Didactic proposal mediated by educational digital resources to promote the use of algorithmic thinking

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Abstract: The present study conducted a research in the fifth grade of Institución Educativa Municipal San José Bethlemitas. The purpose was to design a didactic proposal focused on promoting students' algorithmic thinking. To accomplish this objective was necessary to carry out a research process based on George Polya's methodology for problem-solving. This process considered four stages named: understanding the problem, shaping the plan, implementing the plan, and looking back. Initial data was collected by making use of the measurement instrument of computational thinking developed by Ma. Juan Carlos López from Universidad ICESI. It had the activities called; draw, and order the object, and get the points as a reference. To implement these activities was necessary to use Scratch 2.0, and the code time from code.org. In this way, it was possible to quantitatively demonstrate a significant change in students' performance belonging to the experimental group. This change lets to point out the importance, and relevance of educative digital resources through a didactic sequence of computer technology area.

KeyWords: Didactics, education, digital resources, algorithms.

1 | Introduction

According to the objectives set and based on the methodology selected as the project guide, this research was carried out using a quantitative approach. Similarly, a quasi-experimental design with a control group was used. The research is part of the Informatics and Society line, so the project focuses on observing and identifying aspects of computer science and its use in different situations of today's society.

2 | Methodological Aspects

Population and sample: The selected population was made up of fifth grade students from the San José Bethlemitas Municipal Educational Institution in the city of Pasto. During its development, the quasi-experimental approach was used, given that there were two groups previously formed, having equality criteria according to the regulations of the institution. In addition, there was a control group and an experimental group.

Study variables: According to the analysis of the problem, the following study variables were related to the present work:

Independent variable: This referred to the didactic proposal mediated by educational digital resources, implemented in the experimental group.

Dependent variable: This referred to Algorithmic Thinking (PA), which may or may not vary through the implemented proposal and, in addition, the PA has different dimensions, which are described below.

Dimension 1 (PA). Abstraction and modeling of information: [1] states that "abstraction skills are essential in the construction of appropriate models, designs, and implementations." Thus, taking into account the evaluation instrument, the above definition corresponds to a dimension of algorithmic thinking, which offers a substantial basis for the work developed.

Dimension 2 (PA). Understanding of conditional structures: Control structures, specifically conditional structures, constitute a fundamental basis for problem solving, which allows the student to evaluate different paths to reach a solution by establishing conditions. In this regard, [2] states that "proposing nestable algorithmic structures (iterative and conditional) requires thought processes associated with the operative system of classification or inclusion", this implies in the student the generation of different possibilities, in case one event or another occurs.

Dimension 3 (PA). Systematic search for information: As part of the analysis of a problem for its subsequent solution, the student must make an initial observation of the information presented, in order to filter it and select the most relevant according to previously established criteria.

3 | Results and discussion

Descriptive analysis of the variable "Algorithmic Thinking"

Activity 2: Draw the objects (general comparison).

For activity 2 "Draw the objects", in the first data collection 79 samples corresponding to grades 5-1 and 5-2 of the Municipal Educational Institution San José Bethlemitas were analyzed, the graph of boxes and whiskers shows the following information: for the two groups the box does not present divisions, so 75% of the data are not scattered in a range of 1.8, from 1.6 to 3.4 in both grades.

For activity 2 "Draw the objects", in the second data collection 79 samples corresponding to grades 5-1 and 5-2 were analyzed, the box and whiskers graph shows the following information: for the two groups the box does not present divisions, so 75% of the data are not scattered in a range of 1.7, from 2.5 to 4.2 in both grades.

Activity Weighting (2) Draw and sort objects

$$n = \frac{(D1+(D2*2)+(D3+3))*5}{3}$$

n= note
D1= performance 1
D2= performance 2
D3= performance 3
5= maximum possible rating on the scale
3= number of possible ratings

Activity weighting (4) Earn the points

$$n = \frac{(D1+(D2*2)+(D3+3))*5}{36}$$

n= note
D1= performance 1
D2= performance 2
D3= performance 3
5= maximum possible rating on the scale
36= number of possible ratings

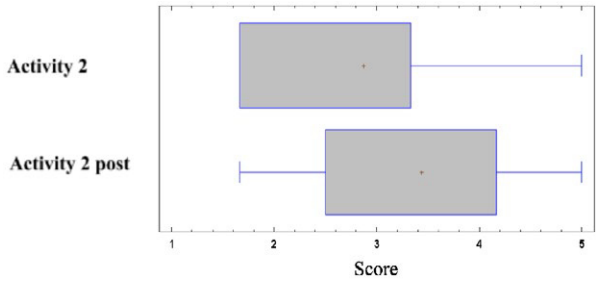

Fig. 1 General comparison – Draw object - Activity 2 (DO) Grades 5-1 and 5-2.

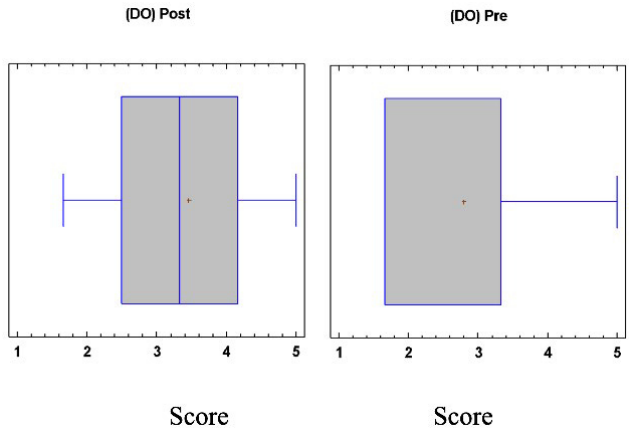

Fig. 2 Comparative first and second takes Activity 2 (DO) Grade 5-2.

Activity 4: Earn the points (general comparison)

For activity 4 "Earn the points", in the first data collection 79 samples corresponding to grades 5-1 and 5-2 of the San José Bethlemitas Municipal Educational Institution were analyzed, the box and whiskers graph shows the following information: the grade point average for both grades, in the first data collection, was 2.28 with a median of 2.36. In addition, a coefficient of variation of 16% was presented, which represents homogeneous data. The box on the left is larger than the one on the right, which means that between 25% and 50% of the data is less scattered than those between 50% and 75%. The mustache on the left is shorter than the one on the right, which means that 25% of the ratings are more concentrated than the top 25% of the grades.

For activity 4 "Win the points", in the second data collection, 79 samples corresponding to grades 5-1 and 5-2 were analyzed, the box and whiskers graph shows the following information: the grade point average in the second data collection was 2.59, with a median of 2.63. In addition, a coefficient of variation of 15% was presented, which represents homogeneous data. The boxes are equally sized, so between 25% and 50% of the data are less scattered than the top 25% of ratings.

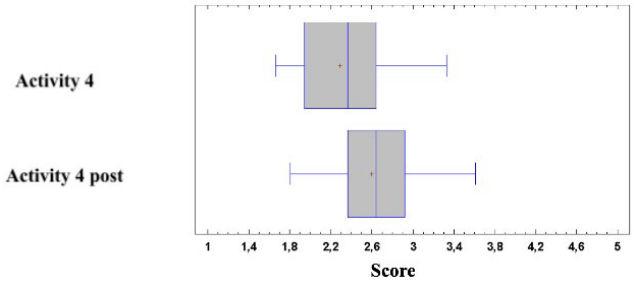

Fig. 3 General comparison – Win game -Activity 4 (GP) Grades 5-1 and 5-2.

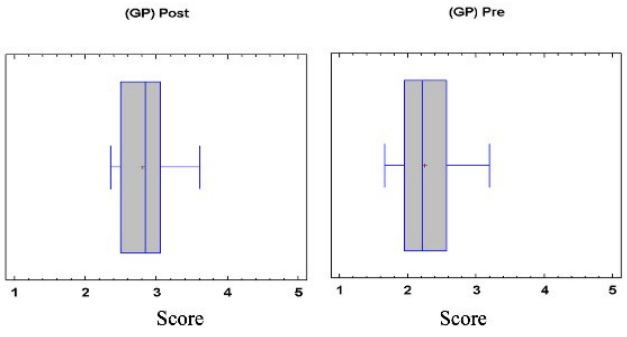

Fig. 4 Comparative first and second takes Activity 4 (GP) Grade 5-2.

4 | Conclusions

A useful way of thinking about the solution of a problem is to abstract said solution into smaller parts, which, through their continuous and sequential interaction, trigger in that solution forming what according to [3] is an algorithm. It is important to encourage the ability to think algorithmically both in the design and construction of solutions, all this framed in an effective didactic implemented by the teacher, which transferred to the current educational reality is contrasted with the teaching of software packages, this is reaffirmed by [4] and [5] as soon as the teaching of computer science is not being taken to the promotion and development of skills, being seen only as an area dedicated exclusively to the use of programs.

Through the application of the activities of the didactic sequence, designed in the present research, positive changes were found in the performance of the students of the experimental group (5-2) compared to the control group (5-1), when contrasting phases 1 and 2 of the application of the measurement instrument. For activity 2 the variation in the average of the students was 0.66 for the experimental group compared to 0.13 in the control group, while in activity 4 the variation was 0.56 for the experimental group compared to 0.05 in the control group. The results obtained confirm that it is possible to promote the use of algorithmic thinking through a didactic proposal, mediated by digital educational resources in students of fifth grade of elementary school.

Variables such as gender or age of the student were related to performance in activities through independence tests, with a P-value of 0.70 for activity 2 (DO) in grade 5-1 in relation to gender, a value of 0.63 in the same activity in grade 5-1 in relation to age. In the case of activity 4 (GP) of grade 5-1, P-values of 0.63 in gender and 0.32 in age were presented.

Regarding the experimental group (5-2), P-values of 0.30 for gender in activity 2 (DO) and 0.31 in age were presented. For activity 4 (GP) values of 0.52 for gender and 0.11 for age were found. Taking into account the results obtained in the -P values in the independence tests, it is possible to infer that the variables exposed may not be related to the performance of the students, although it should be noted that in future research a more elaborate knowledge can be established regarding this relationship of variables.

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