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DEVELOPING STUDENTS' LOGICAL, SPATIAL, AND CRITICAL THINKING SKILLS THROUGH INTERACTIVE LEARNING ACTIVITIES

Olimova Sevara Zokir qizi
Teacher at School No. 3, Chirchiq City
Email: sevaraxaitboyeva@gmail.com

Abstract. This study examines the importance of developing students' logical, spatial, and critical thinking skills in contemporary education. The analysis is based on previously published research on interactive, game-based, and problem-based learning approaches. The reviewed findings indicate that activities requiring analysis, planning, spatial organization, evaluation, problem-solving, and decision-making can support higher-order thinking skills. Particular attention is given to educational games and Spatial Problem-Based Learning, which demonstrate positive contributions to students' critical and spatial thinking. The findings suggest that integrating purposeful learning activities into education can create opportunities for students to develop logical reasoning, spatial understanding, critical analysis, problem-solving, and independent decision-making.

Keywords: logical thinking; spatial thinking; critical thinking; problem-solving; educational games; interactive learning; higher-order thinking.

Introduction

Nowadays, education is not limited to providing students with knowledge and information. Modern educational processes increasingly focus on developing students' ability to think, analyze information, solve problems, and make appropriate decisions. The rapid growth of information and technology requires students to become active learners who can understand, evaluate, and apply information effectively. Therefore, the development of logical, spatial, and critical thinking skills has become an important goal of contemporary education.

Logical thinking enables students to identify relationships between ideas, recognize patterns, analyze information, and reach reasonable conclusions. Spatial thinking helps students understand the relationships between objects, locations, directions, and different elements in space. Critical thinking, in turn, allows students to analyze information, evaluate evidence and different viewpoints, make judgments, and find appropriate solutions to problems. These types of thinking are closely connected and can support students in dealing with academic and real-life problems.

In the learning process, students should be given opportunities not only to memorize information but also to analyze, compare, evaluate, organize, and apply their knowledge. Learning activities that involve problem-solving, discussion, planning, decision-making, and cooperation can create an effective environment for developing thinking skills. Research on educational games, for example, shows that such activities can contribute to the development of students' logical, spatial, creative, and critical thinking skills.

Critical thinking is particularly important because it encourages students to examine information carefully, analyze arguments and evidence, evaluate different alternatives, and make justified decisions. At the same time, spatial activities can help learners visualize relationships and organize information, while logical activities can strengthen reasoning and problem-solving abilities.

Thus, developing logical, spatial, and critical thinking skills should be an integral part of the educational process. Teachers need to create learning environments in which students can ask questions, analyze information, express their ideas, evaluate possible solutions, and make independent decisions. The purpose of this study is to emphasize the importance of developing these three types of thinking skills and to examine learning approaches and activities that can effectively support their development among students.

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Materials and Methods

The study was based on the review and analysis of previously published research related to the development of students' logical, spatial, and critical thinking skills. Relevant academic studies focusing on educational games, problem-solving activities, spatial learning, and student-centered teaching approaches were examined.

The selected studies were analyzed according to their aims, methods, learning activities, and main findings. Particular attention was given to activities that encouraged students to analyze information, identify relationships, solve problems, evaluate alternatives, make decisions, and develop spatial understanding.

The reviewed research demonstrated that interactive and problem-based learning activities can contribute to the development of students' thinking skills. Previous studies showed that activities such as educational games and spatial problem-based learning provide opportunities for students to use logical reasoning, spatial relationships, critical analysis, problem-solving, and decision-making skills.

The findings of the reviewed studies were compared and synthesized in order to identify common approaches and effective practices for developing students' logical, spatial, and critical thinking skills. Thus, the research methodology was based on the review, comparison, analysis, and generalization of existing research findings rather than on conducting a new experimental study.

Results and Discussion

The analysis of the selected studies demonstrates that the development of students' logical, spatial, and critical thinking skills can be effectively supported through active, interactive, and problem-based learning activities. The reviewed findings indicate that such activities encourage students to move beyond simple memorization and engage in analysis, planning, evaluation, problem-solving, and decision-making.

Table 1. Students' self-assessment of skills developed through board game scrabble

I can assess skills developed by Board Game Scrabble in the following way: **A** – excellent, **B** – good, **C** – fair		A	B	C
Items of assessment				
1.	Team building	72%	24%	4%
2.	Spelling skills	88%	12%	0%
3.	Vocabulary skills	86%	14%	0%
4.	Spatial skills	86%	10%	4%
5.	Thinking skills	93%	5%	2%

*Source: Kobzeva (2015).

As shown in Table 1, thinking skills received the highest "excellent" rating (93%), while spatial skills were rated at 86%. These findings indicate that Board Game Scrabble may contribute to the development of students' thinking and spatial abilities, in addition to language and teamwork skills.

The findings of the reviewed research on Scrabble showed that educational games can contribute to the development of several thinking skills simultaneously. In particular, students were required to plan words according to the available spaces on the board, recognize relationships between letters and words, evaluate different options, and make decisions in order to achieve better results. These activities were associated with the development of spatial, logical, creative, and critical thinking skills.

The results of the evaluation presented in the study further support the positive role of interactive activities in developing thinking skills. 93% of respondents evaluated their experience with Scrabble

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as excellent for developing thinking skills, while 86% rated the development of spatial skills as excellent. Vocabulary and spelling skills were also highly evaluated, at 86% and 88%, respectively. These results suggest that learning activities involving active participation can support both cognitive and language-related development.

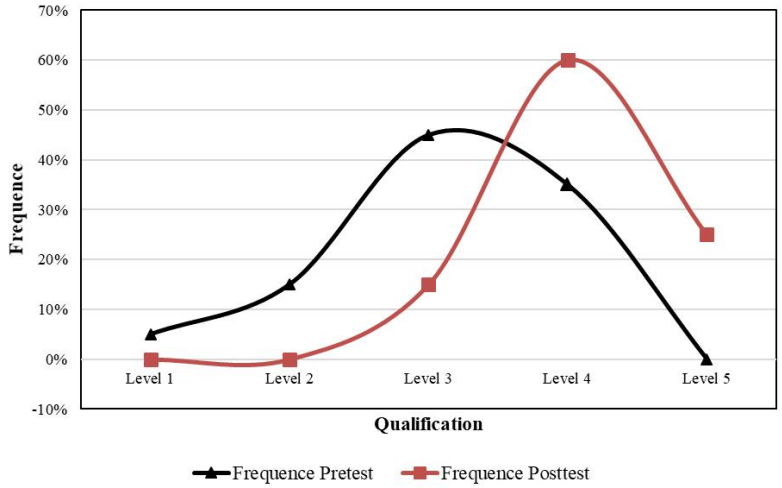


Figure 1. Comparison of students' critical thinking performance before and after the learning intervention (Source: Silviariza, Sumarmi, & Handoyo (2021))

The analysis also indicates that spatial learning can be closely connected with the development of critical thinking. In the reviewed Spatial Problem-Based Learning (SPBL) study, students were involved in identifying and formulating spatial problems, collecting and organizing data, analyzing information, discussing findings, and presenting arguments. Such a sequence requires students to combine spatial understanding with logical reasoning and critical evaluation. Figure 1 presents the comparison of pre-test and post-test results reported in the reviewed study. The results show a positive change in students' critical thinking performance after the implementation of the learning approach. The proportion of students classified as highly critical increased from 0% in the pre-test to 25% in the post-test. Similarly, the proportion of students classified as critical increased from 35% to 60%. At the same time, the percentage of students in the less-critical category decreased from 15% to 0%. These results indicate that the learning approach examined in the study contributed to an improvement in students' critical thinking performance.

In relation to the present topic, the diagram is particularly relevant because the improvement in critical thinking can be considered together with the development of logical and spatial thinking. The learning activities described in the reviewed research required students to analyze information, identify spatial relationships, evaluate alternatives, and make decisions. Therefore, the findings suggest that activities designed to strengthen one type of thinking may simultaneously support other higher-order thinking skills.

The reported results of the SPBL study provide further evidence of this relationship. The experimental group achieved a mean post-test score of 73.95, compared with 63.21 in the control group. The independent-samples t-test showed a significant difference between the groups, with a significance value of 0.000, indicating an improvement in critical thinking among students who participated in the SPBL learning process.

The reviewed findings can be interpreted as evidence that logical, spatial, and critical thinking should not be developed separately. Learning tasks that require students to recognize relationships, organize information spatially, analyze evidence, evaluate alternatives, and make decisions can activate several types of thinking at the same time. The Scrabble study, for example, demonstrates how spatial organization and strategic decision-making can be combined with logical and critical

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thinking, while the SPBL study shows how spatial problem-solving can create opportunities for analysis, evaluation, and decision-making.

Conclusion

Board Game Scrabble was associated with the development of students' thinking and spatial skills. The reported results showed that 93% of students rated thinking skills as excellent, while 86% rated spatial skills as excellent. The game required students to plan word placement, recognize spatial relationships, evaluate possible options, and make decisions. These activities involved logical, spatial, and critical thinking during the learning process.

Spatial Problem-Based Learning also produced higher critical-thinking results in the experimental group. The mean post-test score reached 73.95 in the experimental group, compared with 63.21 in the control group, with a statistically significant difference between the groups ($p = 0.000$). The learning process included identifying spatial problems, collecting and organizing data, analyzing information, discussing results, and presenting arguments. These results indicate that combining spatial problem-solving with analytical activities can improve students' critical-thinking performance.

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