THE ROLE OF GAME IN ENHANCING MATHEMATICS LEARNING IN PRIMARY EDUCATION CLASSROOMS

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Abstract: This scientific study aims to examine the effectiveness of mathematical games as a pedagogical approach to improving mathematics learning outcomes in primary education. Mathematical games are increasingly recognized as more than just recreational activities—they are essential tools for engaging students in active learning, fostering creativity, and developing both cognitive and socio-emotional competencies. This research seeks to understand how game-based strategies influence the mathematics learning process, particularly in enhancing conceptual understanding, sustaining student interest, and supporting individualized learning. The study was conducted across 36 primary schools in the Republic of North Macedonia, involving a total of 616 participants—478 general classroom teachers and 138 subject-specific mathematics educators. Employing a quantitative research design, data were collected through structured questionnaires utilizing a five-point Likert scale and were analyzed using descriptive statistics, analysis of variance (ANOVA), and T-tests via the SPSS statistical software. The findings indicate no statistically significant differences in teachers' perceptions regarding the use of games in mathematics instruction based on their professional experience (ANOVA: $F = 2.3109$, $p = 0.0931$; T-test: $t = -0.5695$, $p = 0.2923$), suggesting a broad consensus on the value of game-based learning across different experience levels. Teachers generally agreed that games help foster student collaboration, improve attention span, and make abstract mathematical concepts more tangible and accessible. Moreover, the study found that games support the development of problem-solving skills, logical reasoning, and persistence in learning—attributes that are critical for long-term academic success. These benefits were evident regardless of classroom size or school setting, pointing to the adaptability and scalability of game-based methods. However, some challenges were noted in implementation, including limited classroom time, lack of training in game facilitation, and insufficient curricular resources. To address these issues, it is recommended that educational institutions and policymakers incorporate structured game-based strategies within the mathematics curriculum and invest in targeted professional development programs for teachers. Additional findings emphasize the importance of designing inclusive games that cater to diverse learning needs and promote equitable participation among students. The integration of well-designed mathematical games can bridge learning gaps, especially among students who struggle with traditional instruction methods. The study ultimately affirms the pedagogical value of games as a complementary strategy in early mathematics education and calls for a broader institutional commitment to innovation in teaching practices.
Keywords: mathematics, games, learning, primary school grades.

1. INTRODUCTION

Building upon the foundational theories and perspectives discussed, it is essential to recognize the enduring significance of incorporating games in primary mathematics education. The theoretical underpinnings presented highlight the intrinsic connection between play, learning, and child development, with insights from educational visionaries such as John Dewey and G. Booker. John Dewey's emphasis on play as a preparatory activity for the future underscores the enduring importance of integrating enjoyable and motivating elements into the learning process. Dewey's viewpoint, rooted in the early 20th century, resonates with contemporary educational imperatives, affirming that play remains a cornerstone for fostering mental and social development in children.

The notion that plays evolves into an enjoyable pursuit within chosen occupations further underscores the enduring impact of childhood play activities on shaping individuals into productive and fulfilled adults. This perspective aligns with the modern understanding that the engagement of children in game-based learning not only enhances their immediate understanding of mathematics but also lays the foundation for a lifelong positive association with learning.

Stevanovic's assertion that play serves as both a form and a tool for the education of children complements Dewey's perspective, emphasizing the dual role of play as both a method of instruction and a medium through which essential educational objectives are achieved. This nuanced understanding reinforces the idea that games serve as more than mere activities; they are integral tools for nurturing well-rounded learners.

G. Booker's practical application of games in primary school teaching, as documented in "Mathematics Games," further substantiates the theoretical underpinnings. His observations underscore the power of play in fostering

heightened interest and intrinsic motivation, even among students initially less inclined to learn through traditional methods. This aligns with the contemporary understanding that games offer a genuine and meaningful context for children's learning experiences.

The findings by Linder, Smart, and Cribbs underscore the importance of tailoring successful mathematics instruction to students' interests and experiences. Recognizing children's inherent curiosity and inclination toward problem-solving, Jansen, Westbrook, and Van Driel advocate for teacher-led discovery learning, wherein students collaboratively tackle complex problems. Social scaffolding in this process aids in enhancing motivation, fostering flexible knowledge, and facilitating an understanding of how knowledge evolves in a specific domain.

According to Plass, Homer, and Kinzer (2015), the literature frequently emphasizes the necessity for sustained student motivation and engagement in learning, providing a compelling argument for the incorporation of games in educational contexts. Rooted in motivational, affective, and socio-cultural attributes, games are designed to invigorate learning. Within the broader learning context, motivation and emotion have been identified as pivotal factors influencing cognitive processes and outcomes.

2. MATERIALS AND METHODS

To investigate and substantiate the assertion that the integration of games enhances the learning of mathematics in classroom instruction, a mixed research design was employed. The study involved a sample of 660 teachers, comprising 478 classroom teachers and 138 mathematics teachers with experience teaching or working with sixth-grade students. The research spanned 36 schools across the Republic of North Macedonia and was conducted from May to June 2022.

Teachers were asked to select from five options provided on Linkert's scale to express their agreement with the statement: 1 – I strongly disagree, 2 – I disagree, 3 – I partially agree, 4 – I agree, 5 – I strongly agree.

To assess the significance of differences among teacher groups based on their work experience, a one-way analysis of variance (ANOVA) was employed. The variation in arithmetic means among respondents from different work environments (urban-rural) was analyzed using an independent samples t-test.

In addition to the quantitative research, qualitative insights were gathered through interviews with experts in the field. This included discussions with five advisors from the Bureau for Educational Development, three classroom advisors, and two advisors specializing in teaching mathematics.

Data Analysis

Main Hypothesis: The systematic integration of educational games into primary mathematics instruction positively influences students' mathematical proficiency, cognitive engagement, and overall satisfaction with the learning process.

Special Hypothesis 1: The use of games in acquiring mathematical knowledge in primary classroom instruction varies across grade levels: I, II, III, IV, and V.

Special Hypothesis 2: Math teachers acknowledge the success of students when classroom teachers employ games as part of the instructional approach.

Special Hypothesis 3: Games are used by classroom teachers in the process of teaching mathematics regardless of the location where they work and their years of professional experience.

3. RESULT

Table.1. The application of games in primary schools in North Macedonia

Lickert Scale / Assumptions:		f strongly disagree %	f Disagree %	f Partially agree %	f Agree %	f Strongly agree %	Average	SD	Nr.
1. The application of games is a good opportunity to improve the teaching of mathematics in the classroom.	I	2 2.17	8 8.69	25 27.17	28 30.43	29 31.52	3.80	1.2505	92
	II	3 3.	9	26 26	39 39	23 23	4.02	1.4282	100
	III	2 2.17	6 6.97	15 17.44	15 17.44	48 55.81	4.17	1.8130	86
	IV	2 2.02	7 7.07	18 18.18	25 25.25	47 47.47	4.09	1.7683	99
	V	3 2.97	10 9.90	27 26.73	30 29.70	31 30.69	3.75	1.2833	101

Source: Merita Ajdini, 2023

Table.1 reflects the perspectives of classroom teachers engaged in the study concerning the assertions related to the use of games for enhancing mathematics learning in primary school. This includes fostering increased student activity in the classroom, facilitating easier knowledge acquisition, and promoting interest in learning mathematics. The table indicates that the affirmative responses from participating teachers across Grades I, II, III, IV, and V consistently surpass 50% for each question, categorized as positive responses (5. strongly agree, 4. mostly agree). Descriptive statistics for these claims reveal low standard deviation values, indicating that the data points are closely clustered around the mean.

Table. 2 "The Application of Games in Primary Schools in Urban and Rural Areas in the Republic of North Macedonia"

	City	Village	Total
I strongly disagree,	7	5	12
Disagree	21	19	40
Partially agree	58	53	111
Agree	71	66	137
Strongly agree	98	80	178
Total	255	223	478
The *t*-value is 0.29367. The *p*-value is.388244. The result is *not* significant at *p* <.05.			

Source: Merita Ajdini, 2023

The variances in arithmetic means among respondents working in urban or rural settings, specifically in relation to the statement "The implementation of games is a valuable opportunity to enhance mathematics instruction in secondary school," were computed using an independent one-sample t-test, as depicted in the table above. The t-test results indicate a lack of statistically significant difference (t=-0.29367, p=0.388244). The outcome does not achieve significance at the p < .05 level.

Cross-tabulations due to work experience

Table 3. Conducting an Analysis of Variance (ANOVA) for the variable of work experience in relation to the assertion, "The utilization of games is a valuable opportunity to enhance mathematics instruction in the classroom."

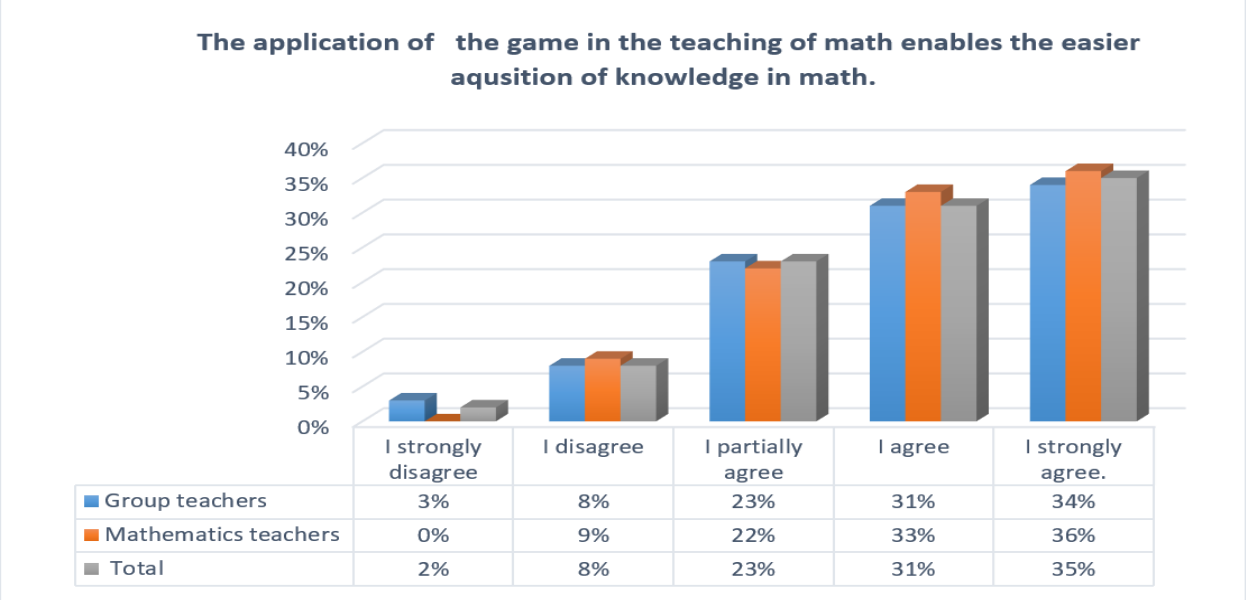
Data collection Work experience	N	Average	Standard Deviation	Standard mistakes
0-10 yrs.	5	27.6	23.2981	10.4192
11-20 yrs.	5	27	20.3593	9.1049
21-30 yrs.	5	25	18.6682	8.3487
31-40 yrs.	5	15.2	9.9599	4.4542
+40	5	0.8	0.4472	0.2

ANOVA Variation Source	DF	SS	MS	f F-Stat	P-Value
Between groups	4	2597.84	649.46	2.3109	0.0931
In groups	20	5620.8154	281.0408		
	24	8218.6554			

Source: Merita Ajdini, 2023

Upon conducting the variance analysis, it is evident that there is no statistically significant difference among employees with varying levels of experience or working time concerning the assertion: "The incorporation of games is a beneficial opportunity to enhance mathematics instruction in elementary school." The calculated f-ratio stands at 2.3109, and the associated p-value is 0.0931. Consequently, the outcome does not reach significance at the $p < .05$ threshold.

Histogram.1



	I strongly disagree	I disagree	I partially agree	I agree	I strongly agree.
Group teachers	3%	8%	23%	31%	34%
Mathematics teachers	0%	9%	22%	33%	36%
Total	2%	8%	23%	31%	35%

Source: Merita Ajdini, 2023

In Histogram 1, the disposition of both classroom teachers and Mathematics teachers is depicted concerning the statement: "The incorporation of games in mathematics instruction facilitates the smoother acquisition of mathematical knowledge." It is evident that the majority, constituting a cumulative percentage of 66%, including both classroom and mathematics teachers, endorse this statement. In contrast, only 10% of the total number of teachers express an opposing view. This indicates strong support for the statement among the respondents.

4. DISCUSSIONS

The results of this study clearly demonstrate that the use of games in mathematics instruction at the primary education level is perceived positively by the vast majority of classroom teachers. Integrating games as a teaching strategy is not merely a method for engaging students actively, but also an effective tool for facilitating the understanding of abstract mathematical concepts, making the learning process more enjoyable, accessible, and long-lasting. One of the key findings was that no statistically significant difference was found in teachers' perceptions of the use of games based on their years of professional experience. This suggests a broad professional consensus—regardless of teaching experience regarding the value that games bring to the teaching and learning process. It reinforces the idea that the inclusion of educational games is already an accepted and integrated practice in modern primary education.

5. CONCLUSIONS

Drawing upon both theoretical knowledge and empirical research findings, this study offers a comprehensive analysis of the significant role that games play in the learning of mathematics, providing an authentic overview of their current utilization in primary education in the Republic of North Macedonia.

The research outcomes suggest a unanimous perspective among classroom teachers that the implementation of games represents a valuable opportunity to enhance mathematics learning in classroom settings. This consensus transcends factors such as the school's location and the teacher's level of experience, emphasizing the belief that games contribute to increased student activity and facilitate a more accessible acquisition of knowledge in the classroom.

Conclusion from the Main Hypothesis: The systematic integration of educational games in primary mathematics instruction has a positive impact on students' learning outcomes. It enhances their mathematical proficiency, fosters greater cognitive engagement, and increases their overall satisfaction with the learning process. Game-based learning proves to be an effective pedagogical strategy for making mathematical concepts more accessible and enjoyable for young learners.

Conclusion from Special Hypothesis 1: The use of games in teaching mathematics differs across grade levels (I–V), indicating that teachers adapt the type and frequency of game-based activities according to the developmental needs and curricular requirements of each grade. This variation suggests that games are a flexible instructional tool that can be tailored to suit learners' age and skill levels.

Conclusion from Special Hypothesis 2: Mathematics teachers recognize and affirm the success of students when classroom teachers incorporate games into instruction. This consensus supports the view that games contribute not only to student engagement but also to improved performance in mathematics, validating their role as an effective supplementary teaching method.

Conclusion from Special Hypothesis 3: Games are widely used by classroom teachers in mathematics instruction regardless of their workplace location (urban or rural) and their professional experience. This indicates a broad acceptance and application of game-based learning across diverse educational settings, highlighting its universal appeal and effectiveness as a pedagogical approach.

Recommendations for teachers: Based on the findings and analysis of this study regarding the use of educational games in teaching mathematics at the primary level, the following recommendations are proposed for classroom and mathematics teachers:

- **Integrate games regularly into mathematics instruction:** Teachers should incorporate educational games as a consistent part of their teaching practice to foster engagement, motivation, and deeper understanding of mathematical concepts.
- **Align games with learning objectives**: Games should be selected or designed in alignment with curriculum goals and specific learning outcomes to ensure they serve a clear instructional purpose.
- **Use games to differentiate instruction**: Teachers are encouraged to adapt games to meet the diverse needs of students, including different learning styles, abilities, and interests, ensuring inclusivity in the classroom.
- **Encourage collaborative learning through games**: Game-based learning offers a valuable opportunity to promote teamwork, peer learning, and communication skills among students. Teachers should design or choose games that encourage cooperation.

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