A MICROLEARNING APPROACH WITH SCRATCH FOR DEVELOPING STUDENT COMPUTATIONAL THINKING.

Manuscript Info

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Manuscript History

Received: xxxxxxxxxxxxxxxx

Final Accepted: xxxxxxxxxxxx

Published: xxxxxxxxxxxxxxxx

Key words:-

Microlearning, Scratch, learning, computational thinking.

Abstract

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This study in Montería evaluated a Scratch microlearning site designed to improve 8th-grade students' computational thinking skills, including problem-solving, sequence tracking, and pattern recognition. Employing a design science methodology and qualitative approach, the research found that the microlearning strategy effectively enhanced these skills and improved academic performance in technology. Students reported high satisfaction, finding the approach fun and educational.

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Introduction:

In today's digital age, the development of computational thinking has become an essential component of education, enabling students to address complex problems and develop crucial skills. According to Wing (2006), computational thinking is a skill that we all must develop, as it allows and aids in efficient real-life problem-solving. Thus, Zapata (2015) and Vázquez et al. (2019) propose that computational thinking enhances the development of critical thinking, creativity, and collaboration, among others, through a didactic and interactive problem-solving process in the classroom.

Scratch is a visual programming language that allows students to be introduced to computational logic in an attractive and accessible way (ScratchEd Team, 2015). In their research, Alvedy García and Jimenez (2020) confirmed that Scratch made a positive contribution to the students' teaching process because it involves students in their learning process and allows them to improve their results and academic performance. Trabaldo et al. (2017) mention that "Learning in the digital age is increasingly associated with mobility and ubiquity, and it takes place in contexts where the line dividing formal and informal learning is increasingly blurred." (p.1).

This research focused on the implementation of a microlearning site to improve problem-solving skills and the ability to follow sequences in 8th-grade students (group 8-2) at the INEM Lorenzo María Lleras educational institution in Montería, Colombia. To do this, the students' needs were identified, then the microlearning site was designed, and finally, its effectiveness regarding Scratch learning was evaluated. The research arose from the need to address the difficulties present in students regarding the development of computational thinking, evidenced by low results in the Bebras tests (see Figure 1) and a lack of mastery of the Scratch platform.

Participation by grade and average grade/score.		
Grade	Average of good results obtained	# students
8°	4,79	91

9°	5,66	100
10°	5,82	11
11°	5,99	102
Total	**5,52**	**304**

Figure 1. Participation and average grade/score of the INEM Lorenzo María educational institution

The literature compiled in this research on microlearning in education highlights its capacity to optimize knowledge acquisition through short content units, accessible anytime and anywhere. This facilitates active student participation and individualized learning.

MATERIALS AND METHODS

This study was conducted under a qualitative approach, aimed at understanding the students' skills and perceptions, as well as relevant aspects of the teaching-learning process in the area of technology and informatics. According to Taylor and Bogdan (1992), qualitative research focuses on the observation and analysis of participants' behaviors and perceptions. The objective of qualitative research is to understand the world of lived experience from the point of view of the people who experience it.

The Design Science (DS) methodology was followed, which, according to Hevner et al. (2024), integrates scientific and design principles for the creation of innovative solutions to complex problems, to generate prescriptive knowledge about artifact design and how it can contribute to the improvement of future practices.

The Design Science process was developed in six steps, following the model proposed by Peffers et al. (2020):

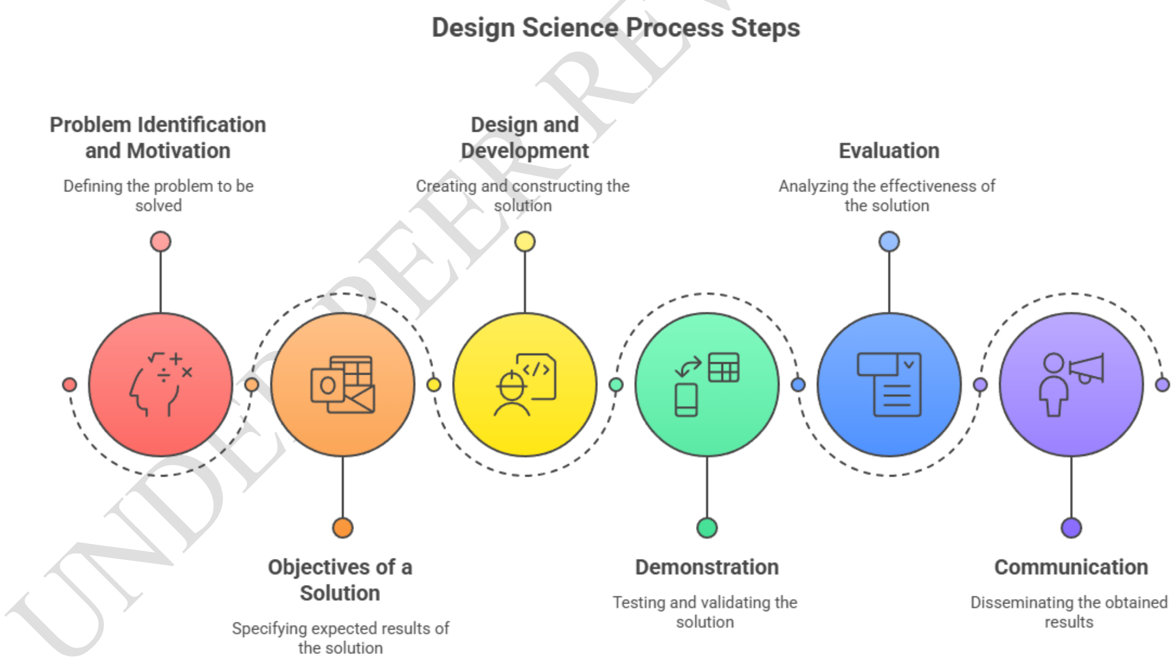

Figure 2. Adapted of Design Science methodology model Peffers et al. (2020)

1. Problem identification and motivation: Clear definition of the problem to be solved.

2. Objectives of a solution: Specification of the expected results when implementing the solution.

3. Design and development: Creation and construction of the designed solution.

4. Demonstration: Testing and validation of the solution.
5. Evaluation: Analysis of the effectiveness of the implemented solution.
6. Communication: Dissemination of the obtained results.

Population and sample

This research was conducted at the INEM Lorenzo María Lleras educational institution, located in Montería, Córdoba. The study population consisted of eighth-grade students, with a sample of 30 students (15 male and 15 female) aged between 12 and 16 years from grade 8-2, selected due to the difficulties they presented.

Techniques and data collection instruments

Various techniques and instruments were used for data collection, including interviews, surveys, and observation grids.

- **Interviews** In this study, two interviews were conducted with the technology and informatics teacher: an initial one to understand needs and resources, and a final one to obtain her perception of the intervention results. According to Cohen and Manion (1990), the interview systematizes information gathered from a person or a group of people by following a planned set of questions.

- **Surveys** Two surveys were designed, an initial and a final one, aimed at the 8th-grade students (8°2). The initial survey collected information about their learning preferences and technological resources, while the final survey evaluated the effectiveness of the microsite for learning Scratch. According to Liliana Sanjurjo (2011), the survey serves as an educational tool, as it can be used with teachers and students to address a problem.

- **Observation Grid** The observation grid allowed for the recording of students' behavior and performance during class sessions. In each class, a record was kept of the students' interaction with the microsite and their performance in the proposed activities. According to Miles and Huberman (1994), this instrument works to organize qualitative data during the implementation process.

RESULTS AND DISCUSSION

The implementation of the educational strategy hosted on Google Sites, with dosed content, demonstrated the strengthening of problem-solving and sequence-following skills in the target study population. This strategy allowed students to access content flexibly and progressively, optimizing knowledge retention. The teaching and learning process became an enjoyable and accessible space for carrying out practices and receiving instant feedback through online activities on Educaplay, which promoted an autonomous experience in the students' learning process, thereby sparking their interest and motivation in the subject matter. The results show clear progress in the ability to break down problems and follow sequences, reflecting the strategy's effectiveness.

The online activities on Educaplay showed that most students understood the theory and were able to apply it in practice, improving their academic performance. The microsite was designed considering the students' learning preferences, thereby fostering autonomy and flexibility in the educational process, allowing access to content anytime and anywhere. Both the students and the teacher expressed a positive perception of the microsite, highlighting its fun and didactic design, which increased motivation and interest in learning Scratch.

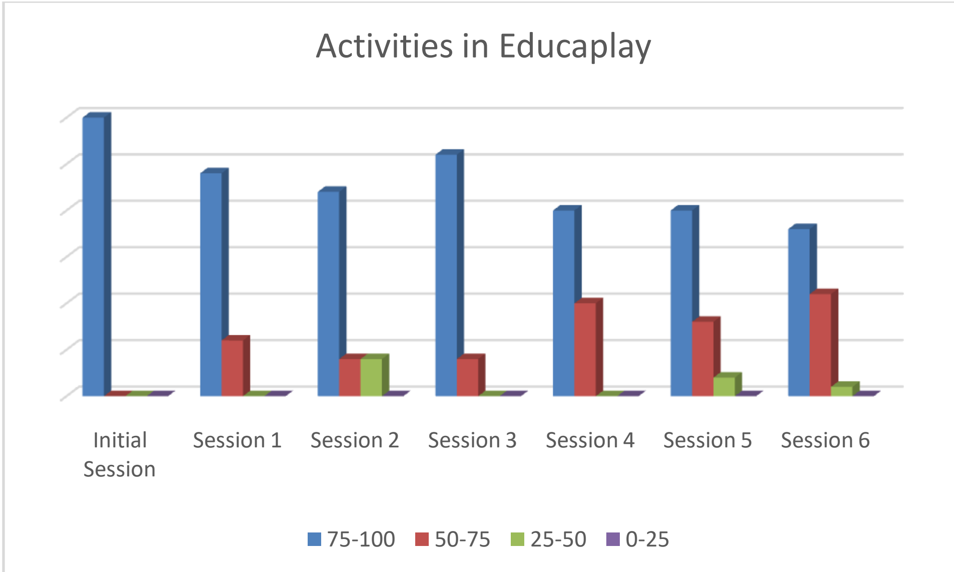

Figure 3. Results of online activities on Educaplay

The results obtained confirm the effectiveness of microlearning as an innovative strategy to support Scratch learning and the development of computational thinking. The microlearning site, by offering concise content, multimedia resources, and practical activities, managed to capture students' attention and facilitate the understanding of complex concepts. The inclusion of online activities with immediate feedback, such as those on Educaplay, was fundamental in maintaining students' motivation and engagement throughout the learning process. However, it is important to consider the connectivity limitations present for some students, for which the inclusion of more practical activities that do not require an internet connection is recommended.

Regarding the problems encountered during the intervention process, the results obtained were that:

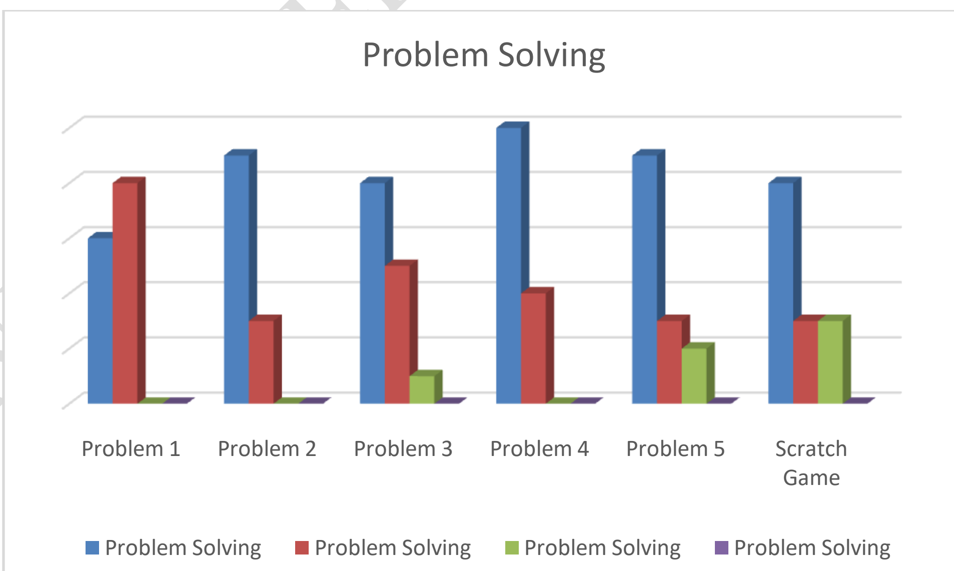

Figure 4. Results of the problems presented in the intervention

In problem 1, 42% completed the task, and 58% needed assistance. In problem 2, 64% completed it, and 36% required help. In problem 3, 58% finished it, 34% asked for assistance, and 8% left it incomplete. In problem 4, 72%

completed it, and 28% needed help. In problem 5, 65% finalized it, 21% required assistance, and 14% left it incomplete. In the Scratch activity, 58% completed the task, 21% asked for help, and 21% left it incomplete.

Regarding the limitations of this study, it was confined to a single eighth-grade group from the educational institution. It is recommended to conduct studies with a larger sample to obtain generalizable results. Furthermore, this study focused on learning Scratch, and its impact on other areas of the curriculum was not evaluated.

It is recommended to:

7. Include more practical and offline activities in the microsite.
8. Use platforms like Educaplay for immediate feedback.
9. Expand the research to other educational levels.
10. Integrate microsites for complex technology topics.
11. Apply diverse pedagogical approaches, considering resources and connectivity.
12. Conduct talks with teachers about the benefits of emerging technologies in learning.

CONCLUSIONS

The conclusions obtained from the analyses and findings demonstrate that:

The intervention developed through the microlearning site showed a positive impact on the development of students' computational thinking. They significantly improved their skills and knowledge regarding problem decomposition, pattern recognition, and algorithmic thinking. This is ratified by the results obtained in the activities and the teacher's positive perception.

The results obtained from the online activities on Educaplay showed that most students understood the theoretical part of the subject, managing to apply this knowledge in the development of practical activities on the Scratch platform, thereby improving their academic performance.

According to the results of the initial survey regarding student learning preferences, these were taken into account in the microsite design process. The incorporation of these preferences into the microsite allowed for flexibility within it; therefore, students could access content adjusted to their preferences at times outside the classroom, fostering autonomy at their own learning pace.

The students and the teacher expressed a positive perception towards the microsite and its impact on the educational process. Students found the site fun and didactic, which increased their motivation and interest in learning Scratch. The teacher observed greater interest and participation from the students throughout the intervention process, especially in class activities.

The results were mostly positive; however, some students have neutral comments and ratings regarding the implementation of the educational strategy. This suggests conducting an analysis of the entire intervention process developed in order to find aspects to improve and make adjustments that increase the acceptance and effectiveness of the strategy.

The microsite was effective in supporting the Scratch learning process and the development of computational thinking. The intervened population showed significant progress in the development of theoretical-practical knowledge and skills related to Scratch and algorithmic thinking compared to other groups of the same grade that did not have access to the microsite.

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