, and using representations to model and interpret mathematical, natural, and social phenomena) were Available for all instructional practices in support of the mathematical representation skills of intermediate school teachers in the light of NCTM standards and ranged between (55.6-100.0%). Two unavailable practices were exempted, namely "The teacher uses appropriate technology when presenting mathematical representations", and "The teacher uses technology tools to explore social and mathematical phenomena models," with an accessibility proportion (47.2 percent), while seven teaching practices have been achieved that Promote mathematical representation skills for teachers of mathematics at the intermediate school in the light of "Building and using mathematical representation to organize, record and communicate mathematical ideas" standard was an average level. In contrast, a low level was achieved by four practices, and the whole standard level was low. with respect to the standard of " selecting, applying, and translating

mathematical representations to solve problems", six instructional practices supporting mathematical representation skills of mathematics teachers was achieved an average level, and three practices achieved a low level, and the overall standard was at an average level. In the intermediate level, seven educational practices supporting the mathematical representation skills of mathematics teachers have been achieved at an average level with respect to the standard of "using representations to model and interpret mathematical, natural and social phenomena "and on the other hand, three practices have reached a low level and the overall standard has been low. The results of the second question, concerning the level of teaching practices in support of the skills of mathematical representation required for intermediate-stage mathematics teachers, in the light of the standards of the National Council of Teachers of Mathematics (NCTM), clarified that teaching Practices in support of the skills of mathematical representation required for intermediate-stage mathematics teachers (NCTM). In general, a poor level is reached in accordance with the standards of the National Council of Mathematics Teachers (NCTM). As for the standards of teaching practices supporting the skills of mathematical representation, was the first in terms of the order. the standard of "selecting, applying and translating mathematical representations to solve problems," as the level of practice was average. In the second- order, the standard of "using representations to model and explain mathematical, natural, and social phenomena," as the level of practice was low. the standard "building and using mathematical representation to organize, record, and communicate mathematical ideas" was last in order. These findings indicate a significant limitation in the level of teaching practices that promote the mathematical representation skills required for intermediate school mathematics teachers, in accordance with the standards of the National Council of Teachers of Mathematics (NCTM). The researchers attribute this result to neglecting teacher training on procedures for implementing mathematical representation skills that are required for mathematics teachers. They also attribute the results to the lack of use of mathematical representation skills in mathematics teaching, in accordance with the standards of the National Council of Mathematics Teachers, and the lack of support for technological techniques in the classroom infrastructure to facilitate the process of using mathematical representation. With regard to the third question, the significance of the differences in the level of teaching practices that promote the ability of mathematical representation among middle school teachers was identified in the light of the National Council of Teachers of Mathematics (NCTM) standards due to the different years of experience. The results of the study showed that the differences between teachers according to years of experience were statistically significant for all NME standards in favor of more experienced teachers. This result shows that years of experience are a decisive factor in increasing the level of teaching practices that support mathematical representation skills. This may be due to the fact that implementing standards for mathematical representations requires training processes and application experience. This was confirmed by the 2015 Dreher & Kuntze study which showed that during their service there were statistically significant differences between pre-service teachers and teachers, and they were differentiated in the subject of observation and their ability to deal with mathematical representations. Finally, the fourth question

relates to the identification of the significance of differences in the level of teaching practices that support intermediate school teachers' Mathematical representation skills in the light of the National Council of Teachers of Mathematics (NCTM) standards, which are due to the difference in academic qualifications. The results of the current study showed that differences between teachers by academic qualification were not statistically significant, and this result shows that academic qualification was not a determining factor in the implementation of the mathematical representation standards by teachers. This may be due to the fact that the implementation of mathematical representation standards requires other factors, such as training, application experience. This was supported by the answer to the second question, which is linked to years of experience, as the level of teaching practices in support of mathematical representation skills among middle school teachers were in favor of more experienced teachers in the light of the standards of the National Council of Mathematics Teachers (NCTM).

7- RECOMMENDATIONS

Based on the findings of the current study, the researchers offered the following recommendations. Firstly, the need to train teachers of mathematics in teaching practices that promote mathematical representation skills in accordance with the standards of the National Council of Teachers of Mathematics (NCTM). Secondly, Training students to use modern mathematics teaching technologies, expressing their ideas in mathematical representations, taking advantage of the list of standards of mathematical representation developed in the observation checklist by the researcher in accordance with the standards of the National Council of Mathematics Teachers (NCTM). Finally, developing the intermediate school mathematics curricula and diversification of mathematical representations to include tangible, abstract, verbal, symbolic, graphic, and drawings in order to confront individual differences between students.

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