Original article

School Recreation to Enhance Cognitive Development of Elementary Students

Gina Maribel Aguilar Osorio[1] https://orcid.org/0000-0002-4631-0253

Natalia Marcia Julio Angamarca[2*] https://orcid.org/0000-0003-2512-6323

Katherine Gissela Rivera Quishpe[3*] https://orcid.org/0000-0003-2872-8696

Silvia Elizabeth Santillán Galarza [3*] https://orcid.org/0000-0003-2383-0245

[1]The 24 de Julio Fiscal Educational Facility Quito. Ecuador.

[2]The Ricardo Alvarez Mantilla Educational Facility. Quito. Ecuador.

[3]Cesar Arroyo Educational Facility. Quito. Ecuador.

Correspondence ginaaguilar07@hotmail.es

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ABSTRACT

Introduction: Physical recreation is a voluntary type of activity that is performed during free time as part of extracurricular activities, whose end is to produce physical and psychic relaxation, providing pleasure, and well-being, and contributing positively to human growth and balance against school-related stress and other daily duties.
Aim: To design a program of physical exercises that contribute to cognitive development of fifth-graders during their mathematics lessons, at the 24 de Julio educational facility. It must engage students in practicing recreational activities at school often, and it is also a tool for motor, cognitive, affective, and social development of the 50 students selected for this study.

Materials and methods: During the research, several methods were included, such as the scientific, analytical, synthetic, and descriptive. The study relied on a pre-experimental design, which included only one group, consisting in the application of a pre-test and a post-test. The techniques used were survey and a cognitive development test.

Conclusions: Regarding the equivalent fraction variables, semi-straight fractions, and combined operations, P 0.000 < 0.05 demonstrated that the null hypothesis was rejected, while the alternative hypothesis was accepted, thus suggesting a highly significant difference between the pre-test and post-test in the three variables related to student cognitive development during the research

Keywords: school recreation, cognitive development, elementary education, mathematics.

INTRODUCTION

Physical recreation is a free-time voluntary type of activity that is part of extracurricular activities, whose end is to produce physical and psychic relaxation, providing pleasure and well-being, contributing positively to human growth and balance against school-related stress and other daily duties. It is a continuous learning process every person is entitled to; it is a spontaneous activity outside school and biological duties which are compelling, creating the necessary balance to reach spiritual and social well-being, on many occasions overlapping with other subjects.

Multi-disciplinary work is a stance that entails overcoming fragmented visions and assuming a more radical position to remove the boundaries between disciplines; multi-disciplinary work involves breaking the barriers between theory and practice. Essentially, it consists of a collective work that involves the interaction of scientific disciplines, their guiding concepts, methodologies, procedures, data, and teaching organization. From its onset, it was a novel principle of epistemological reorganization of scientific disciplines.

Multi-discipline is a process and a work philosophy that entails a way of thinking and acting that permits coming across the complexity of the objective reality, and solve the problems ahead of us. The integrative and multi-disciplinary approach states that every discipline meets a need when it relates to others in common practice, creating an integration of knowledge.

Several authors, such as, Huanca (2017), Varela, (2017), Sinaliza (2016), Juventery (2017), Clementin (2017), Edo and Paucar (2018), Clementin (2019), Chipana (2019), Maldonado (2019), Sinaliza and Miranda (2019), Ruffino (2020), and Alcalá (2020), have contributed with their studies on the association of physical education to other subjects as an integrating axis, especially, mathematics and sports practice, physical and recreational activities, as part of a particular dimension of the educational process, made by a semantic unit containing the noun *education* and the adjective *physical*. However, these activities have focused on the teaching of techniques, physical efficiency, strength, organic endurance, and recreation. Very little has been done in terms of the cognitive-affective, motor, recreational, and attitudinal factors as necessary bonds, as an essential element of an integrated citizen education.

An efficient teaching-learning process is understood as one that places students in situations that challenge their way of thinking, feeling, and acting. The teaching-learning process conforms to a particular way of associating math with physical education, which establishes rules for the students, turning them into players, in which games or ludic activities qualify as imaginative, realist, imitative, discriminating, competitive, propulsive, and pleasant. Through them, students and teachers are the main actors of ludic activity.

According to several authors, such as, Andrade (2010, Catalán (2016). Cabañas, *et al.* (2017)), Herrera (2017), Antonia (2018), Charchabal (2018), Flores (2018), Garzón (2019), Maldonado, E. and Villanueva, A. (2019). Araujo (2020), Pérez (2021), prior to referring to games in math, it is necessary to note that this study not only requires concepts and procedures to address issues, but also a harmonious interrelation among all the educational actors to seek ludic, didactic, and recreational methods and strategies that permit obtaining positive results in significant teaching and learning. Accordingly, it refers that math didactics studies its teaching processes to understand related problems and solve them, through novel theories and practices that strengthen student learning through gaming and physical recreation.

Charchabal (2018) said that recreation has existed throughout the history of humanity, and it pertains to the daily lives and directions of humans. It helps with personal and collective development, elucidating its existence in every manifestation through ludic recreation; an experience with transversal dimensions that goes across lives that attach to human development psychologically, socially, and biologically (p.33).

In a comprehensive analysis of recreation and cognitive development in mathematics, several authors, such as, Payá Rico, (2007) conducted the doctoral study: Ludic Activity in the History of Contemporary Spanish Education; whereas Philco Siñani (2009) published a paper in the Journal, Didactic Games as Strategies of Mathematic Development for elementary School Children. Moreover, Farías & Rojas (2010) mentioned it in the paper entitled Ludic Strategies for Math Teaching in College Freshmen. In that sense, they noted that the ludic process is enhanced the broader the variability and efficiency of student strategies are. Therefore, ludic is a motivating and creative tool to consolidate specific knowledge.

In that direction, the purpose of this paper is to determine the impact of school recreation using activities to enhance cognitive development in mathematics.

MATERIALS AND METHODS

The type of design is pre-experimental, so it is very important to consider that the study will include the population established. There will be a single group which underwent a pre-test–pos-test, with the same instruments that were used in the diagnostic at the beginning where a group was compared before and after the implementation of the proposal.

The individuals in the study were surveyed to know the cognitive development related to positional value, equivalent fractions, semi-straight fractions, and combined operations during the pre-test and following the implementation of the proposal. Hence, the reverse experimental results from the MacNemar non-parametric test for dichotomic nominal qualitative variables were corroborated.

The IBM statistical software SPSS Version 25 was used. The sample taken at the 24 de Julio Educational Facility comprised two levels of the fifth elementary education. The fifth elementary A consisted of students of which 14 were females and 12 males, while elementary B consisted of 24 students, of which 12 were females and 12 males. The total population was 50 students: 26 females and 24 males.

RESULTS AND DISCUSSION

Pre-test to students results according to the MSCA scales

The research began with the application of the MSCA scales: It is one of the essential tests to measure cognitive and motor development of children. It was designed to facilitate evaluation and maintain attention on the children at early ages. The McCarthy test for attitudes and psychomotricity is one of the most relevant instruments and commonly used tools to assess the cognitive and motor skills of 2-6- and 8-6-year-old children. One of the main objectives was to help detect possible learning problems that might influence school performance. Some tests (drawing, verbal fluency) favor a clinical approach thanks to a qualitative analysis of the child's production.

Questions:

1. Can you recognize the positional value of every figure and provide its corresponding value in accordance with the positional system?

Table 1 P value

Indicators Pre-test		f	%	Valid %	Accumulated %	Indicators Post-test		f	%	Valid %	Accumulated %
Valid	Yes	41	82.0	82.00	82.00	Valid	Yes	47	94.0	94.0	94.0
	No	9	18.0	18.00	100.00		No	3	6.0	6.0	100.00
	Total	100	100.00	100.0			Total	50	100.0	100.0	

Made by: Gina Aguilar Osorio.

Source: Fifth-grade students at the 24 de Julio elementary educational facility.

Table 1, shows that 41 students, accounting for 82 %, answered Yes, whereas nine students accounting for 18 % answered no. In the pos-test, can you recognize the positional value of every figure and provide its corresponding value in accordance with the positional system? A total of 47 students, accounting for 94 %, answered Yes, and nine students accounting for 6.0 % answered No (Table 1)

2. Identify the fractions

Table 2. Equivalent fractions

Indicators Pre-test		f	%	Valid %	Accumulated %	Indicators Post-test		f	%	Valid %	Accumulated %
Valid	Yes	12	24.0	24.0	24.0	Valid	Yes	48	96.0	96.0	96.0
	No	38	76.0	76.0	100		No	2	4.0	4.0	100
	Total	50	100	100			Total	50	100.0	100.0	

Made by: Gina Aguilar Osorio

Source: Fifth-grade students at the 24 de Julio elementary educational facility.

Table 2 (identifying equivalent fractions), 12 students accounting for 24% answered Yes, whereas 38 students, accounting for 76%, said No. Upon the post-test, 48 students accounting for 96% answered Yes, whereas 38 students, accounting for 4%, said No (Table 2).

3. Identify the fractions in the semi-straight line

Table 3. Fractions in the semi-straight line

Pre-test Indicators		f	%	Valid %	Accumulated %	Post-test Indicators		f	%	Valid %	Accumulated %
Valid	Yes	20	40.0	40.0	40	Valid	Yes	45	90.0	90.0	90.0
	No	30	60.0	60.0	100		No	5	10.0	10.0	100.00
	Total	50	100	100			Total	50	100	100	

Made by: Gina Aguilar Osorio

Source: Fifth-grade students at the 24 de Julio elementary educational facility.

Table 3 (the positional value of every figure and the corresponding value depending on the positional system), shows that 41 (82%) answered Yes, whereas 9 students

(18%) answered No. As to the post-test: Identifying equivalent fractions, 45 students accounting for 90% answered Yes, whereas 38 students, accounting for 10%, said No\ (Table 3).

4. Identify the combined operations

Table 4. Combined operations

Pre-test Indicators		f	%	Valid %	Accumulated %	Post-test Indicators		f	%	Valid %	Accumulated %
Valid	Yes	3	6.0	6.0	6.0	Valid	Yes	43	86.0	86.0	86.0
	No	47	94.0	94.0	100		No	7	14.0	14.0	100.0
	Total	50	100	100			Total	50	100	100	

Made by: Gina Aguilar Osorio

Source: Fifth-grade students at the 24 de Julio elementary educational facility.

Table 4, in relation to the pre-test: Solving equivalent fractions, 3 students accounting for 6% answered Yes, whereas 3847 students, accounting for 94%, said No. During the post-test (solve combined operations), 43 students accounting for 86.0% answered Yes, whereas 7 students, accounting for 14%, said No (Table 4).

To corroborate the stated hypotheses, the McNemar test was performed; it permitted to computing the results of cognitive development through three variables: p value, equivalent fractions, semi straight-line fractions, and combined operations, comparing the results during the pre-test and post-test, which led to the following results (Table 5).

Table 5 Test[a] statistics

	Positional and positional test	Fractions and post-test fractions	Semi straight line and post-test semi-straight line	Combined and post-test combined
N	50	50	50	50
Chi-square		34.028		38.025
Asymptotic sig.		.000		.000
Exact sig. (two-sided)	.031[b]		.000[b]	

a. McNemar test

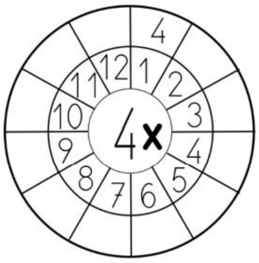
b. Binomial distribution used

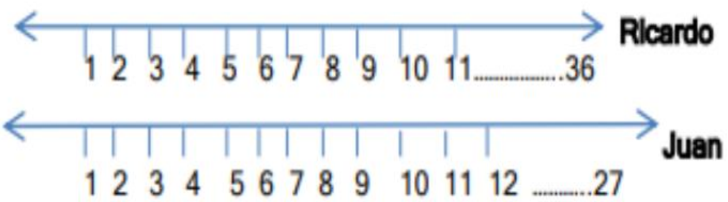
c. Corrected continuity

As the positional value was P 0.031 < 0.05, the null hypothesis was rejected, while the alternative hypothesis was accepted, thus suggesting a little significant difference between the pre-test and post-test. Regarding the equivalent fraction variables, semi-straight fractions, and combined operations, P 0.000 < 0.05 showed that the null hypothesis was rejected, accepting the alternative hypothesis, thus suggesting a highly significant difference between the pre-test and post-test in the three variables related to student cognitive development during the research (Table 6).

Table 6 Physical ludic activities through competitive technical games

<table>
<tr><td colspan="3">The elements that make the competitive technical games are part of the exercises used in methodological teaching during the trainings.</td></tr>
<tr><th>TITLE Y DIMENSION</th><th>Materials</th><th>COMPETITIVE TECHNICAL GAMES, TWICE A WEEK, USING EXERCISES TRAINED IN CLASS</th></tr>
<tr><td>Title: Covering numbers
DIMENSION OF MOVEMENTS</td><td>1. The material includes several players, a carboard with the numbers 1-18 and several counters per player, including dice. By turns, each player throws 4 dice and keeps 3, to get numbers using operations (+, -, x, ÷) with 2 or 3 figures.
Variations: To perform two operations always; to use the 4 dice.</td><td><table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr></table>If done, it is covered with a same-color counter. Then passes. The game ends when all the numbers are covered. The winner is the one who gets the highest score.</td></tr>
<tr><td>LEARNING TO THINK</td><td>Factors using low numbers. The zero, one, and two factors are the simplest, and must be the ones every fifth-grader should learn regardless of their number skills. The factors of 3 are as easy as the previous, as they multiply by 2 then the factor is added. For instance, 3 X 7, multiplying 2 X 7, which is 14 + 7 = 21. The 4th factor is still simpler, as any number is multiplied by 2 and then it is doubled to get the result. For instance, 4 X 8 equals 2 X 8=16 X = 32. The 5th factor is very easy, as it goes 0,5,10,15, and so on.</td><td>High-number factors. Factors between 6 and 9 can be dealt with using a very effective technique the more it is practiced, using thinking and reasoning, which will help memorize the results, so it has a dual effect. Using both hands, raise a right-hand finger and multiply by 6, two fingers if multiplied by 7, 3 by 8, and 4 when multiplying by 9. The closed left hand means that we have 5 units, but if it is 6, then one finger is raised, 7 means two fingers are raised, and so on. The sum of these fingers produces the first unit, while the closed fingers are multiplied by themselves to get the second figure. For instance, 8 X 7 = three raised right-hand fingers (8 is three raised fingers), and 2 raised left-hand fingers produce 5. Multiplying the 2 closed fingers from one hand by the 3 closed fingers from the other = 6, resulting in 56. The only exception is 6 X 6 and 6 X 7, but it is also easy if we know the formula for the 3 factors, then double the results and that is it. 9 X 9. 4+4=8 (the sum of open-hand fingers); 1 X 1=1 (multiplication of closed fingers) = 81 8 X 8= 3+3=6; 2 X 2=4 Total = 64</td></tr>
</table>

		
MATH USING HULA-HOOPS	A total of 20 hula-hoops will be placed in a sinuous way without closing a circle. There will be two starting bases on each end on which ladders will form using the same number of children on each side.	Upon the teacher's signal, the students will start as fast as possible running from either side. Upon meeting face to face, the teacher will ask a mathematical question; the one with the incorrect answer will return to the ladder, activating the next player in the group, whereas the winner will keep running until meeting the next player of the opposing ladder, who started running after his or her partner lost. The child who makes it to the last hula-hoop will score for their team.
ROPE JUMPING WITH MATHEMATICAL OPERATIONS	A long rope is used.	It will be swung, forming two equal teams on each side. A representative from each team joins the game and the teacher will ask them to solve a mathematical problem, which the children will try to solve as they are jumping. The loser will exit and will let the next player on the team start. The number of correct answers is added to determine the wining group.
RUNNING WITH MATHEMATICAL OPERATIONS	Running space: up to 15 m	Two groups are made containing the same number of students on a column each. The first students from each group are requested to solve a mathematical operation. For instance, 12 X 6, then answer: 60, 80, 72, 104. The student who knows the answer will run to a 15-m distant line facing the race; upon crossing the line, the student will provide the right answer, scoring two points for the team. If the student ran but provided the wrong answer, one point will be taken from the corresponding team.
HAVING FUN WITH WOODEN PIECES OR COLOR NUMBERS	The white wooden piece is 1 cm long and represents the number 1. •The red wooden piece is 2 cm long and represents the number 2. •The green wooden piece is 3 cm long and represents the number 3. •The pink wooden piece is 4 cm long and represents the number 4. •The dark green wooden piece is 6 cm long and represents the number 6. •The black	No 1 exchanges the wooden pieces to have the two groups of children play. 2. To ask the children to change the pieces whenever they have the same value so that no group is harmed (for instance, I give you one piece for two of them), and observe all the ways of doing this change. For instance, I'll give you two pieces for one; I'll give you one piece for three (observing different possibilities); I'll give you three pieces for one... Each piece is referred to by the color and the normal child's strategy is size comparison. This game leads to others, including making combinations from the base piece and create several pieces given to the child, finally getting the expected piece. 3. In each change made, the number of pieces and colors changed should be written down. 4. At the end of the game, they should count the colors and bars each group has and how much they represent. Each number with its color. 1.- The children make groups of two or three, then they are asked to place the pieces and cards with numbers in front of them. 2.- Ask them to compare the pieces

	wooden piece is 7 cm long and represents the number 7. •The brown wooden piece is 8 cm long and represents the number 8. •The blue wooden piece is 9 cm long and represents the number 9. •The orange wooden piece is 10 cm long and represents the number 10.	with the numbers, to associate the number with the corresponding piece and place them with the same number, depending on its value.
PLAYING LUDO AND SOLVING PROBLEMS MATCHING QUANTITIES	Materials: 5 ludo games, a dart, and four-color pieces. Procedure: A group is arranged by teams, and each is given a Ludo game with a dart and four pieces. Taking turns, each player rolls the dice and moves forward in the game, depending on the quantity indicated by the dart. Upon reaching a number and there is an order, each player should obey it. The winner is the player who first makes it to the target. The Ludo game is initiated by teams. They take the dice by turns, rolling them to the points to advance in the game.	Pictorial translation: The children represent the problem through drawings on the board or their notebooks. RICARDO goes in square 36. JUAN goes in square 27.  Graphic translation: It is done through the numerical straight line. The students can also dramatize the problem
pictorially or graphically. Third: Execution and calculation	Here, the child executes and formalizes their strategy by means of mathematical calculation, formalizing it into a mathematical language, either concrete	The mathematical symbols are used accordingly. RICARDO has 36 points; JUAN has 27 points (36 - 27 = 9). 
PLAYING THE NUMBER SNAKE AND	In the number snake game, Juan made it to square 45 and Marco	Game: The number Snake of Materials: 05 games, number snake (1-100), two dice and two counts. Procedure: A group is arranged by teams, and each is given a 63-number snake game with two dice

SOLVING PROBLEMS THROUGH QUANTITY COMPARISONS	reached square 36. How many squares less than Juan, did Miguel move?	and four counts. By turns, each player rolls the dice, adds points and moves to the corresponding squares. Upon reaching a number, and there is an order, each player should obey it. The winner is the player who first makes it to 100. They take the dice by turns, rolling them to the points to advance in the game.

According to the hypothesis stated, the implementation of recreational strategies will produce better results in learning mathematics by fifth-grade students at the 24 de Julio Elementary Educational Facility. This was evidenced in the study whose outcome led to the evaluation of the indicators of recreational activity associated with the cognitive development of the individuals, enabling the analysis of the following hypotheses:

Ho: If $P \geq 0.05$. There are no significant differences between the results of the variables associated with cognitive development before and after the implementation of the recreational strategy.

Hi: If $P < \alpha=0.05$. There is a significant difference between the results of the variables associated with cognitive development before and after the implementation of the recreational strategy. Hence, the results of this research study permit the confirmation of the hypothesis. The implementation of recreational strategies will produce better results in learning mathematics. Throughout history, these subjects are still the big issue of Ecuadorian education, in terms of learning, which has been confirmed by this study. However, the same practices and methodologies are still being implemented.

CONCLUSIONS

This research paper has brough about a change of mindset among teachers, students, and parents, by adopting recreational mechanisms that improved the students' conceptual map, and learning how to reason and play with numbers. Accordingly, their interest over this subject as an ally for life, was widened. Its insertion and relevance make mathematics a part of almost all subjects and sciences established by school curricula, even at the universities. As the p value was $0.031 < 0.05$, the null hypothesis was rejected, while the alternative hypothesis was accepted, thus suggesting a little significant difference between the pre-test and post-test.

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The authors declare the are no conflicts of interests whatsoever.

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The authors have taken part in the redaction of the manuscripts and the analysis of documents.