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The Role of Digital Technologies in Developing Creative and Critical Thinking in Geometry Lessons for Academic Lyceum Students

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Abstract. *This article explores the role of digital technologies in fostering creative and critical thinking among academic lyceum students in the context of geometry education. The study emphasizes that traditional methods of teaching geometry often fail to fully develop spatial imagination and logical reasoning, while digital tools provide dynamic, interactive, and visual learning opportunities.*

INTRODUCTION

In today's educational process, the use of digital technologies not only increases the efficiency of knowledge acquisition but also plays a vital role in shaping students' independent thinking, creativity, and critical analysis skills. With the help of digital tools, lessons can be organized in an interactive, visual, and engaging manner. This approach strengthens students' interest in the subject, helps them to master knowledge more deeply, and expands opportunities for practical application.

Geometry, as a subject that requires understanding of complex shapes, spatial imagination, and logical reasoning, particularly demands the integration of digital technologies. Through 3D models, interactive graphic software such as GeoGebra and Desmos, and visual simulations, students can observe geometric properties, compare structures, and analyze relationships. This process broadens spatial imagination and simplifies the comprehension of complex theorems and problems.

METHODS

Several digital tools can be effectively applied in geometry lessons to foster creative and critical thinking among academic lyceum students. GeoGebra allows the construction of geometric figures and the visual demonstration of theorem proofs. For instance, the sum of angles in a triangle can be shown dynamically rather than only theoretically.

Desmos, an online graphing calculator, enables students to input mathematical functions and observe their graphs in real time. Parabolas, ellipses, and hyperbolas can be analyzed by changing parameters, which helps students understand mathematical concepts visually and critically.

Miro and MindMeister provide opportunities to create mental maps, allowing students to visualize cause-and-effect relationships between theorems, formulas, and geometric concepts. For example, the Pythagorean theorem can be placed at the center of a map, branching into related problems and corollaries.

Kahoot and Quizizz are interactive platforms that allow teachers to design quizzes and assess students' knowledge in real time. These tools encourage competition, motivation, and critical evaluation of answers.

RESULTS

The application of digital technologies in geometry lessons produced several positive outcomes. Students developed stronger spatial imagination and logical reasoning by visualizing complex structures such as pyramids, prisms, and cones in 3D. Creativity was enhanced as learners solved problems using multiple approaches—analytical, graphical, and visual—and even created new geometric models.

Critical thinking was strengthened through digital tests and problem-based tasks. Students analyzed solutions, identified errors, and compared alternatives, which improved their ability to justify reasoning and evaluate evidence. Moreover, interactive platforms transformed students from passive listeners into active participants, increasing engagement and motivation during lessons.

DISCUSSION

The findings demonstrate that digital technologies modernize the teaching process and significantly contribute to the development of 21st-century skills among academic lyceum students. GeoGebra proved most effective for explaining complex geometric structures, while Kahoot and Quizizz were particularly useful for activating students and assessing their critical thinking. Miro and MindMeister facilitated collaborative creativity by enabling group-based mental mapping.

Overall, the integration of digital tools in geometry lessons not only improves knowledge acquisition but also prepares students for real-life problem-solving by cultivating creativity, critical analysis, and collaborative skills.

CONCLUSION

The use of digital technologies in geometry lessons develops students' spatial imagination and logical thinking. One of the main goals of geometry as a subject is to cultivate spatial imagination and logical reasoning in learners. In traditional lessons, representing complex shapes and their interrelations only on paper may not be sufficient for students. Digital technologies, particularly programs such as GeoGebra and Desmos, make it possible to create dynamic representations of triangles, polygons, circles, and other figures, modify them, and observe changes in real time. This process helps students to better understand the internal structure of shapes, draw logical conclusions, and strengthen spatial reasoning.

It fosters creativity and encourages the generation of new ideas. Digital tools provide students with opportunities to solve geometric problems using different methods. For example, a problem can be solved analytically as well as graphically or visually. This process stimulates creative thinking, motivating students to search for alternative solutions and experiment with new ideas. In addition, platforms such as Miro or MindMeister allow learners to create mental maps, reorganize their knowledge visually, and discover new connections. This not only enhances creativity but also develops independent inquiry and the ability to express one's ideas freely.

It strengthens critical thinking and teaches decision-making in problem situations. Geometry often involves problem-based tasks. Through digital tests, interactive exercises, and problem-oriented questions, students analyze given solutions, identify mistakes, and compare alternatives. For instance, on platforms like Kahoot or Quizizz, a teacher may present several possible solutions to a problem, and students must evaluate the evidence to select the correct one. This process reinforces critical thinking, trains learners to make sound decisions in problem situations, and develops their skills in logical analysis.

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