Game for improving mathematic (+-×÷) recognition of 8-10 year old student

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Abstract. The subjects/samples of the study is students aged 8-10 years old in Lixin Primary School in Zaozhuang City, with a total of 40 students. The research methodology adopts the literature research method to understand the theoretical foundation and current research status of educational game design and application. The controlled experimental method was used to conduct a one-week experimental study on 40 students in two classes, including the experimental group and the control group, and finally the results of the pre-test and post-test of the experimental and control groups were analysed in a multi-dimensional way to provide data support for the study. It was found that the students in the experimental group showed significant improvement in correctness in addition, subtraction, multiplication and division and overall arithmetic ability as compared to the control group. The experimental group had a significant advantage in the speed of doing the problems, with an average reduction of about 0.2 minutes in the completion time and a 5% increase in the arithmetic speed index. Game-based teaching can effectively improve primary school students' ability to add, subtract, multiply, divide and overall arithmetic ability.

Keywords: Arithematics skills, Primary school children, Teaching through play, Addition, Subtraction, Multiplication and division, Maths games

1 Introduction

In China, maths is a core subject in compulsory education and mastery of arithematicsoperations is crucial. However, traditional teaching cannot meet the needs of all students, especially those who have difficulties in learning mathematics. Educational games are a potential solution as they enhance motivation, self-confidence, and cognitive abilities. Game-based instruction can improve students' arithematicsskills.

Jagust et al. (2017) focused on the development of mathematical games for primary school students, which enhance students' understanding and retention of mathematical concepts, and increase their interest in learning through the introduction of competitions and reward mechanisms.[6] Cruz et al. (2018) developed a mobile game for practising reasoning in arithematicsoperations that Highlighting the role of games in developing students' problem solving and reasoning skills, emphasising the effectiveness of the game and the user experience.[4]Hart et al. (2020) designed a game called Riskio to

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address the limitations of cybersecurity games in active learning environments, allowing players to take on both attacking and defending roles and make strategic decisions related to cyber-attacks and defences.[5]Kouhi & Rahmani (2022) improved preschool children's conceptual understanding of multiplication through gamified design.[7]Bahauddin et al. (2019) examined teachers' and prospective teachers' perceptions of mobile maths games, emphasising the role of teachers in gamified instruction and the integration of gamified design into classroom practice.[2] Costa et al. (2020) focus on gamified learning applications based on augmented reality platforms that incorporate virtual elements into the real world to increase student learning engagement and depth of understanding.[3]Laato et al. (2017) applied mathematical game applications in Finnish primary schools, confirming the effectiveness of gamified design to stimulate students' learning interest and engagement.[10]Arias (2014) analysed the potential of video games in education, noting that games can develop problem solving skills and creative thinking.[1] Koutromanos (2020) explored the use of mobile games in primary education, highlighting the effectiveness of increasing student motivation and engagement. [8]Kyriadikes et al. (2016) described the use of a mobile technology-based game application for mathematical learning that enhanced mathematical comprehension and problem solving skills.[9]This study aimed to assess the arithematics skills of 8-10 year old students and to design an educational game to improve their arithemat-ics skills. The aim is to provide a relaxing and enjoyable learning envi-ronment to help students who have difficulties in maths to improve their performance. By implementing this study, we hope to discover an ef-fective way to help struggling students and improve their arithematics skills.

2 Conclusions

Table 1. Pre-test scores of the experimental and control groups

arithematics test	Experimental group pre-test		Control group pre-test		t	p
	Average value	Standard deviation	Average value	Standard deviation		
Addition	1.900	0.700	1.950	0.740	-0.220	0.827
Subtraction	2.000	0.707	1.950	0.805	0.209	0.836
Multiplica-tion	1.950	0.669	2.050	0.740	-0.448	0.656
Division	1.850	0.654	1.850	0.726	0.000	1.000
Total score	7.700	1.552	7.800	1.720	-0.193	0.848
Average answer time	4.25		4.45			

Table 1 shows that the p-value of the experimental group and the control group in the pre-test of the math computational ability test is 0.848, which is greater than 0.05, and the difference is not significant, and the two groups of students are homogeneous.

Table 2. Post-test scores of experimental and control groups

arithematics test	Experimental group pre-test		Control group pre-test		t	p
	Average value	Standard deviation	Average value	Standard deviation		
Addition	2.95	0.218	2.7	0.458	2.204	0.034
Subtraction	2.6	0.490	2.1	0.700	2.617	0.013
Multiplication	2.9	0.436	2.65	0.477	1.730	0.092
Division	2.25	0.433	1.6	0.663	3.671	0.001
Total score	10.7	0.714	9.05	1.322	4.883	0.000
Average answer time	4		4.35			

Table 2 shows that the calculation of division, the difference between the control group and the experimental group was large ($P < 0.005$), and there was also a significant difference between the control group and the experimental group in terms of total scores ($P < 0.005$), while in other calculations, the experimental group's performance was significantly higher than that of the control group.

Table 3. arithematicsspeed for primary school students

	PRE-TEST		**POST-TEST**	
	Experimental group	Control group	Experimental group	Control group
TOTAL TIME	85	89	80	87
AVERAGE TIME SPENT	4.25	4.45	4	4.35
ARITHEMATICSSPEED INDEX	2.824	2.697	3.000	2.759

Table 3 shows that the experimental group improved their computational speed in the posttest by about 6.22% while the control group improved by 2.30%. This indicates that the improvement in arithmetic speed of the primary school students in the experimental group was more significant and greater as compared to the control group.

Table 4. Comparison of arithematicscorrectness

Comparison of arithematicscorrectness			
Pre-test		Post-test	
Experimental group	Control group	Experimental group	Control group
0.642	0.650	0.892	0.754

Table 4 shows that the increase in the percentage of correct mathematical operations of the pupils in the experimental group is 0.250 and in the control group is 0.104

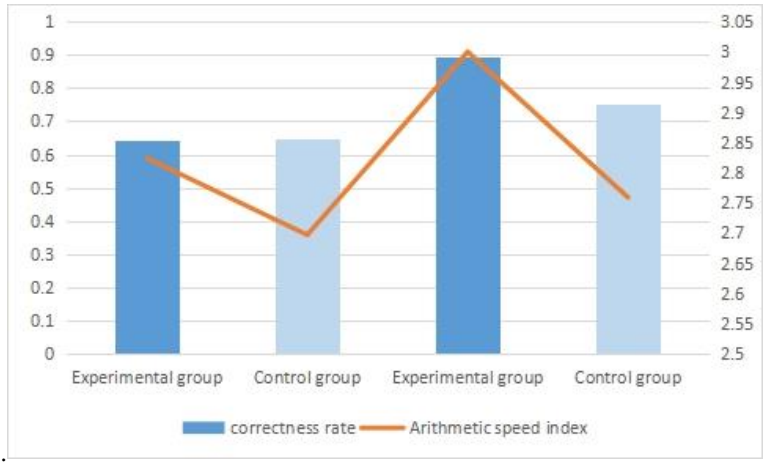

Fig. 1. Pre- and post-test arithematicscorrectness and arithematicsspeed index of the experimental and control groups

Fig. 1 shows that the arithematicsability of the experimental group which has been taught with the game has improved more substantially than the control group which has not been taught with the game, both in terms of arithematicsspeed and the correct rate of arithematicshave improved significantly. In terms of the correct rate, the experimental group's improvement is more prominent.

The increase in the percentage of correct math operations of elementary school students in the experimental group was more significant compared to the control group.

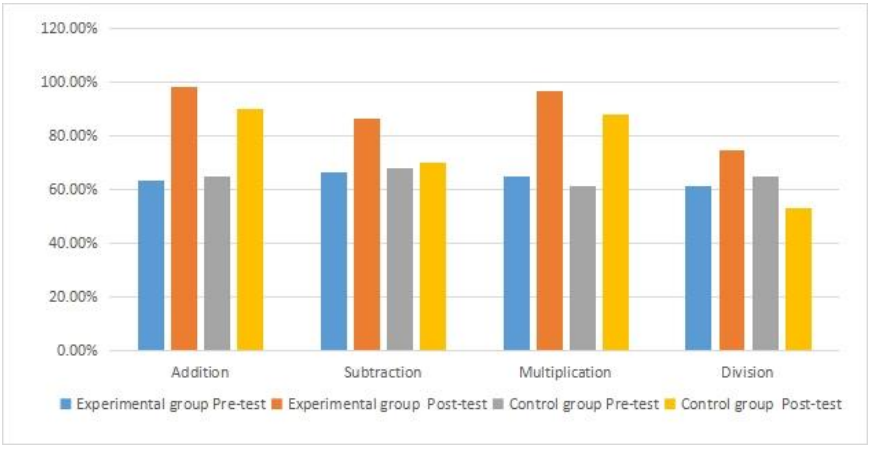

Fig. 2. Pre- and post-test correctness in addition, subtraction, multiplication and division for the experimental and control groups.

Fig. 2 shows that the graph that the correct rate of addition calculation of the experimental group is significantly higher than that of the control group, the correct rate of

subtraction calculation of the experimental group is also significantly higher than that of the control group, the correct rate of multiplication calculation of the experimental group is slightly higher than that of the control group, and the correct rate of division calculation of the experimental group is significantly higher than that of the control group, which indicates that the calculation ability of the experimental group has been significantly improved. Taken together, compared with the control group, the experimental group showed an advantage in the correct rate of all four operations of addition, subtraction, multiplication and division, and the progress was more obvious. This indicates that the game training received by the experimental group helps to improve primary school students' mathematical calculation ability to a certain extent.

Taken together, compared with the control group, the experimental group showed an advantage in the correct rate of all four operations of addition, subtraction, multiplication and division, and the progress was more obvious. This indicates that the game training received by the experimental group helps to improve the math calculation ability of primary school students to a certain extent.

This experiment showed that the Maths Computation Enhancement Game designed for 8-10 year old students had a significant effect on addition, subtraction and multiplication calculations, and was able to effectively improve the correctness and speed of students' calculations. However, the game's enhancement effect on division calculation is relatively small and needs further improvement. In addition, compared to the control group, the game training showed potential in improving students' mathematical calculation ability, especially in addition and multiplication calculations. The experimental group showed greater correctness and computational speed improvement in all calculations, suggesting that the game has a positive impact on improving students' mathematical computational ability.

The findings of this study have important implementation value for rel-evant educators, schools and educational institutions.

For educators in the field of maths education for primary school students, the results of this study provide them with an innovative ap-proach to teaching. Teachers can introduce similar mathematical com-putation skills enhancement games into their teaching to stimulate stu-dents' interest and improve their speed and correctness in mathemati-cal operations.

Schools and educational institutions can consider incorporating maths arithematics enhancement games into their curriculum as an additional teaching resource. By introducing this game after school hours or in classroom activities, students can not only improve their mathematical computation skills, but also increase their interest and engagement in the subject of mathematics.

The findings of this study can also serve as a reference for edu-cation policy makers. In the process of formulating and implementing educational policies, they can consider incorporating similar mathemat-ical computation skills enhancement games into educational resources in order to promote the overall enhancement of students' mathematical skills.

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