

## THE IMPACT OF INSTRUCTIONAL GAMES IN INCLUSIVE CLASSROOMS ON STUDENTS' LEARNING OUTCOMES

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**Abstract.** This study explores the influence of games on mathematics in inclusive classrooms and its effects on the learning outcomes of both typical children and children with special educational needs. In the context of research, a comprehensive review of international scientific literature on the use of educational games in the learning process is conducted. The study then proceeds to assess the practical impact of games on student learning outcomes by implementing a range of desktop, active, and card games in experimental classes within mainstream schools that practice inclusive education. Simultaneously, the study categorizes these classes into control and experimental groups to analyze and compare student learning outcomes, employing various research methods and tools for measurement.

**Keywords:** use of games in training, didactic games, game-based training, organization of training in inclusive classes.

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## İNKLÜZİV SINIFLƏRDƏ OYUNLARDAN İSTİFADƏNİN ŞAĞİRDƏLƏRİN TƏLİM NƏTİCƏLƏRİNƏ TƏSİRİ

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**Annotasiya.** Bu məqalədə inklüziv siniflərdə riyaziyyat fənnini tədrisində oyunların tipik uşaqların və sağlamlıq imkanları məhdud olan uşaqların təlim nəticələrinə təsiri araşdırılır. Bunun üçün təlim prosesində tədqiqatçı oyunlardan istifadənin aktuallığı barədə beynəlxalq elmi ədəbiyyat nəzərdən keçirilir. Şagirdlərin təlim nəticələrinə oyunların təsirinə təcrübədə ölçülməsi üçün tədqiqat çərçivəsində inklüziv təhsili həyata keçirən ümumtəhsil məktəblərində eksperimental siniflərdə müxtəlif masaüstü, hərəkətli və şəkilli kartlarla oyunlar tətbiq edilmişdir. Eyni zamanda, təlim nəticələrinin təhlil olunması üçün tədqiqata cəlb olunmuş məktəblərdə siniflər kontrol və eksperimental qruplara bölünərək, müxtəlif tədqiqat metodlarından istifadə olunaraq şagirdlərin təlim nəticələri ölçülür və müqayisə olunur.

**Açar sözlər:** oyunların təlimdə istifadə olunması, didaktik oyunlar, oyun əsaslı təlim, inklüziv siniflərdə təlimin təşkili, təlim nəticələri.

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## **Introduction / Giriş**

The Republic of Azerbaijan ratified the Convention on the Rights of Persons with Disabilities in 2008. The adoption of the Convention spurred numerous reforms aimed at enhancing the well-being of individuals with disabilities within the country. One of the Convention's paramount requirements for society is the prevention of discrimination against persons with disabilities and the promotion of their integration into society [The Convention on the Rights of Persons with Disabilities., 2006].

The international community has incorporated the concept of inclusive education into pedagogy and educational legislation, emphasizing that the education of persons with disabilities (children with special educational needs), should take place in mainstream educational institutions alongside their peers rather than in segregated special schools. To facilitate the implementation of inclusive education, mainstream schools have adjusted their infrastructure, improved the pedagogical competence of teachers, and customized instructional materials to meet the specific needs of children with special educational needs.

While the concept of inclusion in education is widely embraced by the public, it can be challenging to implement traditional instructional methods and principles effectively in inclusive classrooms. This challenge arises from the varying developmental levels of students in inclusive settings, as noted by Clyde P. in 2013. Consequently, in schools that adhere to traditional instructional methods, children with special educational needs may be isolated from classmates within the instructional process, even though they are physically present in the same classroom as their peers (Clyde P., 2013). In such cases, children with special educational needs may have limited opportunities to interact with their peers, aside from brief encounters during school entry, dismissal, and breaks between lessons. As a result, children with special educational needs spend only 13% of their time at school in direct interaction with their classmates. Given that the learning process typically occupies an average of 87% of students' time in school, it becomes evident that these sporadic interactions during recess and breaks may not suffice for the development of their emotional and social inclusion in the social environment.

In light of the aforementioned challenges, experts in the field of education are actively exploring instruction methods suitable for use in inclusive classrooms. Numerous researchers have highlighted the effectiveness of utilizing games as a method to actively engage students in lessons and tailor content to their needs. This approach has been emphasized in several scientific works, including those

by Trajkovik V., Malinovski T., Vasileva-Stojanovska T., and Vasileva M. (2018), Loreman, T., Deppeler, J., and Harvey, D. (2005), as well as Thiagarajan, S. (1976).

Despite the positive opinions of many researchers regarding the effectiveness of using games in inclusive classes and the examples provided by teachers in their own practice, R. Hays pointed out in his 2005 technical report that no substantial research had been conducted to measure the positive impact of games on the quality of instruction. Consequently, there is a lack of empirical data on the effects of games on instructional quality; the available information relies solely on the subjective opinions of the authors.

### **Main part / Əsas hissə**

To assess the impact of using games on the quality of instruction, a study was conducted in six inclusive 1st-grade classes across three general education schools in Baku. In the context of this research, during the second semester of the 2022-2023 academic year, three experimental classes were identified. Following the annual curriculum, the researcher adapted and implemented 32 different instructional games in these experimental classes, covering the following mathematical topics:

1. Seven instructional games on geometric figures (planar and spatial),
2. Seventeen instructional games on the addition (up to 20),
3. Twelve instructional games on the subtraction (up to 20).
4. Three educational games related to counting (up to 100)

Additionally, didactic materials were prepared to accommodate the number of students for the instructional games.

To ensure the research's objectivity, three control classes taught using traditional instructional methods were selected in target schools, and the students' learning outcomes in these classes were assessed alongside those in the experimental classes. The assessment took place both before the subjects instruction (pre-test) and at the end of it (post-test).

A standardized test known as "Test mathematischer Basiskompetenzen ab Schuleintritt (MBK 1+)," developed by German experts for assessing the mathematical learning outcomes of elementary school students, was employed to evaluate the students learning achievements in the four specified subjects [Ennemoser, M., Krajewski, K., Sinner, D., 2017]. The test tasks related to the four mentioned topics from the standardized tests were adapted to the local context. Templates were created and subsequently probated and approved with 67 students enrolled in the 1st inclusive classes of the mainstream school in Baku. Based on the ap-

proval results, necessary adjustments were made and incorporated into both the experimental and control classes where the research was conducted. Simultaneously, considering the developmental levels of students with special educational needs in inclusive classes, modifications were made to the test tasks to better assess their learning outcomes. Specifically, operations involving addition up to 10, subtraction up to 10, and counting of numbers up to 20 were streamlined. Furthermore, an additional straightforward test task related to counting numbers up to 100 has been added.

Students could attain a maximum of 7 points in the test on geometric figures, 20 points in the test on addition operations, 20 points in the test on subtraction operations, and 4 points in the counting numbers test.

Typically developing students were allocated 5 minutes to complete the geometric figures test, 1 minute and 20 seconds each for the addition and subtraction tests, and 5 minutes for counting up to 100. The time allocation for task completion was determined based on the “Test mathematischer Basiskompetenzen ab Schuleintritt (MBK 1+)” There is no specified time limit for children with disabilities to complete the test tasks.

From the test results, data was gathered not only on the number of correct answers provided by students but also on their incorrect responses and unanswered questions. The aim of collecting this data is to facilitate the comparison of the mathematical problems that students were unable to solve with those they attempted but arrived at incorrect conclusions.

During the study period, there were challenges related to student attendance due to seasonal illnesses affecting the schools. Consequently, it was not feasible to secure full student participation when conducting tests to assess their learning outcomes. Additionally, considering the smaller number of students with special education needs in the classes, children from this group took part in the assessments of their learning outcomes conducted by psychologists of schools on an individual basis, even if they faced attendance difficulties when coming to school.

### **Analysis of the assessment of learning outcomes in the subject of mathematics in the targeted classes.**

In total, 163 students participated in the tests conducted over six weeks, comprising 78 girls and 85 boys. Among the students who took part in the tests, 12 of them (4 girls and 8 boys) are children with special educational needs who are enrolled in inclusive classes (see Table 1).

**The number of students participated in the evaluation of learning outcomes**

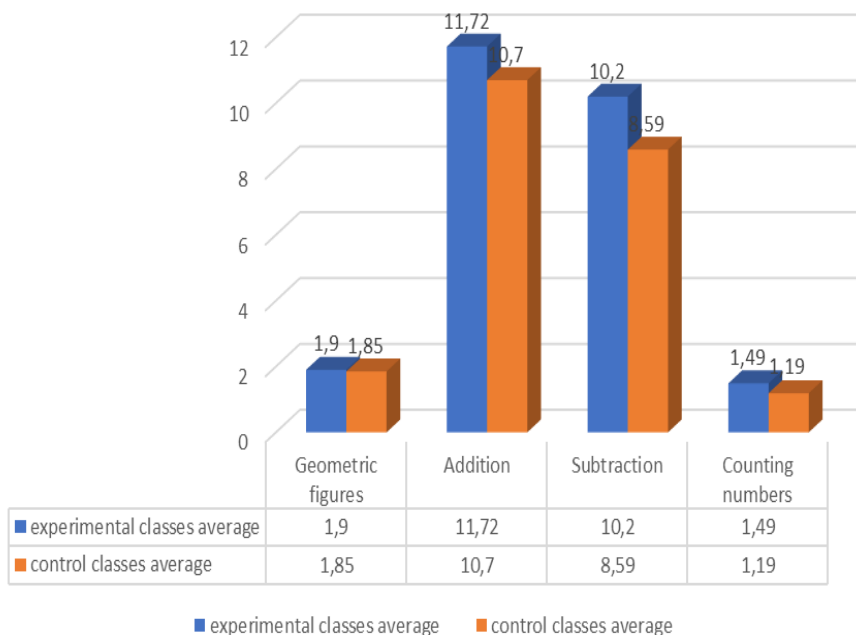
Table 1

Subject	Phase of test	Target group of research	Number of participants
“Geometric figures”	Pre-test	Typical children	140
		Children with special educational needs	12
		Total	152
	Post-test	Typical children	141
		Children with special educational needs	12
		Total	153
“Addition (up to 20)”; “Subtraction (up to 20)”; “Counting of numbers (up to 100)”	Pre-test	Typical children	144
		Children with special educational needs	12
		Total	156
	Post-test	Typical children	143
		Children with special educational needs	12
		Total	155

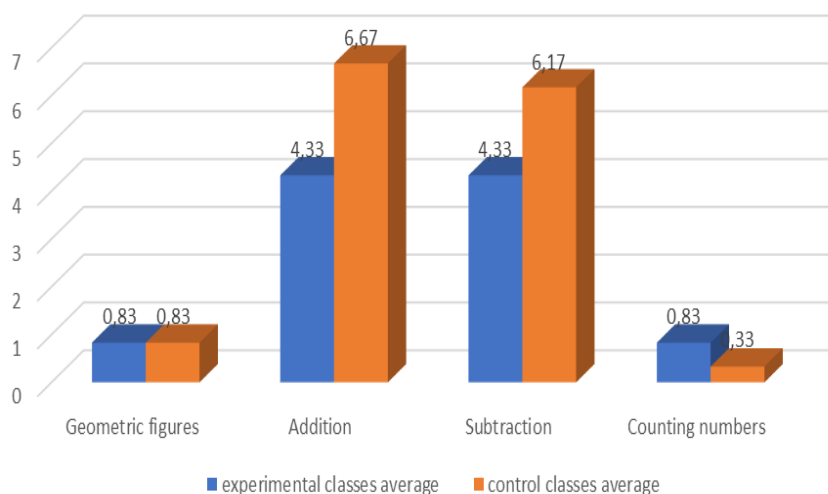
The pre-test and post-test for “geometric figures” were scheduled on separate dates from the tests for the other three subjects. When the tests were probated, it was observed that assessing the knowledge levels of 1st-grade students in all four subjects of “Mathematics” simultaneously posed a challenge for the children. Therefore, preliminary and final tests were conducted in the classes before and at the conclusion of the instruction on “geometric figures. Tests in the three other subjects (addition, subtraction, and counting numbers) included preliminary assessments conducted before the instruction on “addition (up to 20),” and final evaluations were conducted after the instruction on “counting numbers (up to 100)” at the conclusion of the study.

Experimental and control classes were grouped based on the preliminary test results for “geometric figures.” Consequently, the initial results of students in “geometric figures” are nearly identical between the two groups (see Charts 2 and 3).

**Pre-test results of the typical children (chart 2)**



**Pre-test results of the children with SEN (chart 3)**



The preliminary results from the classes, which were divided into control and experimental groups, were analyzed using Levene’s Test for Equality of Variance by using Independent-samples T-test in the SPSS statistical program. Based on the results, it was determined that there was no statistically significant difference between the initial test scores of typically developing students in both the experimental and control classes regarding the subjects of “geometric figures,” “addition (up to 20),” and “counting numbers up to 100” (P-value > 0.05). At the same time, it was determined that the knowledge level of students in the experimental classes regarding the topic of “subtraction (up to 20)” before the subject was taught was statistically significantly different from the knowledge level of the control classes (P-value 0.035) (Table 4).

According to the curriculum, the topics “geometric figures (spatial figures),” “addition (up to 20),” “subtraction (up to 20),” and counting numbers (up to 100) should be taught to first-grade students during the second half of the academic year [General education standards and curriculum, p. 5]. During preliminary test it was revealed that these subjects are typically taught during the preschool period. Regrettably, the current teaching approach does not consider the developmental stages and age-specific characteristics of preschool children. As a result, although a small number of students have displayed a high level of competence in these subjects, the majority of them have demonstrated significant challenges in the preliminary assessment, often providing incorrect answers.

**Independent Samples Test (typical children) table 4**

Pre-test	“ Levene’s Test for Equality of Variances ”		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Differ- ence	Std. Error Dif- ference	95% Confidence Interval of the Difference)	
								Lower	Upper
geometric figures	10.897	.001	.237	138	.813	.053	.225	-.392	.499
addition (up to 20)	4.426	.037	1.207	142	.230	1.024	.849	-.654	2.703
subtraction	.004	.949	2.128	142	.035	1.606	.755	.114	3.098
counting numbers up to 100	6.306	.013	1.970	140	.051	.305	.155	-.001	.611

The preliminary test results of children with special education needs studying in experimental and control classes, revealed that there is no statistically significant difference in students’ knowledge levels across the four subjects intended to be taught in the “Mathematics” “ (P-value > 0.05)



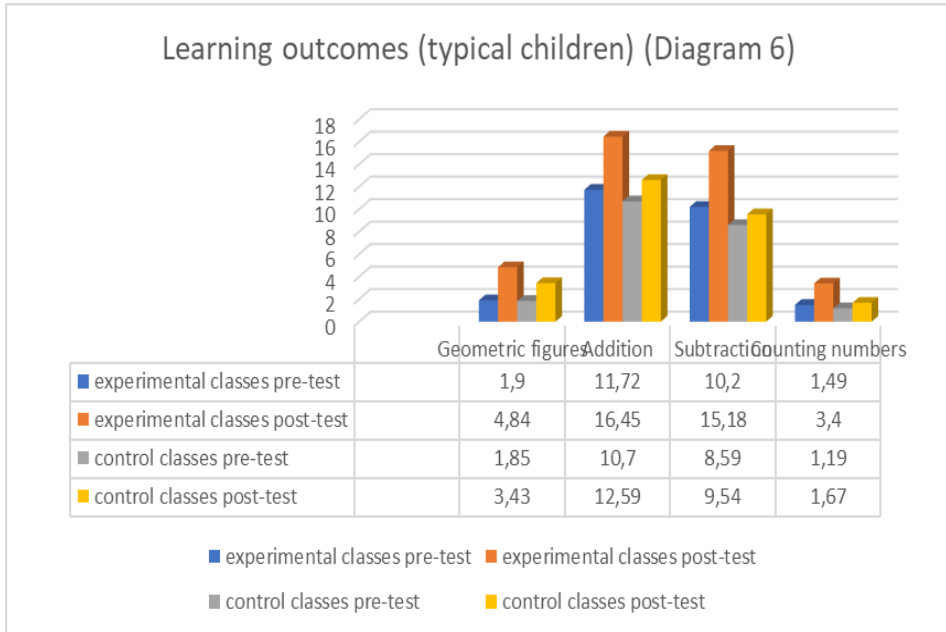
Based on the preliminary test results, it was observed that, with the exception of the topic of subtraction, the knowledge levels of both typically developing students and children with special educational needs in the experimental and control classes regarding the four subjects intended to be taught during the research period in the subject of “Mathematics” were found to be equivalent, and the disparity between them was not statistically significant (Tables 4 and 5).

**Independent Samples Test (children with SEN) (Table 5)**

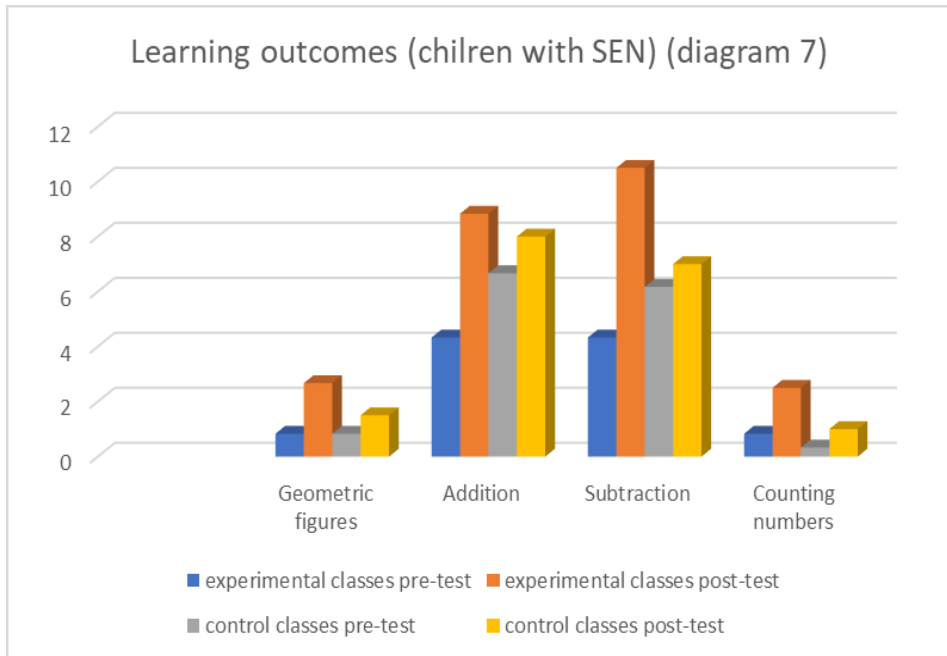
Pre-test	“ Levene’s Test for Equality of Variances ”		t-test for Equality of Means					95% Confidence Interval of the Difference)	
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	yuxarı
Geometric figures	.000	1.000	.000	10	1.000	.000	.435	-.968	.968
Addition (up to 10)	1.553	.241	-1.871	10	.091	-2.333	1.247	-5.112	.446
Subtraction (up to 10)	.694	.424	-1.718	10	.117	-1.833	1.067	-4.211	.545
Counting numbers (up to 20)	.328	.580	1.342	10	.209	.500	.373	-.330	1.330

The results of the preliminary and final tests for the four subjects taught within the “Mathematics” subject, among students in both the experimental and control classes, were analyzed using the “ANOVA” function within the SPSS program.

According to the results, there was an increase in the knowledge levels of the four mathematics subjects among typically developing and children with special educational needs in both experimental and control classes. The SPSS program was used to analyze the average scores of the initial and final tests, assessing the growth in students’ knowledge over the seven-week period. Diagram 6 and 7 presents the initial and final average scores of typically developing students and children with special educational needs in experimental and control classes for the four subjects taught.



As evident from the test results of typically developing students in both experimental and control classes, although their initial knowledge levels on the subject of “Geometric figures” were identical, their final knowledge levels differed. In the experimental classes, the increase in students’ knowledge levels for the “Geometric figures” topic, taught through games, was 2.94 points, whereas in the control classes, it only reached 1.58 points. Similarly, in the subject of “Addition (up to 20),” the experimental classes exhibited a substantial improvement of 4.74 points, while the control classes saw a more modest increase of 1.89 points. Notably, students in the experimental classes outperformed their counterparts in the control classes across other subjects taught through games, indicating higher learning outcomes. Specifically, typically developing students in the experimental classes demonstrated a significant positive shift of 4.98 points in their knowledge of the “Subtraction (up to 20)” subject, compared to a mere 0.95-point increase among students taught using traditional instructional methods in the control classes. Additionally, while the initial results of students in the experimental classes for the “Counting numbers (up to 100)” subject were nearly identical to those in the control classes, there was a notable improvement of 2 points in the experimental group’s learning outcomes, whereas the control group only showed a minimal development of 0.48 points (Diagram 6).



The educational outcomes of children with special educational needs in experimental and control classes are depicted in Diagram 7. In the experimental classes, the average improvement in learning outcomes for children with special educational needs in the subject of “geometric figures” was 1.84 points, whereas it was only 0.67 points in the control classes. For the subject “addition (up to 10),” the experimental classes exhibited a significant difference of 4.5 points between the pre-test and post-test, while the control classes showed a more modest improvement of 1.33 points. Regarding the final subject, “counting numbers up to 20,” the experimental classes demonstrated an average positive difference of 1.67 points. In contrast, children with special education needs in the control classes only exhibited an average increase of 0.67 points in their learning outcomes during the study.

Throughout the research period, overall improvement was observed in the educational outcomes of both typically developing and children with special educational needs across the four subjects in “Mathematics” when taught through games in the experimental classes and with traditional instructional methods in the control classes. Through the use of “average scores,” it was uncovered that the educational outcomes of students in both categories studying in experimental classes surpass those of students in control classes. Based on the results of the final tests, it is evident that the difference between the initial and final tests is more

pronounced in the experimental classes and less noticeable in the control classes. However, it remains uncertain whether this difference is statistically significant. To assess the statistical significance of the difference in learning outcomes between students in the experimental and control classes, the final test results from both groups' students were analyzed by the Levene's Test for Equality of Variance method with using the Independent-samples T test. The results of typically developing students and children with special educational needs were analyzed separately. Based on the analysis results, it was determined that the outcomes in the experimental classes, where instructional games were implemented, significantly differed from the control classes, where traditional instructional methods were employed (Table 8 and 9).

When assessing the initial learning outcomes of typically developing students in both experimental and control classes, it was observed that the results for the three subjects did not exhibit statistically significant differences, except for the subject of "Subtraction (up to 20)." Following the final tests, it was identified that the difference between the experimental and control groups across the four subject is statistically significant (Table No. 8). By observing that the learning outcomes in the experimental classes are higher, it has been demonstrated that the positive difference is attributed to the use of games.

**Independent Samples Test (typical children) (table № 8)**

	" Levene's Test for Equality of Variances "		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference)	
								Lower	Upper
Geometric figures (pre-test)	10.897	.001	.237	138	.813	.053	.225	-.392	.499
Geometric figures (post-test)	.055	.815	5.558	139	.000	1.411	.254	.909	1.913
Addition (pre-test)	4.426	.037	1.207	142	.230	1.024	.849	-.654	2.703
Addition post-test	26.628	.000	4.796	142	.000	3.832	.799	2.253	5.412
Subtraction (pre-test)	.004	.949	2.128	142	.035	1.606	.755	.114	3.098
Subtraction (post-test)	7.687	.006	7.792	144	.000	5.651	.725	4.218	7.085
Counting numbers (pre-test)	6.306	.013	1.970	140	.051	.305	.155	-.001	.611
Counting numbers (post-test)	9.009	.003	12.185	140	.000	1.717	.141	1.438	1.995

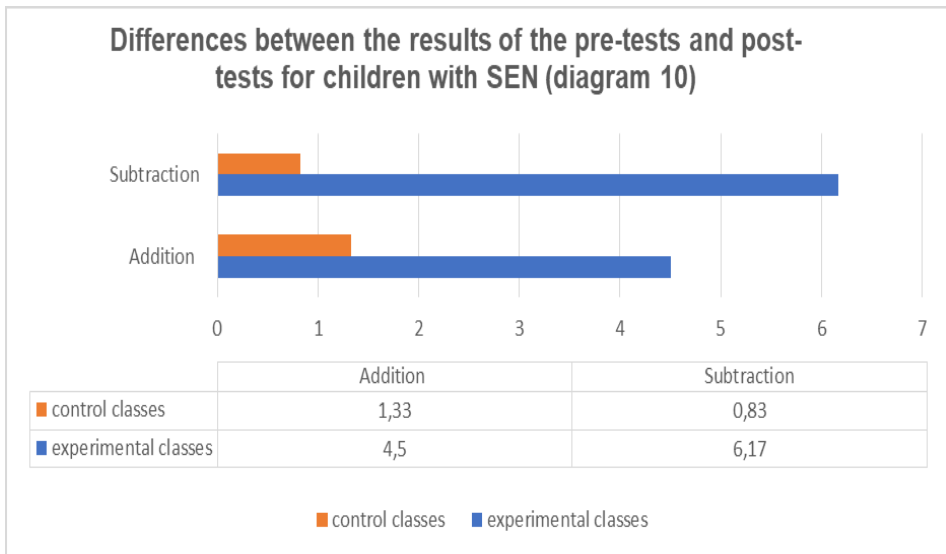
When the final test results of children with special educational needs were analyzed using the Levene's Test for Equality of Variance method with the Independent-samples T-test, it was found that there is a statistically significant difference in the educational results of students in the experimental and control classes in the subjects of "Geometric Figures" and "Counting Numbers" (up to age 20). At the same time, it was determined that there is no statistically significant difference in the educational results of students studying in experimental and control classes in the subjects of "Addition" and "Subtraction" (Table 9)."

<b>Independent Samples Test (children with SEN) (table № 9)</b>									
	"Levene's Test for Equality of Variances"		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference)	
								Lower	Upper
Geometric figures (pre-test)	.000	1.000	.000	10	1.000	.000	.435	-.968	.968
Geometric figures (post-test)	1.509	.247	2.907	10	.016	1.167	.401	.272	2.061
Addition (pre-test)	1.553	.241	-1.871	10	.091	-2.333	1.247	-5.112	.446
Addition post-test	1.144	.310	.653	10	.528	.833	1.276	-2.009	3.676
Subtraction (pre-test)	.694	.424	-1.718	10	.117	-1.833	1.067	-4.211	.545
Subtraction (post-test)	1.359	.271	2.049	10	.068	3.500	1.708	-.305	7.305
Counting numbers (pre-test)	.328	.580	1.342	10	.209	.500	.373	-.330	1.330
Counting numbers (post-test)	1.538	.243	3.503	10	.006	1.500	.428	.546	2.454

It is important to note that in Table 7, significant positive dynamics in the educational results of students with special educational needs studying in experimental classes are observed. The difference between the initial and final test scores in the subject of "Addition" was 1.33 points in control classes compared to 4.5 points in experimental classes. In contrast, for the subject of "Subtraction," the difference was 6.17 points in the experimental classes, while control classes only achieved a 0.83-point increase. The reason the statistical significance of the two

subjects between the experimental and control classes has not been determined is that the initial results in the control classes were higher. Furthermore, the limited number of children with special educational needs (a total of 12 children) is not conducive for analysis in the SPSS statistical program. When the results of the initial and final tests of children with special educational needs were analyzed, it was observed that children studying in experimental classes had lower initial scores than students in control classes in three subjects (“geometric figures,” “addition,” and “subtraction”). However, after participating in the game-based instruction, children from the experimental classes showed higher improvements compared to those from the control classes over the course of 7 weeks.

The difference between the initial and final test results of children with special needs is presented in diagram form to enhance comprehension of the teaching quality of “Mathematics” in both the experimental and control classes that were part of the study (Diagram 10).



### Conclusion \ Nəticə

As a result of the research, it was determined that when mathematics subjects are taught using a variety of desktop games, card games and active games, students achieve higher learning outcomes compared to those taught using traditional instructional methods.

To demonstrate the positive impact of games on students’ learning proficiency, it was determined, based on the preliminary test results comparing experimen-

tal and control classes, that there is no significant statistical difference (indicating that the level of knowledge among students in both control and experimental classes is similar). “Based on the results of the final tests, it was observed that the educational outcomes in the experimental classes, which included typically developing students and children with special educational needs, exhibited varying degrees of positive progress when compared to the students in the control classes. According to the results of the final tests, the educational outcomes of typically developing students studying in experimental classes across four subjects are statistically significantly different from the outcomes of students in control classes. The difference between the final results of the children with special educational needs studying in the experimental classes and the learning outcomes of students in the same category in the control classes for two subjects (“geometric figures” and “counting numbers”) was statistically significant. Although the statistical significance of the difference in the other two subjects (“addition (up to 10)” and “subtraction (up to 10)”) was not established due to the limited number of children with special educational needs participating in the research (only 12 individuals) and the high initial results of the students in the control classes, it was determined that by analyzing the average difference between the initial and final test results, the educational outcomes of children with special educational needs studying in experimental classes were superior to those in control classes.

Based on the aforementioned findings and the learning outcomes, it was determined that the use of games in teaching mathematics in experimental classes has a positive impact on the learning results of students with varying levels of development. Furthermore, it has been demonstrated that adapting the curriculum to the students' needs and promoting active participation, which serves as an indicator of the quality of education in inclusive classrooms, positively influences students' comprehension of lesson content and leads to improved learning outcomes.

### **The relevance of the article**

Since 2020, the educational legislation of the Republic of Azerbaijan has embraced the concept of inclusive education, allowing children with special educational needs to enroll in general educational institutions alongside typically developing students in the same class.

When the instructional methods typically employed in traditional (segregated) classes are applied in inclusive classes comprising students with varying developmental levels, it often results in discrimination against children with special educational needs, leading to their isolation from their classmates. Consequently, identifying effective instructional methods for organizing collaborative education among students in inclusive classes is an urgent issue in modern education.

### **The scientific novelty of the article**

This study analyzes the learning outcomes of children with special educational needs studying in inclusive classes, compares them with typically developing students, and assesses the positive impact of using games in teaching subjects on the quality of learning.

### **The practical importance of the article**

The results of the empirical research described in the article will offer scientific and methodical support for the organization of education in inclusive classes.

## **Literature / İstifadə olunmuş ədəbiyyat**

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