Enhancing competence-oriented learning in grade 5 through online educational resources

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Abstract: *This study investigates the integration of digital educational resources into fifth-grade mathematics instruction, aligned with the Moldovan National Curriculum for lower secondary education. It highlights how these resources apply constructivist and formative principles to create an interactive, personalized learning experience. Through an analysis of exercise typologies and specialized digital tools, the study shows that digitalization fosters essential mathematical competencies and critical thinking. The findings indicate significant potential for improving learning quality through adaptive platforms, interactive simulations, and digital formative assessment, highlighting that the strategic integration of technology fosters 21st-century skills and supports educational equity.*

Keywords: Digital mathematics education, Interactive educational resources, Constructivism in mathematics teaching, Digital formative assessment, Mathematical competencies.

1. Introduction

In the context of the educational transformations driven by digitalization, mathematics textbooks can no longer be viewed exclusively as printed supports, but rather as integral parts of a complex digital ecosystem. This ecosystem includes a wide range of online educational tools, such as interactive applications, educational games, and collaborative learning platforms. These resources can significantly expand the possibilities for learning mathematics, offering students opportunities for visual exploration, simulation, and self-assessment. Through their interactive functionalities, multimedia elements, and dynamic activities, digital resources become essential tools for stimulating students' critical thinking and developing their digital skills. This aligns with the requirements of contemporary education and the objectives of the National Curriculum, whose mission is to ensure quality, inclusive, and equitable education (Andrițchi et al., 2025).

Thus, the Mathematics Curriculum for lower secondary education and its associated educational process are based on the constructivist principle (of structural learning) – which requires a spiral approach for the systematic review and in-depth study of essential concepts, aimed at developing mathematical thinking – and on the formative principle, oriented towards the direct development of the student's personality (National Curriculum, Mathematics, Grades V-IX, 2020).

https://doi.org/10.58503/icvl-v21y202643

Complementarily, online educational resources – such as web applications, digital textbooks, specialized mathematics teaching-learning websites, and mathematical games – enhance the learning experience through interdisciplinary and interactive approaches, playing a fundamental role in transforming the educational process. The convergence of digital textbooks and other digital learning environments is redefining mathematics instruction, creating a dynamic, participatory, and competency-oriented framework (Balmuș & Chiriac, 2021).

In this regard, the interaction between digital education and mathematical thinking becomes essential, not only for modernizing the learning process but also for developing a flexible mathematical mindset. By using digital resources, students not only learn mathematical concepts but also develop critical problem-solving and self-assessment skills, thereby becoming more capable of applying their knowledge in complex and diverse situations. Furthermore, digital education contributes to the development of a deeper and more adaptable mathematical thinking, preparing students to face the educational and professional challenges of the future.

Mathematics textbooks intended for the 5th grade integrate a wide variety of exercises and problems designed to support the gradual development of mathematical competencies specific to this age level. In the Republic of Moldova, the 5th-grade Mathematics textbook is based on a curricular structure organized around fundamental chapters such as: Natural Numbers, Sets, Divisibility, Fractions, Decimal Numbers, Elements of Geometry, and Units of Measurement (Mathematics, textbook for the 5th grade, 2020). The content is supported by a progressive system of exercises, designed with increasing levels of complexity, from introductory and consolidation activities to tasks involving reasoning, exploration, and practical application, all meant to stimulate students' logical thinking and cognitive autonomy.

Given these considerations, this article aims to analyze how digital educational resources can leverage the principles of the curriculum to enhance the teaching-learning process for the 5th grade. By referencing the constructivist and formative principles of the National Curriculum (National Curriculum, Mathematics, Grades V-IX, 2020), the research seeks to highlight the educational value, interactive functionalities, and formative potential of these tools, as well as their impact on active learning and the development of students' digital competencies.

This article is structured around a literature review on integrating digital tools into fifth-grade mathematics. It examines the theoretical foundations of constructivism and formative assessment, detailing their implementation via digital resources. The analysis also covers textbook exercise typologies to determine their role in promoting active learning and critical thinking. Ultimately, this work elucidates how online educational resources modernize mathematics teaching and explores the interplay between digital education and mathematical thinking in lower secondary students.

The research presented in this article was supported by the project “Innovation in the Design and Implementation of Interactive Digital Math

Textbooks for Lower Secondary Education" (Strategic Direction: "Innovative Educational Technologies and Products"), project code 25.80012.0807.42SE.

2. Competence-oriented learning in mathematics education

The concept of "competence-based learning" refers to an educational paradigm that shifts the emphasis away from the passive knowledge acquisition but toward the development of skills and attitudes required for effectively solving complex problem situations by integrating theoretical and practical knowledge in an applicable manner. Competencies, according to this viewpoint, involve not only knowledge acquisition but also the ability to apply knowledge in practice; they also include students' capacity to apply what they know in real-world situations.

According to the European Key Competences Framework (European Commission, 2019), key competences are defined as an integrated set of knowledge, skills, and attitudes essential for personal development, social inclusion, employability, and active participation in society. This definition emphasizes the role of competences as tools for individual autonomy and adaptation to the demands of a complex and dynamic society.

At the conceptual level, competence can be understood as an integrated system (Andrițchi et al., 2025) that combines knowledge (factual, conceptual, and procedural information), skills (the ability to apply knowledge to achieve results), and attitudes or values (dispositions and principles that guide actions and reactions). Consequently, competence-based learning focuses on applicability, transferability, and cognitive autonomy, offering students the opportunity to use what they learn in creative and responsible ways.

In the context of teaching mathematics in grade 5, concrete mathematical skills, as formulated in the National Curriculum (2020), include: identifying, reading, writing, representing, comparing, ordering and rounding natural numbers, fractions and finite decimal numbers; manipulating sets and determining whether an object or number belongs to a given set; performing arithmetic operations and applying their properties; solving problems; selecting, organizing and interpreting data from texts, tables, schemes or diagrams; representing and making plane geometric figures; measuring and comparing values, expressing them in appropriate units; describing geometric figures and bodies, recognizing their elements, calculating perimeters, areas and volumes; and justifying the steps and results through one's own arguments.

Integrating these skills into practice aligns with "competence-based learning," providing students with opportunities to apply knowledge in varied contexts, developing reasoning and critical thinking, as well as stimulating autonomy and creativity (Burlacu, 2019). Educational resources and digital textbooks enable the consolidation of these skills through practical activities, simulations, contextualized problems, and visual explorations (Balmuș & Doroftei, 2021), making mathematical knowledge more transferable and applicable in real-world situations.

The report "Mathematics for Europe" (2016) highlights the essential role of mathematics as a fundamental tool in technological progress and in solving complex societal problems. In this context, the development of mathematical competence at the individual level becomes a priority, being defined in the European Union's "Key Competences for Lifelong Learning" (2019) document as the ability to develop and apply mathematical thinking and intuition in order to solve problems in everyday life.

Specialized research deepens mathematical competence from complex perspectives, highlighting multiple interconnected dimensions. As Lee's (2016) analysis highlights, mathematical competence is multidimensional, and its assessment can be approached through two distinct paradigms: one based on norms and the other on criteria. Also, the perspective on its structure oscillates between a hierarchical and a continuous view, and its development is influenced by both biological and educational factors. Essentially, this diversity of perspectives highlights the fact that mathematical competence is not a universal and static concept, but a dynamic one, the understanding of which is shaped by methodological choices, educational values and the complex interaction between individual predispositions and the learning environment.

The competence-oriented approach, as described, is implemented and developed organically through the application of constructivist and formative principles in the mathematics curriculum. These principles provide the theoretical and methodological framework necessary for transforming the competencies established at the curricular level into tangible educational realities, ensuring deep and sustainable learning. Therefore, the analysis of constructivist and formative principles becomes essential to understand how the curriculum supports the gradual and integrated acquisition of mathematical competencies.

3. Constructivist and formative principles in the mathematics education

In the context of modern education, constructivism asserts itself as a fundamental theory of learning, placing the student at the center of the educational process as an active constructor of knowledge, and the teacher in the role of facilitator. Murugesan et al. (2016) state that constructivism radically shifts the mathematics education paradigm towards active learning and critical thinking. In this model, the student constructs knowledge while the teacher facilitates, guiding exploration and providing tailored support. Assessment becomes formative, focusing on the learning process rather than final outcomes. While this approach helps students apply knowledge in real-world contexts, its implementation faces challenges in teacher training, classroom management, and alignment with standardized tests.

Díaz (2017) elaborates that mathematics learning is an internal, constructive process dependent on a student's cognitive development. Authentic learning occurs when students actively build new understanding by integrating practical experiences into existing mental schemas, a process driven by the resolution of cognitive conflicts during social interaction.

An effective practical transposition of constructivism is the 5E instructional model, considered a representative pedagogical tool, as highlighted by Shittu and Alex (2025). This model provides a coherent structure for lesson design, through the stages of engagement, exploration, explanation, elaboration and evaluation. This progressive approach guides students from activating curiosity and prior knowledge, through investigation and conceptualization, to applying and transferring knowledge in new contexts.

Çibukçiu (2025) provides empirical support, demonstrating that constructivist methods significantly enhance mathematical problem-solving skills compared to traditional approaches. In a study with third-graders, average scores rose from 39.77 to 59.46 following a constructivist-based intervention ($p < 0.001$). The author concludes that by centering on the student through discussions, group work, and real-world problems, constructivism facilitates active and sustainable knowledge building.

While constructivism provides the theoretical framework for how students learn, formative principles provide the practical tools necessary to guide and evaluate this process. Formative assessment thus joins constructivist pedagogy as an essential component, focused on obtaining continuous feedback that supports the simultaneous improvement of learning and teaching. Maskos et al. (2025) establish that the efficacy of formative assessment in mathematics is contingent upon the sustained use (a minimum of three months) of interactive digital tools that are clearly aligned with learning objectives. This approach is particularly effective for low-achieving and disadvantaged students, thereby promoting educational equity through enabling real-time pedagogical adjustments.

3.1 Interactive exercises for developing digital competencies in constructivist learning

The constructivist and formative principles promoted by the National Mathematics Curriculum (2020) for Grade 5 are directly reflected in the structure of the exercises included in the school textbook (Mathematics for Grade 5, 2019). More precisely, these principles illustrate the concrete application of curricular guidelines in teaching practice, integrating them into learning activities through methods that support the development of both students' mathematical and digital competencies.

Within the theoretical framework of constructivist learning, the diversity and interactivity of the exercises allow students to progress from the mechanical practice of mathematical procedures to their conceptual understanding. These exercises not only support the fixation of mathematical procedures, but also develop a deep understanding of mathematical concepts in a framework in which technology plays an essential role.

An essential category within the textbook are *algorithmic exercises* (e.g.: adding and subtracting multi-digit numbers; fraction operations; calculating perimeters and areas using standard formulas). These are designed to ensure the

consolidation and automation of computational skills. The digital environment supports this type of exercises through drill & practice applications or exercise generators with immediate feedback, facilitating adaptive learning and self-regulation.

A second important category is *conceptual recognition and understanding exercises* (e.g.: completing a table with the divisors and multiples of given numbers; ordering large numbers; representing fractions on the number line). These exercises help students identify properties, classify mathematical objects, and establish relationships between concepts. In digital format, these can include interactive drag-and-drop activities, matching, or dynamic visualizations, which increase conceptual accessibility.

Also, *applied problems* require the transfer of mathematical knowledge in various contexts, often taken from everyday situations such as: calculating costs, determining distances or converting units of measurement. Significantly, the digital environment extends these activities through the use of spreadsheets, educational modeling applications or graphical representation tools, stimulating algorithmic thinking.

Another important category is represented by *reasoning and demonstration exercises* (for example: "prove that the sum of two even numbers is always an even number"; "justify geometric properties of triangles"), which aim to develop logical thinking and mathematical argumentation capacity. To this end, the digital environment offers interactive applications such as GeoGebra, where students can visualize the demonstrated steps, verify hypotheses and represent concepts through visual simulations.

Formative assessment and self-assessment exercises (such as: decimal number review tests; unit conversion problems) reinforce the formative process by providing personalized feedback and encouraging reflection on one's own progress. As a result, automated electronic tests contribute to the development of self-regulation skills and the assumption of responsibility for one's own learning path.

Overall, these typologies allow the achievement of the general competencies provided by the school curriculum, balancing procedural and conceptual learning and integrating digital skills. The structure of the exercises thus reflects the convergence between constructivist principles and formative assessment, transforming the mathematics textbook into an active, adaptive and digital learning tool.

4. Integration of digital tools in 5th grade mathematics education

4.1. The role and impact of digital tools on learning

The integration of digital educational resources into 5th grade mathematics teaching is a key element in the modernization of education, supported by the requirements of the National Curriculum for Mathematics, Grades V-IX (2020) and other official documents. This involves not only transferring content to an

electronic format, but also restructuring the interaction between the student and the learning task, allowing for the personalization of the educational process according to the pace, style, and competence level of each student.

Digital transformation becomes concrete by correlating content units with activities and learning products recommended in the curriculum – concept maps and chapter-level schemes, idea plans, solved exercises or complex STEM projects. In this framework, the integration of modern educational applications supports the achievement of mathematical competencies provided by the curriculum and pedagogically reconceptualizes traditional tasks, capitalizing on the innovative potential of digitizing exercises.

Taukebayeva & Bakirova (2024) emphasize that digital technologies support personalized learning through adaptive platforms, offering exercises and support adapted to students' strengths and weaknesses. Also, interactive applications, educational games and simulations can increase their motivation and academic engagement.

Complementing this view, Gavrilă (2024) argues that ICT makes mathematics a dynamic, interactive process rather than an abstract domain. This shift is facilitated by platforms that allow for the visualization of concepts and provide personalized feedback. The integration of STEAM further develops practical problem-solving skills and innovative thinking.

Each type of exercise integrates effectively into specialized digital tools, contributing to the development of specific mathematical skills. Examples include:

- *Recognition and association*: LearningApps, Kahoot! – dynamic activities and immediate feedback;
- *Algorithmic exercises*: Desmos, GeoGebra, ThatQuiz – adaptive practice;
- *Applicative problems*: PhET, Math Apps, interactive spreadsheets – simulations and practical scenarios;
- *Investigation and exploration*: Scratch, Blockly – visual programming and mathematical projects;
- *Reasoning and demonstration*: GeoGebra Geometry, Desmos Geometry – interactive modeling and hypothesis testing;
- *Formative assessment and self-assessment*: Quizizz, Edpuzzle, LearningLemur – immediate feedback, progress analysis and personalized recommendations;
- *Collaboration*: Padlet, Miro – discussions and collective constructions of mathematical reasoning.

Thus, digital integration in teaching mathematics in the 5th grade ensures a holistic approach, which combines fundamental mathematical competencies with the digital skills needed in the 21st century. The strategic correlation between the targeted competencies, the types of exercises and the digital tools facilitate a coherent didactic planning adapted to the individual needs of the students.

4.2 A Comparative analysis of digital platforms for 5th grade mathematics

The digital transformation of education has led to the emergence of numerous learning platforms aimed at improving mathematical understanding through interactive, adaptive and collaborative methods. Below is a comparative analysis of the most relevant platforms used for learning mathematics in 5th grade. However, this abundance of digital resources generates a real challenge for teachers: identifying and integrating the most appropriate digital tools, which are consistent with curricular objectives and adequately respond to the diversity of learning styles of 5th grade students.

Although the theoretical advantages of using digital technologies in the teaching-learning process are well presented in the specialized literature, in practice there remains a significant gap between the pedagogical potential of these resources and their effective integration into educational activities. In particular, the educational context of the Republic of Moldova reveals an increased need for correlation between existing digital resources and the requirements of the National Curriculum for Mathematics, grades V–VIII.

In this context, a comparative analysis of the main international and national digital platforms used in teaching mathematics in grade V is proposed. The analysis is guided by the following research question: *To what extent do existing digital platforms, both national and international, support the specific learning objectives and the competence-centered approach of the mathematics curriculum for grade V in the Republic of Moldova*?

To answer this question, the evaluation of the platforms will be carried out based on pedagogical criteria, aligned with curricular requirements and contemporary teaching practices, namely:

- *curriculum alignment* – the extent to which the content, typology of exercises and learning scenarios reflect the chapters, competencies and formative values stipulated in the National Curriculum (for example: natural numbers, fractions, geometry, logical reasoning);
- *pedagogical basis* – the coherence between the platform structure and the assumed educational paradigm (algorithmic practice, digital constructivism, collaborative or project-based learning);

In this context, 10 digital platforms were selected – 8 from the Moldovan and Romanian space and 2 international – which meet the following basic criteria:

- contain relevant content for 5th grade mathematics;
- are accessible in Romanian or have an intuitive interface;
- offer significant free options.

The results of the analysis presented in Table 1 contribute to strengthening a critical perspective on how digital resources can be synchronized with the objectives of contemporary mathematics education, supporting teachers in the process of strategic planning of digital learning, oriented towards the development of mathematical and digital skills necessary in the knowledge society.

Table 1. Analysis of digital mathematics platforms for grade 5: alignment with curriculum and pedagogical principles

Online platform	Alignment with the National Curriculum (Mathematics, 5th Grade)	Pedagogical Principles
Educație Interactivă https://educatieinteractiva.md	Aligned with the National Curriculum of the Republic of Moldova, it is a digital application/library with over 8,000 lessons for grades 1–12, in Romanian and Russian; includes resources for core topics in 5th grade mathematics.	Based on visual and active learning; emphasizes the connection between theory and applications.
MozaWeb https://www.mozaweb.com	A global platform offering digital textbooks, interactive content, and exercises; implemented in 195 institutions in the Republic of Moldova under the "Digital Innovations in the Educational System" project (mecc.gov.md).	Interactive digital pedagogy; exploration through 3D scenes, digital textbooks, interactive exercises, online tests, automated feed-back, and visual acti-vities.
VirtualSchool https://virtualschool.ro/	Content partially aligned with the 5th grade curriculum; covers general topics (numbers, fractions, geometry), but not all exercises are competency-based.	Promotes guided learning; focuses on individual practice and consolidation.
Digitaliada https://www.digitaliada.ro	Fully aligned with the Romanian curriculum and compatible with the Moldovan curriculum. Offers over 4,000 digital educational resources (lessons, tests, exercises) accessible for school use.	Based on digital constructivism; students discover through exploration, applications, and gamified activities.
Clasa Digitală https://www.clasadigitala.ro	Provides digital textbooks and exercises aligned with Romanian	Focused on blended learning and student autonomy.

	national school programs; good support for core topics (numbers, fractions, geometry).	
Genizz https://genizz.ro/	Includes common mathematical topics (arithmetic, algebra, geometry). |	Focused on motivation and educational games; learning through challenges and rewards.
Eduboom https://eduboom.ro/	Content aligned with the Romanian curriculum; contains video lessons and exercises, automatic grading tests.	Explanatory and constructivist pedagogy; focuses on clarity and recap through visual examples.
Pauza de Mate https://pauzademate.ro/gimnaziu-lectii/	Support for teaching mathematics in middle school, especially for 5th grade, with well-organized, accessible lessons and useful video resources	Predominantly lesson viewing, not necessarily student activity; set of video lessons.
Usable Math https://usablemath.org/	An open educational resource designed for elementary school students, includes activities for 5th grade, aimed at developing problem-solving skills in mathematics. In the context of digitalizing textbooks and ICT resources, it offers a great opportunity to integrate external material without access barriers.	Integrates student-centered digital pedagogy; based on con-structivist and socio-constructivist principles; promotes active, reflective, and collabo-rative learning.
Zearn https://www.zearn.org/	Designed for American standards; can be adapted to the national curriculum with linguistic and curricular adjustments; covers most core areas for 5th grade.	Supports active learning through direct student involvement in problem-solving and selecting appropriate strategies for each situation.

The comparative analysis of digital platforms for learning mathematics in the 5th grade highlights the significant potential of digital educational resources in supporting competence-centered learning and in line with the National Curriculum. The results indicate that most of the selected platforms offer relevant content for the fundamental chapters of mathematics – natural numbers, fractions, geometry,

logical reasoning – and allow the integration of constructivist and formative principles in the teaching-learning process. The *Digitaliada*, *MozaWeb* and *Usable Math* platforms are distinguished by their interactive, student-centered pedagogical approach. Other platforms, Pauza de Mate or Eduboom, offer more traditional or lesson-based educational support, which can limit the active involvement of students if they are not complemented by interactive practical exercises. International platforms, such as *Zearn*, can be successfully adapted to the local context, offering personalized learning opportunities and automated feedback, but require linguistic and curricular adjustments.

5. Conclusion

This paper has revealed that the integration of digital educational resources in teaching mathematics in grade 5 represents a fundamental necessity in the current educational context, being essential for achieving the objectives set by the National Curriculum. Following the analysis, it was found that digital platforms, both national and international, play a significant role in applying constructivist and formative principles, transforming the learning process from a mechanical activity into an interactive, personalized educational experience focused on developing skills. The comparative analysis revealed a diversity of digital resources that can be effectively adapted to the educational context of the Republic of Moldova. The Educația Interactivă and Digitaliada platforms offer a higher degree of alignment with the National Curriculum, offering well-structured educational content and relevant interactive activities. On the other hand, international solutions, such as MozaWeb and Zearn, bring additional value by implementing innovative pedagogical approaches and advanced interactive functionalities, which can support personalized and adaptive learning of students.

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