EduSol
Vol. 25. Publicación Continua
ISSN: 1729-8091
(https://edusol.cug.co.cu)

Valoración neutrosófica del uso de Educaplay para mejorar el rendimiento académico en matemáticas
Neutrosophic Evaluation of Educaplay Usage to Improve Academic Performance in Mathematics

Ramón Cornelio Yankur Tsukanka[1]
Ramiro Eduardo Larreategui González[1]
Roger Martínez Isaac[2]
[1]Escuela Medardo Ángel Silva. Ecuador
2Universidad Bolivariana de Ecuador. Ecuador
ORCID: https://orcid.org/0009-0003-7977-1069
https://orcid.org/0009-0007-4735-1069
https://orcid.org/0000-0002-5283-5726
Correo electrónico(s):
roymanyankur1@hotmail.com
larreategui39pich@gmail.com
rmartinez@ube.edu.ec

Recibido: 14 de enero de 2025
Revisado: 17 de febrero de 2025
Aceptado: 05 de marzo de 2025

RESUMEN: Educaplay se presenta como una herramienta innovadora para la enseñanza de las matemáticas, abordando la necesidad de métodos didácticos efectivos. Este estudio evalúa su implementación en la Unidad Educativa "Luis A. Martínez" para mejorar el rendimiento académico en cuarto año de Educación Básica. Se analizan factores como accesibilidad tecnológica, capacitación docente, integración curricular y respuesta estudiantil. La incorporación de Mapas Cognitivos Neutrosóficos (NCM) permite un análisis profundo de interdependencias en el proceso educativo. Este enfoque holístico busca no solo mejorar el aprendizaje inmediato, sino también establecer un modelo replicable y sostenible para futuras innovaciones educativas.
Palabras clave: Métodos; Didácticos; Mapas; Cognitivos; Neutrosóficos; Tecnología; Educaplay

ABSTRACT: Educaplay emerges as an innovative tool for mathematics teaching, addressing the need for effective didactic methods. This study evaluates its implementation at the "Luis A. Martínez" Educational Unit to improve academic performance in the fourth year of Basic Education. Factors such as technological accessibility, teacher training, curriculum integration, and student response are analyzed. The incorporation of Neutrosophic Cognitive Maps (NCM) enables an in-depth analysis of interdependencies in the educational process. This holistic approach seeks not only to enhance immediate learning but also to establish a replicable and sustainable model for future educational innovations.
Keywords: Methods; Didactic; Maps; Cognitive; Neutrosophic; Technology; Educaplay

Introduction

The teaching of mathematics has traditionally been one of the greatest challenges in education. Conventional methodologies, although effective in certain contexts, often fail to capture the interest and active participation of all students (Van de Walle, Karp & Bay-Williams, 2013). Based on these inadequacies and the epistemological study conducted, the scientific problem identified was: How to contribute to raise academic achievement in mathematics in fourth grade students of Basic Education in the Luis A. Martínez Educational Unit?

In fact, in recent years there has been a growing interest in incorporating digital tools in the classroom. Educaplay, a platform that allows the creation of interactive educational activities, has gained popularity for its versatility and ability to adapt to different learning styles. This technology not only facilitates the understanding of complex mathematical concepts, but also fosters a more dynamic and collaborative learning environment (Gojak, 2016). So the implementation of Educaplay in mathematics education is not without its challenges. Identifying the critical elements that ensure its success is fundamental to maximize its educational benefits. Among these factors, teacher training and availability, the technological infrastructure available and the adequacy of the contents to the curricula are aspects that require a thorough evaluation.

One of the emerging methods to analyze and manage these key elements is the use of Neutrosophic Cognitive Maps (NCM). This advanced technique allows modeling and visualizing the complex relationships between multiple variables, providing a powerful tool for informed decision making. NCMs offer a unique perspective by incorporating degrees of truth, falsity and indeterminacy, thus reflecting the uncertain and multifaceted nature of the educational process. The present study focuses on the Luis A. Martinez Educational Unit, an institution committed to pedagogical innovation and the continuous improvement of its students' academic performance. In this context, the implementation of Educaplay in the mathematics curriculum for students in the fourth year of Basic Education has been proposed (Schoenfeld, 2017).

Indeed, this group of students, at a crucial stage of their education, will greatly benefit from a methodology that combines academic rigor with attractive technological resources. To this end, a research has been designed that considers both qualitative and quantitative aspects, i.e., a mixed approach. Teachers' perceptions, students' reactions, and academic results measured through standardized assessments form the core of the data collected. Additionally, an NCM analysis has been incorporated to delve deeper into the interactions and dependencies among the various factors identified.

The initial analysis has revealed several areas of interest, such as teacher training, which emerges as a decisive factor. A teacher well trained in the use of Educaplay can transform classroom dynamics, making mathematics accessible and entertaining. However, the lack of adequate technological resources can become a significant obstacle, underlining the need for strategic investments in infrastructure (Boaler, 2016). Another crucial aspect is the adaptation of educational content. Interactive activities must align with the official curriculum objectives, ensuring that they are relevant and consistent with established academic standards. In this sense, Educaplay's flexibility to customize activities is a notable advantage, but requires careful planning and constant monitoring (Rowland & Ruthven, 2017). Therefore, this study aims not only to evaluate the implementation of Educaplay in the specific context of the "Luis A. Martínez" Educational Unit, but also to provide insights and strategies that can be applicable to other educational settings.

The combination of emerging technologies and advanced analytical methods, such as NCMs, represents an opportunity to revolutionize the teaching of mathematics and significantly improve students' academic performance.

Development

Research on academic achievement in mathematics has identified personal and social factors that influence student performance. These include intelligence, aptitudes, class attendance, family environment and socioeconomic context. Traditionally, mathematics teaching has followed a structured approach, but the incorporation of innovative methodologies and technology is transforming learning, and to improve performance, it is essential to foster a safe environment where students can explore without fear of making mistakes. Technology, such as interactive software and online platforms, facilitates understanding of concepts and enables personalized learning. However, its success depends on teacher training and proper integration into the curriculum.

Collaborative work in the classroom promotes different perspectives and develops social skills, strengthening the growth mindset. In addition, assessments must go beyond traditional tests, incorporating formative tools that reflect true student progress equitable access to educational resources is crucial to reduce socioeconomic gaps in learning. Mathematics education must be a joint effort between parents, teachers and administrators, creating support networks that enhance learning. A holistic vision, combining technology, innovative pedagogy and a positive learning environment, can transform mathematics education, fostering a lasting appreciation for this fundamental discipline.

Results and Discussion

In order to successfully implement Educaplay technology in the teaching of mathematics and raise the academic achievement of students in the fourth year of Basic Education at the Luis A. Martínez Educational Unit, it is crucial to consider several critical success factors. These factors are described below:

Table # 1.

Key elements for the implementation of Educaplay technology in the teaching of mathematics and the improvement of the academic performance of students in the fourth year of Basic Education at the Luis A. Martínez Educational Unit.

FACTORS
FCE 1 Teacher Training
- Continuous Training: Teachers must receive adequate and continuous training in the use of Educaplay, both in technical and pedagogical aspects.
- Technical Support: Availability of technical support to solve problems and doubts quickly.
FCE 2 Curricular Integration
- Planning: Align the use of Educaplay with the mathematics curriculum, ensuring that the interactive resources are integrated coherently into the curriculum.
- Clear Objectives: Define specific objectives for the use of Educaplay in each lesson and activity.
FCE 3 Access to Technology
-Adequate Equipment: Ensure that all students and teachers have access to appropriate devices (computers, tablets) and a reliable Internet connection.
- Technology Infrastructure: Ensure that the school's technology infrastructure supports the intensive use of online tools.
FCE 4 Adaptability and Customization
- Personalized Content: Create and use content that adapts to the students' level and pace of learning
- Diversification of Activities: Offer a variety of interactive activities that cover different aspects of mathematics and cater to diverse learning styles
FCE 5 Student Motivations and Engagement

- Gamification: Use gamification elements to make learning more attractive and motivating for students.
- Active Participation: Encourage active participation and collaborative learning through interactive activities and friendly competitions.
FCE 6 Evaluation y Feedback
- Periodic Evaluations: Implement periodic evaluations to measure the progress and effectiveness of using Educaplay.
- Immediate Feedback: Provide immediate feedback to students to correct errors and reinforce concepts.
FCE 7 Educational Community Support
Parent Involvement: Involve parents in the educational process, informing them about the use of Educaplay and how they can support learning at home.
- Teacher Collaboration: Encourage collaboration among teachers to share best practices and educational resources.
FCE 8 Evaluation of Results
- Monitoring and Analysis: Constantly monitor students' academic performance and analyze data to adjust strategies and improve implementation.
- Research and Development: Be open to new research and developments in the educational field to continuously improve the use of Educaplay.

Source: Self elaboration

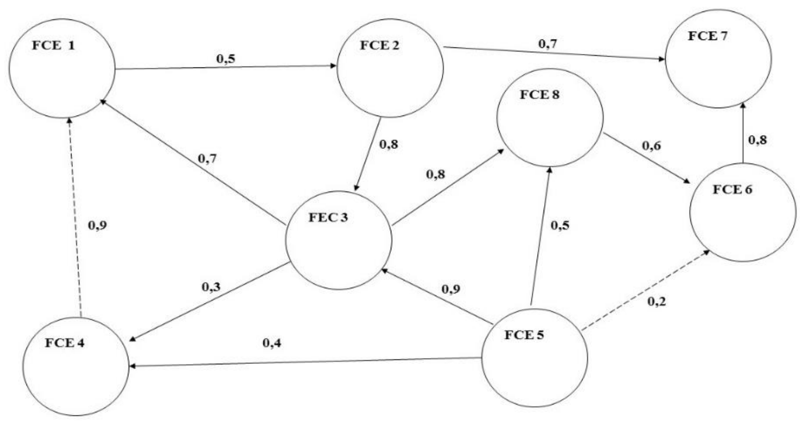
We believe that implementing these factors effectively can contribute significantly to improving students' academic performance in mathematics through the use of Educaplay at the Luis A. Martínez Educational Unit. These issues may vary in their impact on academic performance depending on the cultural and social context of each student.

The process was initiated by developing an NCM to represent the causal connections between the eight key elements for the implementation of Educaplay technology, which affect parental competencies according to Table # 1.

This stage involved defining the interactions between various factors and visualizing them in a Neutrosophic Cognitive Map, detailed in Figure # 1 and Figure # 2.

Figure # 1.

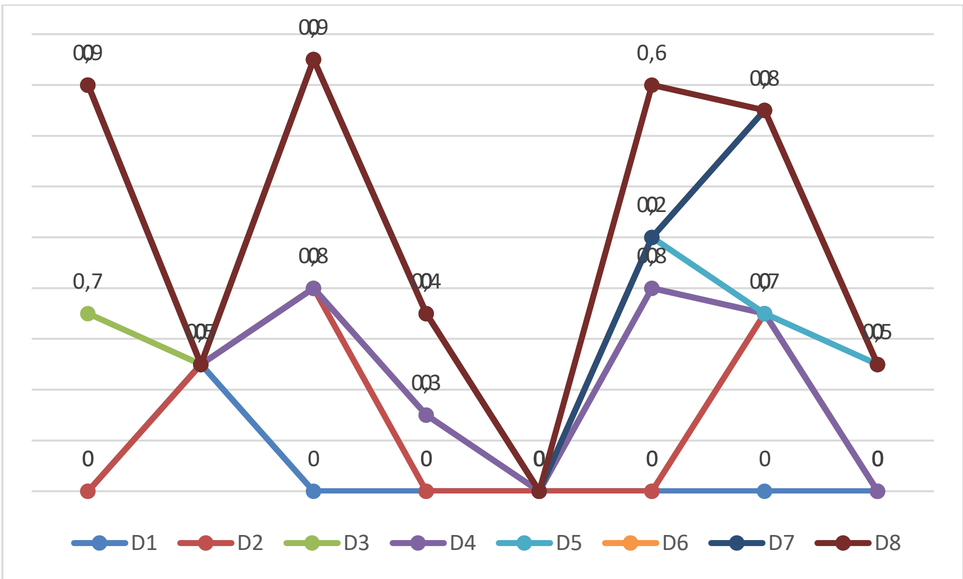
Neutrosophic cognitive map among critical success factors



Source: Own elaboration

Figure # 2.

Map of neutrosophic relationships between issues



Source: Self elaboration

The NCM is developed through the collection and representation of relevant knowledge. The adjacency matrix obtained, which is based on the neutrosophic values provided by the specialists, is detailed in Table # 2 as an essential tool to analyze and interpret the causal connections in the framework of the study.

Table # 2.

Adjacency matrix

	FCE1	FCE2	FCE3	FCE4	FCE5	FCE6	FCE7	FCE8
FCE1	0	0 5	I	0	0	0	0	0
FCE2	0	0	0.8	I	0	I	0.7	0
FCE3	0.7	I	0	0.3	0	0.8	0	0
FCE4	0.9	0	0	0	0	I	0	I
FCE5	I	0	0.9	0.4	I	0.2	I	0.5
FCE6	I	0	0	0	I	0	0.8	0
FCE7	0	I	0	0	0	0	0	0
FCE8	I	0	I	0	I	0.6	0	0

Source: Self elaboration

Following this perspective, the centrality measures calculated are presented below (Table # 3). These metrics provide a quantitative analysis of the relative relevance of the nodes within the network framework, which is crucial to understand the dynamics and impact of the various components in the analyzed system.

Table # 3.

Centrality analysis

Node	od(vi)	Identification(vi)	td(vi)
FCE1	0,5+I	1,6+3I	2,1+4I
FCE2	1,5+2I	0,5+2I	2+4I
FCE3	1,8+I	1,7+2I	3,5+3I
FCE4	0,9+2I	0,7+I	1,6+3I
FCE5	2+3I	0+3I	2+6I
FCE6	0,8+2I	1,6+2I	2,4+4I
FCE7	0+I	1,5+I	1,5+2I
FCE8	0,6+3I	0,5+I	1,1+4I

Source: Self elaboration

In the context of the static analysis in the NCM, initial results are obtained that incorporate the indeterminacy element "I" within its neutrosophic values. To refine these results, it is essential to perform a process known as de-neutrosophication, recommended by Latreche *et al.* (2020).

This process consists of substituting the indeterminacy parameter I, which ranges from 0 to 1, considering in this case "I" as 0.5. The importance of this method lies in its ability to produce more defined and precise results, which significantly simplifies the understanding of the interconnections present in the analysis in question, thus being observed in Table # 4, Table # 5 and Figure # 3.

Table # 4.

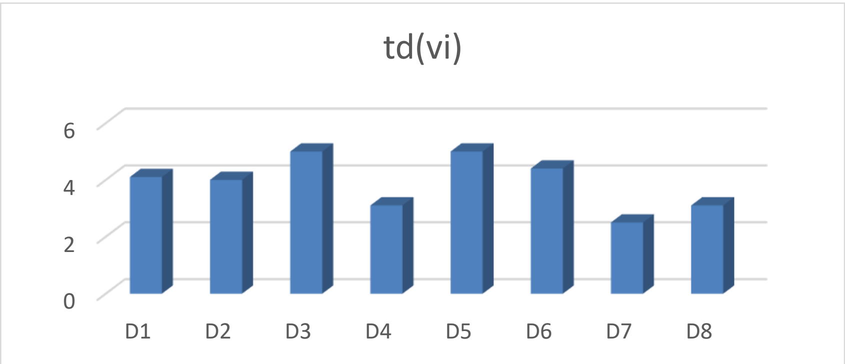
Deneutrosified centrality

Nod	*td(vi)*
FCE1	4.1
FCE2	4.0
FCE3	5.0
FCE4	3.1
FCE5	5.0
FCE6	4.4
FCE7	2.5
FCE8	3.1

Source: Self elaboration

Figure # 3.

Deneutrosified centrality



Source: Self elaboration

Table # 5.

Deneutrosified centrality ordered from highest to lowest

Factor	Deeutrosophized Centrality
Access to Technology	5,00
Student Motivation and Engagement	5,00
Evaluation and Feedback	4,40
Teacher Training	4,10
Curricular Integration	4,00
Adaptability and Personalization	3,10
Evaluation of Results	3,10
Educational Community Support	2,50

Source: Self elaboration

Evaluation of critical factors for the implementation of educaplay in mathematics

The integration of innovative technologies in education, such as Educaplay, has the potential to transform the teaching of mathematics. However, for this transformation to be effective, certain Critical Success Factors (CSFs) need to be assessed and secured. Based on the de-utrosophized centrality of these factors, a deep and applicable understanding of how to optimize the implementation of this tool in the classroom can be developed.

Let us analyze and assess these factors in detail:

- Access to technology emerges as a crucial element, scoring highest in centrality. This is not surprising, since, without an adequate technological infrastructure, any attempt to integrate digital tools would be hindered.
- Fourth-year Basic Education students and teachers at Unidad Educativa Luis A. Martínez must have adequate devices and a reliable Internet connection to take full advantage of Educaplay. This infrastructure need is a basic requirement, and any deficiency in this aspect can compromise the effectiveness of the entire initiative.

- Motivation and engagement of the students of the Luis A. Martinez Educational Unit are also of utmost centrality, reflecting their importance in the educational process.
- Using gamification elements within Educaplay can make learning more engaging and keep the fourth year Basic Education students of the Unidad Educativa Luis A. Martínez engaged.
- Active participation through interactive activities and friendly competitions fosters a dynamic and collaborative learning environment. Here, motivation refers not only to momentary interest, but to the development of a positive attitude toward learning mathematics
- Evaluation and feedback are vital to ensure that the use of Educaplay is not only a novelty, but an effective educational tool.
- Implement periodic evaluations with the objective of obtaining feedback on the learning of mathematical content, enabling the teacher to work on the difficulties detected and adjust strategies that make it possible to raise the academic performance of students in the fourth year of Basic Education.
- Teacher training is another crucial factor, with a high centrality. Continuous training and technical support are fundamental for teachers to feel comfortable and competent in the use of Educaplay.
- Curricular integration must be carefully planned to ensure that Educaplay is aligned with the mathematics curriculum. This involves defining clear objectives and ensuring that the interactive resources are integrated coherently into the curriculum.
- Diversification of interactive activities can cater to different learning styles, ensuring that all students benefit from Educaplay. This requires a continuous effort to adjust and personalize educational resources.
- Involving parents in the educational process and informing them about the use of Educaplay can create a supportive environment at home.
- Encouraging collaboration among teachers to share best practices and educational resources can enhance the implementation of this tool.

Conclusions

The study shows that the integration of innovative technologies, such as Educaplay, in the teaching of mathematics has great potential to transform the educational experience and improve academic performance. However, for its effective implementation, it is essential to have a robust technological infrastructure that guarantees access to appropriate devices and a reliable Internet connection for students and teachers at the Luis A. Martínez Educational Unit. In addition, gamification and active participation through interactive activities have proven to be effective strategies to maintain student engagement, fostering a positive and sustained attitude towards learning mathematics. The application of periodic assessments and immediate feedback allow for quick error correction and reinforce the assimilation of content.

Likewise, ongoing teacher training in the technical and pedagogical use of this tool is key to maximizing its impact. The diversification of interactive activities favors attention to different learning styles, ensuring that all students benefit from Educaplay, which requires a continuous effort in the personalization of educational resources. This proposal is not only applicable to mathematics, but can also be extended to other subjects, adapting to their particularities.

Finally, it is recommended to future researchers in Educational Technology to continue deepening in this line of study, since there are still multiple possibilities of exploration and optimization from the pedagogical and didactic point of view.

Bibliographic references

Boaler, J. (2016). Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages, and innovative teaching. *Educational Studies in Mathematics*, *93*(2), 301-322.

Gojak, N. L. (2016). Teaching mathematics for understanding: Challenges and strategies. *Journal of Mathematics Teacher Education*, *19*(2), 101-119.

Latreche, A., Barkat, O., Milles, S., & Ismail, F. (2020). Mapeos neutrosóficos de valor único definidos por relaciones neutrosóficas de valor único con aplicaciones. *Neutrosophic Sets and Systems*, *1*, 203-220.

Rowland, T. D., & Ruthven, K. (2017). Mathematics teaching: Enhancing instructional practices. *International Journal of Mathematical Education in Science and Technology*, *48*(4), 415-432.

Schoenfeld, A. (2017). *Mathematical problem solving. In Handbook of Research on Teaching and Learning Mathematics*(pp. 123-145). Springer.

Van de Walle, C., Karp, K., & Bay-Williams, J. (2013). *Elementary and Middle School Mathematics: Teaching Developmentally*. Pearson.