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The Use of Physical Education to Improve Arithmetic Skills among Primary School Pupils

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Abstract:

The study aimed to reveal the effectiveness of physical education in improving the arithmetic skill of primary school students , And to know the extent to which this sport affects the results of the arithmetic test, Where the study sample consisted of 20 male and female students, distributed into two groups: The experimental group, whose members received practice on sports to improve the skill of arithmetic, And the control group did not receive its members practice on sports to improve the skill of arithmetic, taking the pre-measurement of the arithmetic test multiplication operations on the two groups, and the experimental group was practiced on sports to improve the skill of arithmetic for teen shares, and after the end of the work quotas, the post-measurement was taken to test the arithmetic multiplication operations on the two groups, Then we compared the two groups in the pre- and post-measurement, where the results showed:

-The presence of a statistically significant difference in the scores of the arithmetic test between the experimental and control groups in the dimensional measurement, in favor of the experimental group.

- There is a statistically significant difference in the scores of the arithmetic test between the pre- and post-measurements of the experimental group, with high test scores in the post-measurement.

Keywords: Educational Games in Physical Education ،Mathematics

1. Introduction

Computation is considered one of the essential mathematical skills that modern curricula emphasize developing among pupils at all levels of primary education, due to its importance in everyday life. Many real-life situations require learners to provide approximate answers to certain operations in order to solve problems they encounter. When learners succeed in giving correct answers, they experience confidence resulting from their ability to use computational skills appropriately and effectively.

Play, on the other hand, is one of the most valuable learning opportunities that contribute to the child's development, acquisition of experience, and exploration of the surrounding world. It serves as a tool for expression, and thus can be employed in educational situations—whether individually or collectively—according to learners' developmental characteristics, through the use of educational games. Educators constantly seek the best ways to create an interactive learning environment that captures learners' attention and enhances their motivation.

Mathematics, being an abstract subject, has often been accused of rigidity, boredom, and lack of connection with real life. Most primary school learners struggle with computational skills, as they are unable to perform operations quickly—especially multiplication—which they need in daily life. This accusation is reinforced by traditional teaching methods that lack excitement and enjoyment, which negatively affect pupils' achievement in mathematics.

According to studies related to educational games (Youssef, 2007, p. 36), one study investigated a *motor education program* designed to develop numerical, geometric, and arithmetic concepts among preschool children. The researchers designed a motor-based educational program that included a variety of movement games aimed at developing number concepts (such as counting), geometric concepts (shape recognition), and simple arithmetic concepts. Using an experimental design with pre- and post-testing, the sample consisted of children aged 4–6 years in kindergartens. The results revealed statistically significant differences in favor of the post-test, indicating the effectiveness of motor activities in supporting the learning of numerical, geometric, and arithmetic concepts (Faiza, 2011/2012, p. 25).

Another study examined *learning through play* using motor games and mathematics. The aim was to integrate physical movement with play activities to enhance motor control and develop simple arithmetic skills among first-grade pupils. The results revealed significant differences in both motor and cognitive performance (Mohamed, 2009, p. 41).

A third study addressed *quasi-sport games* and the development of motor skills. It focused on how structured play—conducted within an educational environment but involving tangible movement—can foster motor skills and educational values among pupils. The results indicated that organized practice is more beneficial than random free play, and that *mini-games* help develop perceptual–motor awareness through mathematics (Kebsi, 2008, p. 45).

Moreover, Ben Sassi Ridouane and El-Antri Mohamed Ali implemented an educational program using small games during physical education classes to address learning difficulties and enhance perceptual–motor development among middle school pupils. The results demonstrated improvements in cognitive and motor skills within the physical education context, and a reduction in hyperactivity (Fayad, 2011, p. 36).

2. Research Problem

In an effort to improve teaching methods and strategies that increase learners' motivation and bridge the gap between abstract theoretical knowledge and concrete application, this study seeks to make learning more engaging and enjoyable. This would allow pupils to apply mathematical knowledge to various life situations.

Accordingly, the research problem is formulated as follows: **What is the effect of proposed educational games in physical education on developing computational skills among fourth-grade pupils—using multiplication lessons as a model?**

3. Research Questions

a. Is there a significant difference in arithmetic test scores between the experimental and control groups in the post-test?
b. Is there a significant difference in arithmetic test scores between the pre- and post-tests within the experimental group?

4. Research Objectives

a. To verify the effectiveness of educational games in physical education in developing computational skills among fourth-grade pupils.
b. To propose a set of educational games in physical education that contribute to developing computational skills—specifically multiplication lessons—as a model.

5. Operational Definitions

a. Educational games in physical education:

An instructional program based on specific procedures and game rules designed to achieve educational objectives, particularly the development of computational skills (multiplication operations). The teacher's role is supervision, guidance, and facilitation. This refers to the *adapted educational games program in physical education for learning multiplication tables* designed by the researcher.

b. Mathematics:

A subject included in the national curriculum prepared by the Ministry of National Education, encompassing arithmetic and geometry.

c. Computational skill:

Measured by the score obtained by the learner in the arithmetic test (multiplication operations) integrated within the educational electronic game implemented by the researcher.

d. Multiplication lessons:

The knowledge and understanding acquired by the learner through practicing multiplication operations in order to apply them—represented in the exercises included in the educational electronic game.

e. Fourth-grade pupil:

A student aged between 9 and 10 years who regularly attends the fourth grade of primary school.

6. Research Delimitations

a. Spatial boundaries:

Two primary schools in the Wilaya of Mostaganem were selected due to the administrative facilities provided.

b. Temporal boundaries:

The entire first semester of the 2016–2017 academic year.

7. Research Hypotheses

a. There is a statistically significant difference in arithmetic test scores between the experimental and control groups in the post-test.
b. There is a statistically significant difference between the pre- and post-tests within the experimental group, with higher scores in the post-test.

8. Research Procedures

Given the nature of the study, the **experimental method** was adopted to determine the effect of the independent variable (educational games in physical education) on the dependent variable (development of computational skills in multiplication).

The study sample consisted of two groups:

- An **experimental group** (n = 10) that practiced educational games in physical education.
- A **control group** (n = 10) that did not engage in such activities.

This design involved administering a **pre-test** to both groups to measure multiplication skills, followed by a **post-test** after introducing the experimental variable to the experimental group only.

9. Research Instruments

Two tools were used in this study:

1. **Pre-test and post-test in arithmetic (multiplication operations)**
2. **Educational games in physical education**

The arithmetic test was adapted from the *Multiplication Lessons Achievement Test* developed by **Obaid Al-Harbi**, as presented in his PhD dissertation in Mathematics Education at *Umm Al-Qura University, College of Education (2010)*.

10. Psychometric Properties of the Instrument

10.1 Internal Consistency Validity

To verify the validity of the arithmetic test (multiplication operations), the internal consistency was calculated after administering the test and recording the results, using **Pearson's correlation coefficient**. The following table summarizes the findings of this analysis.

Item Number	Correlation Coefficient	Significance Level	NotesNotes
1	**0,875**	**0,05**	Statistically significant
2	**0,885**	**0,05**	Statistically significant
3	**0,855**	**0,05**	Statistically significant
4	**0,865**	**0,05**	Statistically significant
5	**0,845**	**0,05**	Statistically significant
6	**0,875**	**0,05**	Statistically significant
7	**0,865**	**0,05**	Statistically significant
8	**0,979**	**0,01**	Statistically significant
9	**0,714**	**0,05**	Statistically significant
10	**0,979**	**0,01**	Statistically significant
11	**0,979**	**0,01**	Statistically significant
12	**0,979**	**0,01**	Statistically significant
13	**0,979**	**0,01**	Statistically significant
14	**0.865**	**0,05**	Statistically significant
15	**0,979**	**0,01**	Statistically significant
16	**0,979**	**0,01**	Statistically significant
17	**0,092**	**0,01**	Statistically significant
18	**0,714**	**0,05**	Statistically significant
19	**0,979**	**0,01**	Statistically significant
20	**0,979**	**0,01**	Statistically significant

Table (01): Results of the Internal Consistency Calculation for the Items of the Arithmetic Test (Multiplication Operations).

Commentary on the Table

It is evident from this table that all the items are statistically significant at the 0.05 level. This confirms that the scale demonstrates **internal consistency** among its items.

10.2. Reliability of the Arithmetic Test (Multiplication Operations)

The reliability coefficient of the test was calculated using the **split-half method**. The test was divided into two parts:

- The **first half** included items 1 through 10.
- The **second half** included items 11 through 20.

The obtained correlation coefficient between the two halves was **0.46**. After applying the **Spearman–Brown correction formula**, the reliability coefficient increased to **0.63**, which is considered a relatively high value.
This indicates that the arithmetic test possesses a **high degree of reliability**, confirming its suitability for use in this study.

11. Study Sample and Its Characteristics

The study sample consisted of **20 pupils**, divided equally into:

- **10 pupils** representing the control group, and
- **10 pupils** representing the experimental group.

Each group included **five (5) males** and **five (5) females**, ensuring gender balance.

Due to the limited number of participants in the control group, the pupils of *Al-Wifaq Al-Watani Primary School* were selected as the **control sample**, whose members did **not** participate in the educational games activities within the physical education sessions.

The following table presents the distribution of the experimental and control groups according to the variables of **age** and **gender**:

(Table showing the age and gender distribution of both groups would appear here in the full tex

Total	Age Group	Females	Males	Group Type
10	**10**	**05**	**05**	Experimental
10	**10**	**05**	**05**	Control

Table (02): Distribution of the Experimental and Control Groups According to Age and Gender

Commentary on Table (02)

It can be observed from Table (02) that the number of **female pupils equals the number of male pupils** in both schools, and that the **average age** of the two groups is also identical.

11.1. Characteristics of the Study Sample

The research sample—both the experimental and control groups—was selected according to the following criteria:

- Pupils must be enrolled in the **fourth grade of primary school**.
- Pupils may be **male or female**.
- Pupils must be **approximately 10 years old**.

12. Statistical Methods Used in the Study

The researcher employed the following **statistical methods**:

- **Pearson's correlation coefficient (r):**

  Used to calculate the *reliability* and *internal consistency* of the study instruments.

- **t-test for independent samples:**

  Applied to determine the significance of differences in the arithmetic test (multiplication operations) scores between the experimental and control groups.

- **Arithmetic mean (M):**

  Used to calculate the average scores of the multiplication test for both groups.

- **Standard deviation (SD):**

  Used to measure the degree of dispersion of the scores in the arithmetic test for both the experimental and control groups.

13. Presentation of the Study Results

13.1. Presentation of the Results of the First Hypothesis

"There is a statistically significant difference in the arithmetic (multiplication operations) test scores between the experimental and control groups in the post-test."

The results of this hypothesis are summarized in the following table.

(Table summarizing post-test differences between the experimental and control groups would appear here in the full document.)

Statistical Significance	**t-value**	Degrees of Freedom	Standard Deviation	Arithmetic Mean	Number of Participants	**Group**
Statistically significant at 0.01 level	**13,18**	**18**	**0,56**	**12,2**	**10**	Control
			1,01	**17,7**	**10**	Experimental

Interpretation of Table (03))

It is evident from Table (03) that there is a difference in the **mean scores** between the **experimental group**, whose members practiced the educational game within physical education lessons, and the **control group**, which did not receive any such intervention.

The mean scores of the **experimental group** were notably higher on the **arithmetic (multiplication operations) test**.

By applying the **t-test**, a **statistically significant difference** was found between the two groups in favor of the experimental group.

The **calculated t-value (13.18)** exceeded the **tabulated t-value (2.55)** at **18 degrees of freedom** and a **significance level of 0.01**. Therefore, the **null hypothesis is rejected**, and the **research hypothesis is accepted**, confirming that there is a statistically significant difference in the arithmetic test (multiplication operations) scores between the experimental and control groups in the post-test, in favor of the experimental group.

13.2. Presentation of the Results of the Second Hypothesis

“There is a statistically significant difference in the arithmetic (multiplication operations) test scores between the pre-test and post-test within the experimental group, with higher scores in the post-test.”

The results related to this hypothesis are summarized in the following table.

(Table summarizing the pre-test and post-test comparison for the experimental group would appear here in the full document.)

Interpretation of Table (04)

Statistical Significance	**t-value**	Degrees of Freedom	Standard Deviation of Differences	Mean Difference	Arithmetic Mean	Number of Participants	**Measurement**	**Group**
Statistically significant at 0.01 level	**4,96**	**9**	**0,32**	**3,2**	**5,11**	**10**	**Pre-test**	
					17,7	**10**	**Post-test**	**Experimental**

It is clear from Table (04) that the **mean score** on the arithmetic test (multiplication operations) increased from **5.11 in the pre-test** to **17.7 in the post-test** among the members of the **experimental group** who practiced the **educational game** in physical education sessions related to multiplication.

This difference was **statistically significant** at the **0.01 level**, as the **calculated t-value (4.96)** exceeded the **tabulated t-value (2.82)** at **9 degrees of freedom** and a **significance level of 0.01**.

Therefore, the **research hypothesis** is accepted, confirming that there is a statistically significant difference between the pre-test and post-test arithmetic scores within the experimental group, in favour of the **post-test results**.

14. Discussion of the Study Hypotheses

In light of the statistical analysis of the study data, the following discussion interprets the results obtained, supported by the most relevant previous studies.

14.1. Discussion of the First Hypothesis

“There is a statistically significant difference in the arithmetic (multiplication operations) test scores between the experimental and control groups in the post-test.”

The results presented in **Table (15)** showed a **statistically significant difference** at the **0.01 level** between the **experimental group** and the **control group**, in favour of the experimental group.

The **calculated t-value (13.18)** exceeded the **tabulated t-value (2.55)** at **18 degrees of freedom** and a **significance level of 0.01**.

These results confirm that **educational games in physical education** contributed to improving pupils' performance in the arithmetic (multiplication) test after they engaged in **10 sessions** of educational game-based practice.

This improvement was also observed during classroom observation, where members of the experimental group displayed **greater enthusiasm and motivation**, striving to provide correct answers, unlike the control group, whose members followed traditional teaching methods that did not enhance their arithmetic skills.

Hence, the findings affirm the **effectiveness of educational games in physical education** as a means of developing multiplication skills.
Such games provided experimental group pupils with opportunities to learn new skills in an environment filled with **fun, enjoyment, and engagement**, while introducing a **novel instructional tool** that integrates movement with learning.

14.2. Discussion of the Second Hypothesis

"There is a statistically significant difference in the arithmetic (multiplication operations) test scores between the pre-test and post-test within the experimental group, with higher scores in the post-test."

As shown in **Table (17)**, the **mean score** increased from **5.11 in the pre-test** to **17.7 in the post-test** for the experimental group who practiced educational games related to multiplication in physical education.

This difference was statistically significant at the **0.01 level**, with a **calculated t-value of 4.96**, which exceeded the **tabulated t-value of 2.82** at **9 degrees of freedom**.

This result indicates that pupils who engaged in educational games in physical education benefited from these activities.

They experienced **enjoyment, relaxation, and confidence-building**, as they successfully provided correct answers, demonstrating the **positive psychological and cognitive impact** of integrating play with learning.

15. Conclusion

From the results obtained, it becomes evident that integrating **physical education** into the process of **learning mathematics** is not a mere formal combination of two school subjects; rather, it represents an **effective pedagogical strategy** that enhances pupils' mathematical understanding, particularly in the **early stages of education**.

Both local and international studies have shown that **motor activities** help to improve **attention, concentration, and working memory**, while simplifying abstract mathematical concepts such as addition, subtraction, and numerical sequencing through **kinesthetic and sensory representations**.

This approach also accommodates **individual differences** and creates a **stimulating learning environment** that encourages pupils to participate actively and interact positively, leading to marked improvements in both **academic and behavioural performance**.

Accordingly, developing **integrated curricula** that combine movement and mathematics, and **training teachers** to apply such approaches innovatively, has become an urgent necessity in view of the challenges facing educational systems—especially those related to **mathematics learning difficulties** and **low motivation** among pupils.

Therefore, this study recommends expanding **Arab research** in this area and adopting **educational policies** that promote integration between **cognitive** and **motor learning**, thereby fostering a generation that is more balanced in **intellectual, physical, and emotional development**.

16. Recommendations

- **Integrating Physical Activity into Mathematics Education**
  Encourage schools to include **educational physical activities** within mathematics lessons, especially in the primary stage, as they improve comprehension and arithmetic skills.
- **Teacher Training in Integrative Pedagogy**

  Provide **training programs** for physical education teachers and general educators on designing and implementing **movement-based learning activities** linked to mathematical concepts.

- **Designing Integrated Curricula**

  Review school curricula to include **cross-disciplinary programs** combining mathematics and physical education to promote **active, holistic learning**.

- **Researching the Impact of Motor Activities on Learning Difficulties**
  Conduct **in-depth studies** on how physical education activities can reduce **mathematics learning difficulties**, particularly for pupils with **attention deficit or hyperactivity**.
- **Creating a Movement-Friendly School Environment**

  Equip schools with suitable **spaces and materials** for implementing educational movement activities (e.g., playgrounds, instructional sports tools), and encourage regular teacher use.

- **Encouraging Parental Support**

  Raise parents’ awareness of the importance of combining **movement and learning**, and motivate them to support such activities at home or outside school.

- **Developing Arabic Educational Guides**

Produce **Arabic-language manuals** offering ready-made models of **movement-based arithmetic activities** to serve as references for teachers in basic education.

- **Measuring Long-Term Educational Impact**

Recommend **longitudinal studies** to track the long-term effects of integrating physical activity into arithmetic learning on **academic achievement**, **life skills**, and **self-confidence**.

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