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The Extent of Application of Final Mathematical Competencies in Problem Solving Situations.Field Study in Some Secondary Schools in M'sila.

تطبيق الكفاءات الرياضياتية الختامية في حل وضعيات مشكلة
دراسة ميدانية في بعض المدارس الثانوية في المسيلة

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Article abstract:

This study aimed to evaluate pupils' proficiency in applying final mathematical competencies to solve problem-based situations. Conducted within the framework of competency-based pedagogy—which repositions the teacher as a facilitator and the learner as an active agent—this assessment sought to measure how pupils engage in real or simulated problem-solving tasks. The research adopted a descriptive method and designed problem situations across four key mathematical domains: numbers and arithmetic, numerical functions, geometry, and statistics. Findings revealed a significant deficiency in pupils' ability to apply competencies across all domains. Based on these results, the study recommends greater emphasis on practical applications of mathematics, encouraging pupils to use their knowledge in authentic, everyday contexts to enhance both understanding and retention.

Keywords: Competency-Based Approach; Mathematical Competencies; Problem-Based Learning; Algeria; Secondary Education

ملخص المقال :

هدفت هذه الدراسة إلى الوقوف على واقع تطبيق التلاميذ للكفاءات الرياضياتية الختامية المستهدفة ، في حل وضعيات مشكلة ، وهذا في ظل التدريس وفق بيداغوجيا المقاربة بالكفاءات ، هذه الأخيرة التي جاءت لتغير العلاقات التربوية النمطية القديمة التي كانت قائمة بين المتعلم و المعلم فتجعل من المعلم منشطا و منظما و ليس ملقنا للمعارف ، و تجعل من المتعلم محورا للعملية التعليمية التعلمية ، و مسؤولا عن التعلمات التي يحرزها ، فيمارس و يحاول و يبني التعلمات و يقوم و يثمن تجاربه السابقة و يعمل على توسيع آفاقها. لذلك قمنا ببناء وضعيات مشكل في ميادين التعلم الأربعة المقررة على هذه الفئة من التلاميذ وهي: الأعداد والحساب ، الدوال ، الهندسة ، الإحصاء ، فمن خلال معالجة المتعلم لهذه الوضعيات المشكل سيقوم بتوضيح تعلمه وتوظيف مهاراته في مواقف حياتية حقيقية ، أو مواقف تحاكي المواقف الحقيقية.

كلمات مفتاحية: المقاربة بالكفاءات ؛ تقويم الكفاءات ؛ الوضعية المشكلة.

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Introduction:

The progress of nations is closely linked to the quality of their educational systems, which play a central role in developing competence and creativity in individuals. A vital aspect of effective education is the implementation of scientifically grounded evaluation mechanisms, which not only assess achieved objectives but also refine educational processes to enhance learning outcomes.

As education increasingly emphasizes relevance and real-life application, there is a growing need for assessment strategies that align with learners' experiences and societal demands. This study investigates the extent to which pupils in the Common Core Science and Technology track apply final mathematical competencies in solving problem situations across four domains: numbers and arithmetic, geometry, functions, and statistics.

1 .Theoretical Background:

The key to fostering learning lies in transforming knowledge into problem-solving activities. Teachers should present challenges that resonate with pupils' experiences—challenges that seem difficult but are achievable and promote learning. This approach, rooted in constructivist theory, places the learner at the center of the teaching process, with educators acting as facilitators. The goal is to develop cognitive and affective learning outcomes, nurturing critical thinking and essential skills.

Previous studies, such as Harquas (2009) and Al-Mutairi (2010), underscore the gap between prescribed competencies and actual pupils needs, emphasizing the importance of problem-solving strategies. These strategies aim to help pupils engage with real-world contexts, applying knowledge in a meaningful way.

2 .Problem Statement:

Competency-based pedagogy emphasizes empowering pupils to take control of their learning, fostering creative and critical thinking. This approach encourages pupils to actively participate in their education, building on existing cognitive structures and adapting them through feedback.

True learning occurs when pupils encounter situations that allow them to apply their experiences and modify their understanding based on feedback. The iterative cycle of application and reflection strengthens comprehension and facilitates long-term retention. Educators must create activities that build on prior knowledge, promoting self-directed learning aligned with pupils' developmental stages.

The present study evaluates the extent to which pupils in the Common Core Science and Technology curriculum apply mathematical competencies in solving problem situations. By examining pupils engagement across domains like numbers, functions, geometry, and statistics, this research aims to evaluate the effectiveness of competency-based pedagogy and its impact on real-world learning.

2.1 .Research Questions:

Main Question:

To what extent do pupils at the end of the Common Core Science and Technology curriculum apply mathematical competencies in solving problem situations?

Sub-Questions:

1- Do pupils apply mathematical competencies in numbers and arithmetic?

2- Do pupils apply mathematical competencies in numerical functions?

3- Do pupils apply mathematical competencies in geometry?

4- Do pupils apply mathematical competencies in statistics?

2.2 .Hypotheses:

Based on the theoretical framework, the study proposes the following hypotheses:

- Most pupils do not effectively apply mathematical competencies in numbers and arithmetic.
- Most pupils do not effectively apply mathematical competencies in numerical functions.
- Most pupils do not effectively apply mathematical competencies in geometry.
- Most pupils do not effectively apply mathematical competencies in statistics.

2.3 .The Importance of the Study and Its Objectives:

This study is significant for assessing how well first-year secondary pupils in the Common Core Science and Technology curriculum can solve problem situations using acquired mathematical competencies. The study aims to:

- Evaluate pupils ability to apply mathematical competencies to real-life situations.
- Assess the implementation of competency-based pedagogy in secondary schools.
- Support national education reforms focused on applied learning.
- Contribute to future educational research.

3 .Key Terms' Definitions:

3.1 .The Competency Approach:

Competency has evolved from vocational contexts to education, encompassing the ability to apply knowledge, skills, and attitudes in real-world situations. (Carette, V. p02, 2003).

It involves adapting to unforeseen circumstances, mobilizing integrated resources, and solving complex problems. The competency approach emphasizes learning through action, where the pupils is at the center of the process, and teachers act as facilitators. (Boufama, B.p50, 2002).

3.2 .Learning Strategies According to the Competency Approach:

3.2.1 .Planning Learning:

Learning planning involves determining final competencies, organizing the necessary knowledge and skills, and structuring integration courses throughout the year.

3.2.2 .Pillars of Learning:

Key pillars include determining final competencies, organizing relevant knowledge, and addressing expected difficulties to support learners.

3.3 .Evaluation of Competencies:

3.3.1 .The Place of Evaluation:

In competency-based pedagogy, evaluation is integral to the learning process and takes place before, during, and after learning. It assesses whether pupils have acquired the necessary competencies and provides necessary support.

3.3.2 .Competency Evaluation:

Evaluation in this context aims to assess not only knowledge but also the ability to apply competencies in real-world situations.

3.3.3 .Requirements for Evaluating Competencies:

Teachers must define goals, determine learner abilities, and identify the necessary tasks to assess competencies.

3.3.4 .Objectives of Evaluation:

Evaluation serves motivational and corrective goals, enhancing performance and identifying areas for improvement.

3.2 .The Problematic Situation:

3.2.1 .The Concept of the Problem Situation:

A problem situation involves tasks that require learners to apply knowledge to overcome obstacles. It engages pupils in meaningful learning, fostering reflection and problem-solving. (Al-Lahiya, A, p246,2010)

3.2.2 .Components of the Problem Situation:

The problem situation includes context, task, and instructions, all aimed at overcoming a defined obstacle.

3.2.3 .Characteristics of the Problem Situation:
A problem situation must be relevant, concrete, and engaging, encouraging the use of prior knowledge and stimulating cognitive development. (DOUADY, R.,p32, 2006)

4. -Methodology:
This study employed a descriptive-analytical methodology, which focuses on observing and describing phenomena as they exist in reality. It combines both qualitative and quantitative techniques to accurately represent the characteristics of the subject matter and to examine the extent of its relation to other phenomena. (Ayesh, Z. 2008, p. 92) .

4.1. Study sample: The number of members of the study sample was 1,037 pupils from the first year of secondary school, common core, science and technology, who were chosen randomly. It is a cluster sample, which is chosen when the members of the community are in the form of clusters, groups, so that each cluster contains many from the vocabulary of society. Bouallaq, M. (2009, p. 21) included pupils from some secondary schools in the state of M'Sila, which was estimated at 25 secondary schools, and we applied those situations to this sample .

4.2. Data Collection Tools: The stage of collecting information and data is considered one of the most important stages of scientific research. These methods vary according to the topic to be studied, and the appropriate research method is determined in light of the objectives, hypotheses, and methodology of the study. Due to the nature of our study, we have prepared problem situations in the four fields of learning for this level, which are as follows :

1 -Numbers and arithmetic: The aim of the problem situation was to assess the student's ability to apply the targeted competencies within a specific context. These competencies include:

- Understanding and utilizing the properties of natural and rational numbers.
- Familiarity with real and complex numbers and their applications.
- Formulating situations using equations or inequalities.
- Differentiating between the unknown, the variable, and the parameter.
- Using equations and inequalities to solve problems.
- Functions: This problem situation was designed to evaluate the student's ability to employ the targeted competencies in this area. The competencies include:
- Grasping the concept of a function in its three forms: algebraic, arithmetic, and graphical.
- Applying functions in various scenarios.
- Understanding and accurately interpreting graphical representations.
- Solving problems using functions effectively.

2 - Numerical Functions: This problem situation was designed to assess the student's ability to apply the targeted competencies in this area. These competencies include:

- Understanding the concept of a function in its three aspects: graphical, algebraic, and numerical.
- Applying functions in various situations.
- Demonstrating clear and accurate understanding of algebraic expressions.
- Utilizing functions effectively to solve problems.

3 -Geometry: This problem situation was constructed to assess the student's ability to apply targeted competencies in geometry and spatial reasoning. The specific competencies evaluated include:

- Solving problems related to familiar geometric shapes in both plane and space.
- Completing basic and complex geometric constructions and identifying groups of points.
- Solving problems in analytical geometry within the plane and space.
- Identifying point transformations and utilizing them to address engineering problems.

4 -Statistics: The problem situation in the field of statistics was designed to assess the student's ability to apply targeted competencies in solving statistical problems. These competencies include:

- Identifying statistical series and extracting key measures such as location and dispersion indicators.

- Modeling situations to conduct comprehensive statistical studies.
- Using various graphical representations to display data, indicators, or results effectively.
- Recognizing sample variation and constructing appropriate probabilistic models.
- Linking data from random experiments to their respective probabilistic models.
- Understanding the concept of probability and performing probabilistic calculations.

Statistical treatment method: In processing the obtained data, we applied a statistical approach by organizing it into statistical tables. These tables include the following elements:

- Mark 01: Assigned if the pupils is able to solve the problem correctly.
- Mark 00: Assigned if the pupil is unable to solve the problem correctly.
- Frequencies: Calculated based on the pupils answers to indicate the occurrence of correct or incorrect solutions.
- Percentages: Used to represent the frequencies, translating them into percentages to provide a clearer indication of the distribution of results.

5. -Results and Discussion:

5.1. The field of numbers and arithmetic: The field of numbers and arithmetic, as we mentioned before, is considered a major gateway to other fields .

The student's success in other fields depends on his success in this field. Therefore, this field works on developing computational techniques related to numerical arithmetic, algebraic arithmetic, arranging numbers, and strengthening the concept of absolute value, approximate arithmetic, and the use of Scientific calculator...These topics are addressed by solving problems. Ministry of National Education (2005, p. 16) .

Table 1: pupils' answers to the problem situation related to numbers and arithmetic.

Mark	Frequencies	%
01	50	04.82
00	987	95.18
Σ	1037	100

Source: (Prepared by the researcher, 2023, p:06)

The results of our study confirm, as shown in Table (01) above, that the percentage of pupils who reached the correct solution to the problem situation is 4.82%. In contrast, a significant percentage, estimated at 95.18%, did not arrive at the correct solution. This finding reinforces the results of our exploratory study and supports our hypothesis. This means that more than 9 out of 10 pupils do not employ the targeted competencies in the areas of numbers and arithmetic to solve a problem situation. A problem situation is one in which the learner requires a logical context that leads to results, and this context or outcome, or both, are new to the learner. It consists of three components (Roegiers, 2006, p. 04). The description clarifies what is required of the learner. However, the teachers' approach to the problematic situation, aimed at applying the knowledge that pupils acquire in their courses to everyday life, still falls short of the requirements of a competency-based pedagogy.

5.2. The field of Numerical Functions:

Table 02: Pupils' answers to the problem situation related to functions.

Mark	Frequencies	%
01	26	02.50
00	1011	97.58
Σ	1037	100

Source: (Prepared by the researcher, 2023, p:07)

The results presented in Table No. 02 indicate that pupils are unable to employ the necessary competencies and knowledge to solve a problem situation in the field of functions. Specifically, the percentage of pupils who did not reach the correct solution to the proposed problem situation is 97.58%, while only 2.50% managed to find the correct solution. This implies that more than 9 out of 10 pupils do not utilize the targeted competencies in the area of functions to solve a problem situation. This field is equally important as the area of numbers and arithmetic. According to the Ministry of National Education (2005, p. 19), five basic points stand out in this field:

1. Building the concept of the function by integrating three aspects: the arithmetic aspect, the graphical aspect, and the algebraic aspect, so that they are interconnected and cohesive.
2. Conducting a qualitative study of the function to highlight some general properties.
3. Studying reference functions to use them as a basis for examining examples of functions.
4. Connecting functions to algebraic expressions for various purposes.
5. Incorporating graphing calculators and tables to clarify the concept of the function and to solve problems.

5.3. Geometry field: The programs of the first year of secondary education, a common core of science and technology, aim as a whole to continue the learning that was initiated within the framework of the general perspective of reforming the educational system. They are within a path that takes into account the construction of knowledge in accordance with the requirements of the competency approach, and also makes solving problems a starting point for many... The processes of educational and learning action, especially those derived from reality or that have a relationship with reality .

Table 03: Pupils' answers to the problem situation related to geometry.

Mark	Frequencies	%
01	12	01.15
00	1025	98.85
Σ	1037	100

Source: (Prepared by the researcher, 2023, p:07)

The results presented in Table No. 3 indicate that most pupils are unable to employ their knowledge and competencies in solving a problem situation in this field. Specifically, only 1.15% of them were able to reach the correct solution, while the majority, 98.85%, could not utilize their targeted competencies and knowledge to solve this situation.

The field of geometry is particularly valuable as it helps pupils practice vector calculations, use observation and experimentation, and create various geometric shapes, both in the plane and in space. Placing pupils in a problem situation specific to this field may enhance their abilities to visualize and represent shapes in space, as well as to practice proofs of different types. This implies that more than 9 out of 10 pupils do not employ the targeted competencies in the field of geometry to solve a problem situation.

5.4. Statistics field: Most of the concepts and information that the student will cover in the first year of secondary education in the field of statistics are considered an extension of what was covered in the intermediate education stage. Therefore, the teacher is required to work on consolidating and developing these gains, so that the matter expands to approaching some location indicators for a statistical series and approaching the concept of dispersion from During the range indicator, the student also begins this year by performing a simulation of some simple random experiments in order to observe the change in frequencies from one experiment to another. Ministry of National Education (2005, p. 24) .

Table 04: Pupils' answers to the problem situation related to statistics.

Mark	Frequencies	%
01	75	07.23
00	962	92.77
Σ	1037	100

Source: (Prepared by the researcher, 2023, p:08)

Given the results of our study recorded in Table 04 above, pupils were unable to employ their various competencies and knowledge in this field to solve a problem situation. We found that only 7.23% of them were able to reach the correct solution, while the majority, 92.77%, did not achieve this. This means that more than 9 out of 10 pupils do not utilize the targeted competencies in the field of statistics to solve a problem situation.

Statistics provides specific and organized methods for collecting, tabulating, and summarizing data in various forms, such as frequency tables and graphs, which help describe, process, and analyze the data. Pupils at this level are encouraged to practice these statistical methods through problem situations relevant to their experiences.

In general: The results of this study highlight significant challenges faced by first-year secondary education pupils in employing their mathematical competencies across the four essential fields: numbers and arithmetic, functions, geometry, and statistics. In each domain, the data reveal an alarming trend: a large majority of pupils struggle to apply the targeted competencies needed to solve problem situations effectively.

Field of Numbers and Arithmetic: The findings in the field of numbers and arithmetic show that only 4.82% of pupils were able to reach a correct solution, indicating that over 95% did not successfully apply their knowledge to problem-solving scenarios. This reliance on rote memorization, as indicated by the pupils' performance, is concerning as it limits their ability to understand and manipulate numerical concepts meaningfully. The Ministry of National Education emphasizes that problem-solving should be rooted in real-life contexts, yet the results suggest a disconnect between pupils' learning experiences and practical applications of mathematical concepts. To address this, educators must implement teaching methods that foster critical thinking and contextual understanding, ensuring pupils can navigate numerical problem situations in everyday life.

Field of Numerical Functions: Similarly, the field of functions presents a disheartening picture, with only 2.50% of pupils successfully solving related problem situations. The fundamental concepts of functions are critical for mathematical understanding, as they intertwine arithmetic, graphical, and algebraic aspects. The pupils' inability to demonstrate proficiency in this area suggests a need for more robust instructional strategies that integrate these concepts cohesively. By utilizing graphing calculators and real-world applications of functions, educators can enhance student engagement and facilitate a deeper comprehension of this essential mathematical area.

Field of Geometry: In geometry, the results are even more troubling, with a mere 1.15% of pupils able to solve the problem situation correctly. Geometry is vital for developing spatial reasoning and

visualization skills, yet the overwhelming majority of pupils struggle to connect theoretical knowledge with practical application. The educational programs should emphasize experiential learning opportunities that enable pupils to explore geometric concepts through observation and experimentation. This hands-on approach can help cultivate a stronger understanding of geometric principles and enhance pupils' problem-solving capabilities in this field.

Field of Statistics: Lastly, the statistics results indicate that only 7.23% of pupils could apply their knowledge to solve problem situations effectively. Statistics is foundational for analyzing and interpreting data, skills that are increasingly important in today's data-driven society. The significant number of pupils unable to utilize statistical methods highlights a critical gap in their mathematical education. Teachers must create opportunities for pupils to practice these methods in contexts relevant to their lives, enhancing their ability to understand and analyze statistical data meaningfully.

Implications for Teaching Practice: The overarching theme across all four fields is the necessity for educational reforms that prioritize problem-solving skills and contextual learning. A shift toward competency-based pedagogy requires teachers to design learning experiences that challenge pupils to think critically and apply their knowledge in real-world scenarios. This can include project-based learning initiatives, where pupils tackle authentic challenges that require the integration of multiple mathematical concepts.

Furthermore, professional development for educators is essential to equip them with innovative teaching strategies that effectively engage pupils. Collaboration among teachers can also foster an environment where they can share best practices and develop interdisciplinary lessons that highlight the relevance of mathematics across various fields.

Engaging parents and the community in the educational process can further reinforce the importance of mathematics. By demonstrating the applications of mathematical literacy in everyday life and various professions, pupils can gain a deeper appreciation for the subject.

5-Conclusion :

The results obtained from this study, which pertains to the extent to which first-year secondary education pupils in the common core science and technology curriculum are able to employ their targeted competencies to solve problem situations in the four fields of learning—numbers and arithmetic, functions, geometry, and statistics—clearly indicate that these pupils remain largely dependent on memorization and retrieval of information during exams. This reliance on rote learning significantly limits their ability to engage with mathematical concepts meaningfully and to apply them in real-world contexts.

As a result, it can be affirmed that the hypotheses have been validated. However, these findings also highlight that there is still a long way to go in achieving the goals set for mathematics education, particularly in establishing connections between the subject matter and pupils' everyday experiences. The Ministry of National Education emphasizes that engaging in problem-solving practices helps pupils develop a positive perception of mathematics, asserting that the topics studied should arise from the realities they encounter in their daily lives.

To address this disconnect, it is crucial to implement teaching strategies that not only emphasize theoretical understanding but also encourage critical thinking and creativity. Educators should design learning experiences that involve real-life problem situations, allowing pupils to explore mathematical concepts in context. For instance, incorporating project-based learning, where pupils tackle authentic challenges in their communities, can enhance their engagement and motivation.

Additionally, professional development for teachers is essential. Educators need training in innovative teaching methods that facilitate the integration of mathematics with other subjects, fostering interdisciplinary connections. Collaborative learning environments that encourage peer-to-peer interaction can also help pupils articulate their thought processes and deepen their understanding.

Furthermore, it is important to involve parents and the broader community in the educational process. By creating partnerships that highlight the relevance of mathematics in various fields—such as

economics, science, and technology—we can reinforce the importance of mathematical literacy and its application in real-world scenarios.

Ultimately, by fostering a more meaningful learning experience that emphasizes the practical application of mathematics, we can help pupils appreciate its relevance and cultivate a lifelong interest in the subject. This shift in pedagogy will not only improve pupils' problem-solving abilities but also prepare them for future academic and career challenges, ensuring that they are equipped to navigate an increasingly complex world.

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