# The inclusion engineer with STEAM in the educational institution

## *El ingeniero de inclusión con STEAM en la institución educativa*

## *O engenheiro de inclusão com STEAM na instituição de ensino*

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## Abstract

*Introduction:* This article is the product of research carried out in an educational institution in the city of Neiva, where young researchers, in their role as inclusion engineers within higher education, work on video game design through Kodu, during the years 2017 to 2019, in a teaching-learning process of Mathematics and Natural Sciences in primary school with the STEAM methodology.

*Objective:* Strengthen skills in mathematical logic, creativity and environment as a basis for future engineering in fifth grade students.

*Methodology:* The research was of a mixed type, using a documentary analysis for performance levels in mathematics and natural sciences in fifth grade, an observation protocol for the characterization of the population, and a verification test in the creation of video games.

*Results:* As part of the statistical analysis, significant progress is evidenced in the results obtained during the three years, and in conclusion, it is considered that the STEAM methodology is adequate to work with Kodu as the appropriate programming environment for the development of competence through video game design in the educational process.

*Conclusion:* The young researchers assume the role of inclusion engineer, using the Kodu programming environment with a STEAM learning methodology that integrates Science, Technology, Engineering, Art and Mathematics through the creation of their own video games, with representative bases to start in the world of engineering.


**Keywords:** STEAM, Kodu, education, video game.


## Resumen

*Introducción:* El articulo es producto de una investigación realizada en una institución educativa en la ciudad de Neiva, donde jóvenes investigadores en su rol de ingeniero de inclusión desde la educación superior, trabajan el diseño de videojuegos mediante Kodu, durante los años de 2017 a 2019 en un proceso de enseñanza - aprendizaje de Matemáticas y Ciencias Naturales en la escuela primaria con metodología STEAM.

*Objetivo:* Fortalecer las competencias en lógica matemática, creatividad y medio ambiente como base para futuros ingeniero en estudiantes de grado 5.

*Metodología:* La investigación fue de tipo mixta, utilizando un análisis documental para los niveles de desempeño en matemática y ciencia naturales en grado quinto, un protocolo de observación para la caracterización de la población, una prueba de verificación en la creación de videojuegos.

*Resultados:* Como parte del análisis estadístico se evidencia un progreso significativo en los resultados obtenidos durante los tres años, y como conclusión, se considera que la metodología STEAM es la adecuada para trabajar con Kodu como el entorno de programación apropiado para el desarrollo competencia mediante el diseño de videojuegos en el proceso educativo.

*Conclusión:* Los jóvenes investigadores asumen el rol de ingeniero de inclusión, utilizando el entorno de programación Kodu con metodología de aprendizaje STEAM que integra Ciencias, Tecnología, Ingeniería, Arte y Matemáticas a través de la creación de videojuegos propios, con bases representativa para iniciar en el mundo de la ingeniería.


**Palabras claves:** STEAM, Kodu, educación, videojuego.


## Resumo

*Introdução:* The article is the product of a research carried out in an educational institution in the city of Neiva, where young researchers in their role as inclusion engineer from higher education work on video game design

through Kodu, during the years 2017 to 2019. in a teaching - learning process of Mathematics and Natural Sciences in primary school with STEAM methodology.

*Objetivo:* Fortalecer habilidades em lógica matemática, criatividade e meio ambiente como base para engenharia futura em alunos do 5º ano.

*Metodologia:* A pesquisa foi do tipo misto, usando uma análise documental para níveis de desempenho em matemática e ciências naturais no 5º ano. protocolo de observação para caracterização da população, um teste de verificação na criação de videogames.

*Resultados:* Como parte da análise estatística, evidencia-se um progresso significativo nos resultados obtidos ao longo dos três anos, e em conclusão, considera-se que a metodologia STEAM é adequada para trabalhar com o Kodu como ambiente de programação adequado para o desenvolvimento de competência através do design de videogames no processo educacional.

*Conclusão:* Os jovens pesquisadores assumem o papel de engenheiro de inclusão, utilizando o ambiente de programação Kodu com uma metodologia de aprendizagem STEAM que integra Ciência, Tecnologia, Engenharia, Arte e Matemática através da criação de seus próprios videogames, com bases representativas para iniciar no mundo de engenharia.

**Palavras-chave:** STEAM, Kodu, educação, videogame.

# 1. INTRODUCTION

According to [1], STEM is the acronym used in the United States during the educational approach that has generated important policies for academic processes developing didactics to strengthen the teaching of engineering, mathematics, technology and science. This process involves different activities, such as workshops, conferences, lectures, etc. According to [2], in STEM+A engineering students experience the creation of innovative structures through the use of specific elements, while complying with restrictions determined by the instructor, who seeks to connect those "hard" concepts of science, technology, engineering and mathematics with real problems. That is, the teaching-learning process is active and collaborative between disciplines, using creativity to generate practical solutions from an early age; scientific and engineering curiosity are promoted and remain in them naturally.

STEAM is used in the academic community so that students and teachers integrate knowledge and can make decisions, solve problems, work in teams, develop creativity and strengthen their communication activities, among others. Thus, integrating STEAM is considered the appropriate didactic strategy to dynamize and generate significant learning, where the teacher or tutor articulates a flexible action plan with procedures that dynamize learning. Therefore, the inclusion engineer contributes in educational institutions to the development of competencies supported with video games designed in software tools that fit their skills, as well as using the

STEAM methodology for the development of critical thinking, imagination, creativity and problem solving, which impact competencies [3].

On the other hand, as a complement to STEAM, video games have an important place in the culture of children and adults, and can be used as educational tools, from the teaching and learning process, where children develop their imagination and narrative thinking; they can dream with different worlds, contexts, and play with video games to live fantastic experiences either as a hero, or solving specific problems that must be overcome in the course of the game [4].

The video games developed from the classroom require theories such as the behaviorist theory, where the child's learning involves a change of behavior to use the technological resource; in the case of the constructivist theory, with the idea that knowledge is not transmitted by the teacher, but the student builds it by interacting with its context, in a dynamic and interactive way. It can be stated that what is clear in the use of technology in the classroom is the opportunity for collaboration to have access to content, in relation to the type of technological tool and the management of this at the appropriate time for learning [5].

According to [6], software systems integrate daily activities to be used in different devices as applications developed and implemented by human beings, in this case benefiting the teaching-learning process. It is important to identify how teachers develop methodologies with appropriate structures to strengthen the training process that, through software tools and educational robotics, motivates the child and youth population, thus guaranteeing future engineers [7]. In the same way, [8] proposes a strategy from the classroom, used to solve the inverse kinematics that involves the precise prediction and solutions with the training data in a neural network related to the direct kinematics of the robot; with homogeneous transformation matrices and solution positional geometry of each joint. On the other hand, serious games are used in the educational process with computer tools that support social interaction and encourage the desire to learn [9], being able to include them in the classroom to strengthen learning difficulties is representative.

There are video game projects developed in Kodu, from the Kodu community whose official page allows access to video games that have been developed worldwide and can be accessed, downloaded and used to learn by playing, either by teachers to support teaching-learning processes in the classroom or outside it. In the Kodu community there are video games developed from 2011 to 2018. Specifically in Latin America, various projects have been developed: In El Salvador, a 3-D video design program, developed through Kodu developed computational skills in elementary students in schools. In Ecuador, English learning is encouraged with Kodu, with Kodu-created

narrative stories from national events, all oriented to the learning of the English language [10]. In Chile, video games have been used to support the development of ICT skills in teacher training with Kodu. Teacher training students (future secondary school teachers) from the University of La Serena in the "Educational Informatics" course of the Pedagogy in Mathematics and Computer Science career developed video games to support their teaching practice under the concepts of the Project Based Learning methodology [11]. In Colombia, the project creation of video games in natural sciences used the Kodu programming environment in extracurricular spaces with sixth grade students of the Colegio Gimnasio Cantabria, in La Estrella, Antioquia. Information was collected based on the application of the sequence, through videos, a field diary and interviews with students [12].

According to Cabrera et al., an educational video game can be considered a Virtual Learning Object used to help promote self-study and learning with the help of ICT. According to Sanchez et al., a video game can be considered as a digital resource encoded to be manipulated by a computer and used as a virtual aid, conformed by a series of digital actions whose purpose is to support teaching-learning processes. The use of video games in the classroom is in line with a theory of education based on the critical educational model with a competency approach that emphasizes the constructive development of knowing, doing and being [13]. From "knowing", according to Rosas, games "improve school performance, develop cognitive skills and motivate learning" [14]. According to Higgins, "they improve logical and critical thinking and in problem solving skills". According to Kirriemuir and Mcfarlane, "they improve concentration, thinking and strategic planning" [15], and from "being" values, according to Dondi, Edvinsson and Moretti, "video games allow the development of social skills" [16].

Finally, according to Alvarez, "From video games, children can learn in a different way and develop other skills" [17]. According to Sanchez et al. 88% of students use video games and 12% do not use them as support in their academic activities.

Kodu is considered as a video game programming environment, being a visual programming tool that is based on the ideas that started with Logo. Logo appeared in the 1960s, created specifically to develop games providing their own scenarios and designed to be accessible by children, youth and adults, it is user friendly. The programming environment runs on Xbox, allowing fast design interaction using only a single gaming device for input. The core of the Kodu project is the simple, icon-based programming user interface. Programs are composed of pages, which are broken down into rules, which are subdivided into conditions that lead to actions [18].

The video games elaborated in Kodu are expressed in physical terms, using concepts such as vision, hearing and time to control the behavior of the characters. In addition, it can express advanced game design concepts in a simple, direct and intuitive way, providing easy tools to create 3D landscapes and provide control of lighting and cameras. It involves the selection of tiles, incorporates primitive elements of real life: collision, color, vision, movement and avoids writing code by having users build programs using visual elements through a game controller [19]. The video games in Kodu are executed in a 3D simulation environment. It has an interactive terrain editor giving the possibility to build worlds of different sizes with bridges and paths. It has 20 objects as shown in Figure 5. Finally, Kodu has been used as a dynamic learning tool in the classrooms of schools and learning centers. Kodu contains different screens to start development [20].

Kodu Game Lab is a 3D game development environment designed to teach children and young adults basic programming principles. Kodu allows creators to build the terrain of the world, populate it with characters and props, and then program its behaviors and game rules in a customized image [21]. It is necessary to provide clarity regarding its graphical interface. Figure 1 shows the main menu of Kodu with its respective usage options (Resume, New Empty World, Load World, Community, Options, Help, and Quit Kodu) [22].

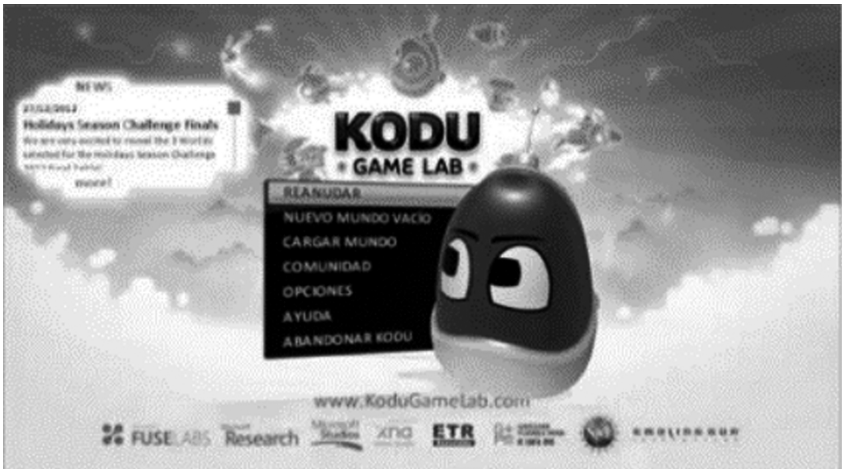


**Figure 1.** Kodu main menu - options.
**Source:** Own work.

Figure 2 shows a new empty world without character, only with a fragment of green grass scenery. Also shown at the bottom is the tools menu offered by Kodu to work on the development of the video game.


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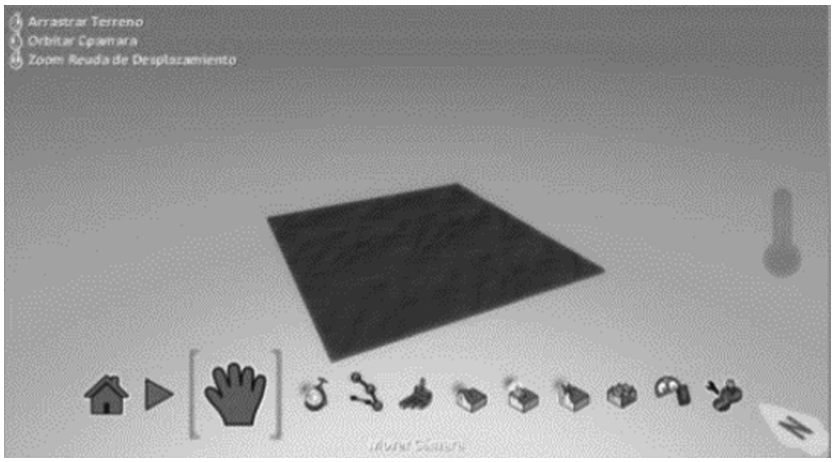


**Figure 2.** Empty world - Kodu tools.
**Source:** Own work.

Table 1 shows the icons of some of the tools available in Kodu for the development of video games and their respective functions.

**Table 1.** Kodu menu tools.

| Icon | Function |
|---|---|
|  | Restart the world, save the world, load a new world, generate a new empty world, print the code for the level and exit to the main menu. |
|  | Execute the world. |
|  | Move the camera across the stage; either pan forward, backward, right, left and rotate the view. |
|  | Add objects, program them and access their options. |
|  | Add route paths, edit existing routes and add nodes to existing routes. |
|  | Add materials to the stage, with options to choose the type of material and how the material is painted on the stage. |
|  | Raising, smoothing or lowering the terrain to create valleys and hills. |
|  | Smoothing or leveling the ground. |
|  | Create hilly ground by crumpling, smoothing or turning the terrain into hills. |
|  | Create water, raising or lowering its level. |
|  | Mass deletion of elements. |
|  | Change the configuration of the world. |

**Source:** Kodu Game Lab [23].


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Figure 3 shows a world created in Kodu, its respective placement and toolbar.

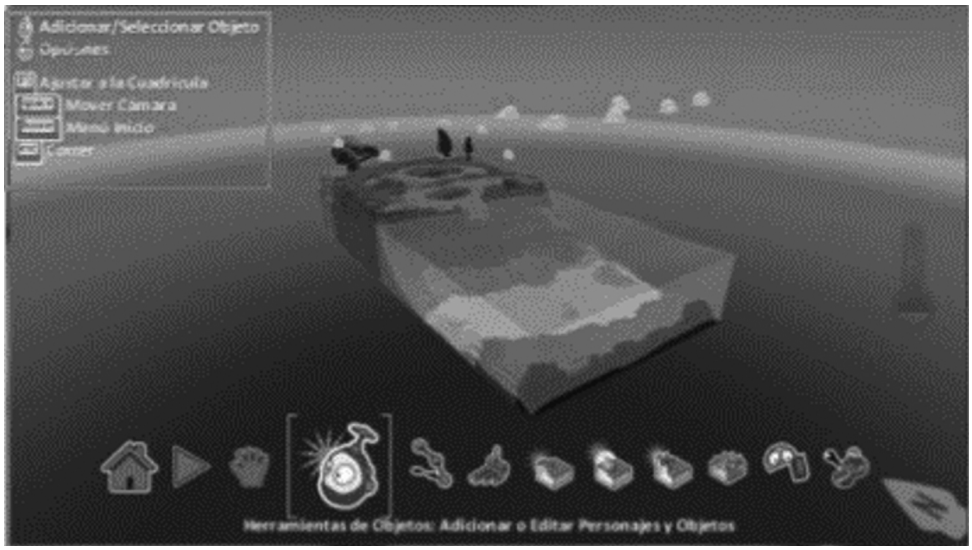


**Figure 3.** Terrain and toolbar.
**Source:** Own work.

Figure 4 presents the objects offered by Kodu to start programming them (apples, trees, and three other options).

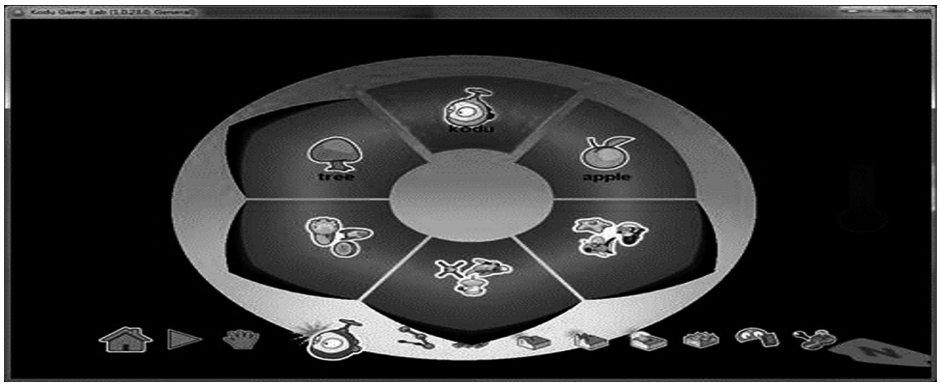


**Figure 4.** Kodu objects.
**Source:** Own work.

Figure 5 shows the set of objects that can be added to the terrain, which can be programmed.

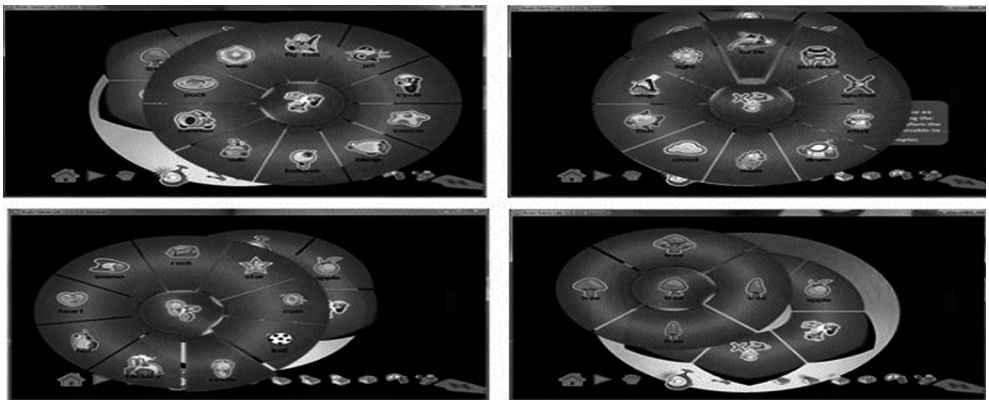

**Figure 5.** Objects to add to a terrain.
**Source:** Own work.

**Kodu programming - use of when-do statements.** The Kodu programming environment is based on conditionals (If ... then) and then the object must be told what to do when the given condition occurs. The condition is programmed with the **WHEN** statement and to indicate what to do with the **DO** statement; Kodu programming is done on objects created in the world, the idea is to tell the object what to do when something happens [23], it is so easy to program that the order of programming the objects does not matter, that is, the sixth statement can be the one to be performed first [24].

Finally, the competition event called Copa Kodu was held in Colombia in 2016, 2017 and 2018; developed at the Universidad Cooperativa de Colombia headquarters Neiva and led by the students of the systems engineering program with the objective that children of primary, basic and middle education of the educational institutions of the department of Huila develop necessary criteria in mathematical logic competence and environment [25].

**Kodu in education.** Video games in Kodu are part of our culture and have become a new way of communicating. According to Garcia, a video game is an "interactive computer program for entertainment that can run on various devices: computers, consoles, cell phones, tablets, etc.; it integrates audio and video, and allows you to enjoy experiences that, in many cases, would be very difficult to live in reality" and according to Alvarez "today it has been found that video games serve as support tools in teaching and learning processes". In education, video games are currently in fashion. They are activities that attract children and young people as Brian Eno points out in his lecture "Video games, present and future": "If you look at children, they play all the time, but what do they do when they play? They imagine. They try things out. They try to understand what other people think about things. Children learn by playing

and adults learn by art." Today it has been found that video games serve as support tools in teaching and learning processes [17].

On the other hand, according to Montes "The use of video games by children and young people has become very common, and they have been the subject of reflection and criticism, both for their content and for the high percentage of time this population spends in front of a television and/or computer" [26].

**Kodu a didactic resource**. A didactic resource is any tool used to support teaching-learning processes. According to Bohórquez, "they are materials that facilitate the teaching-learning process in the classroom, both for the student and the teacher. A board, crayons and paper, plasticine, bibliographic cards, figures, books, music, web pages, digital applications, a PowerPoint presentation, toys, masks, hats, among others, are some of the examples of didactic resources. Basically, any element can become a didactic resource if the teacher's criteria and creativity consider that it can be appropriate and beneficial in the educational context" [27].

**Kodu - mathematical logic and environment in elementary school.**

**Kodu and mathematical logic.** Kodu is a simple programming environment that is used to stimulate and motivate learning in children and young people through simple programming rules, in addition to fostering open mathematical thinking by allowing for the creation of mathematical logic games. The idea is not to make children play in an improvised way, but to play in a deliberate and planned way to achieve results.

Games favor the acquisition of flexibility and mental agility, promote ingenuity, creativity and imagination and stimulate inductive-deductive reasoning. In mathematics, video games are a strategy to develop mathematical logical thinking in children and young people; according to Irving and Cohen, "logic is the study of the methods and principles used to distinguish good (correct) from bad (incorrect) reasoning" [28].

**Kodu and Environment**. Today the concept of environment is linked to that of development. This relationship allows us to understand environmental problems and their link to sustainable development, which must guarantee an adequate quality of life for present and future generations [29].

Kodu offers a variety of video games focused on learning mathematics and the care and conservation of the environment; the video games can be seen on the Kodu community page.

On the other hand, the Colombian Institute for the Evaluation of Education (ICFES for its Spanish acronym) periodically applies the Saber tests to measure the performance levels of fifth graders in the areas of Spanish language, mathematics and natural sciences in Colombia. Table 2 shows the performance levels used by ICFES to measure the performance of schoolchildren in this test.

**Table 2.** Performance levels of the fifth grade Saber test

| Level | The average student placed at this level |
|---|---|
| Advanced | Shows outstanding performance in the expected competencies for the area and grade assessed. |
| Satisfactory | Has an adequate performance in the competencies required for the area and grade assessed. This is the expected level that all, or the vast majority of students, should achieve. |
| Minimum | Shows minimal performance in the competencies required for the area and grade assessed. |
| Insufficient | Does not pass the less complex questions of the test. |

**Source:** ICFES - Informe nacional, Saber 3, 5 y 9 [30]

Below is a summary of children's performance in the fifth grade Saber test in the areas of mathematics and natural sciences from the period 2013 to 2017. Figure 6 shows that, on average, 38.8% of fifth grade children are at the insufficient performance level and 29.2% at the minimum performance level; adding these two levels of performance we conclude that on average 68.7% of children are at an unsatisfactory performance level in the area of mathematics.

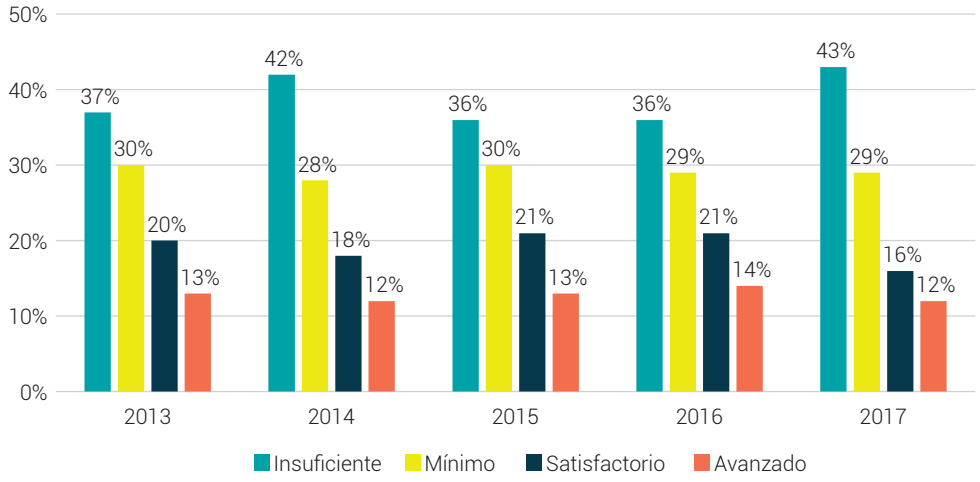


**Figure 6.** Percentage performance in the area of fifth grade mathematics in Colombia 2013 to 2017.
**Source:** ICFES [30]

Figure 7 shows that, on average, 16.0% of fifth grade children are at the insufficient performance level and 49.3% at the minimum performance level; adding these two levels of performance we conclude that on average 65.3% of the children present an unsatisfactory academic performance in the area of natural sciences.


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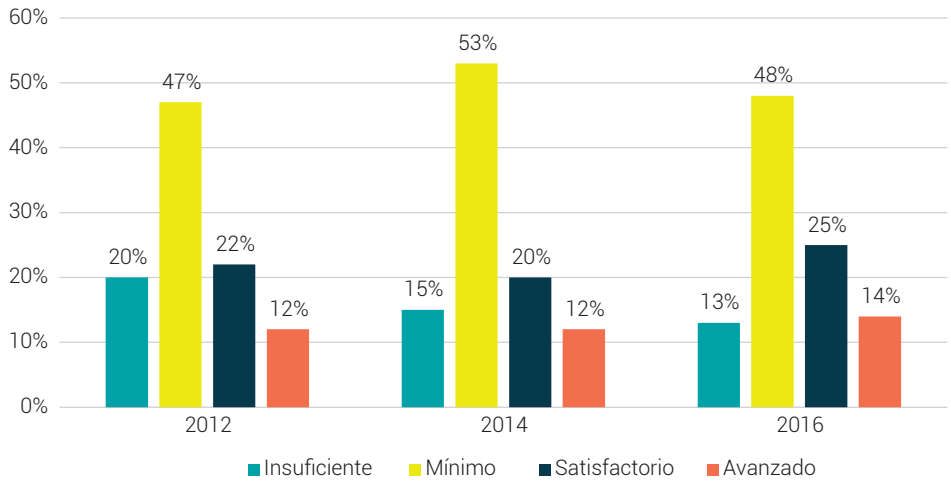


**Figure 7.** Percentage performance in the area of fifth grade natural sciences in Colombia 2013 to 2017.
**Source:** ICFES [30]

The above results do not contribute to the idea that by 2025 Colombia will be the most educated country in the region. Concerned about the above statistics, a series of strategies were initiated by the Universidad Cooperativa de Colombia to contribute to this goal; one of them, go to schools with young researchers of the systems engineering program and work with children and young people in video game programming in order to verify how it influences the design of video games through Kodu Game Lab to strengthen mathematical competence and understanding of the environment in educational institutions in the department of Huila.

Complementing the above, it was chosen to work with Kodu as a programming environment that allows children to design and develop a variety of types of games, which depend on the ingenuity, creativity, interest and purpose of each user. The video games that can be developed in Kodu include, adventure games, races, shooting, balls and missile trajectory, strategies, number games and puzzles, among others. Video games in Kodu are used to develop creativity, solve problems, tell stories or learn to program [31], contributing to personal and social development, knowledge, understanding of the world, language, literacy, creative and physical development [32].

# 2. MATERIALS AND METHODS

The project was developed over 3 years; the first year worked with a population of 400 students with a confidence level of 95% and a margin of error of 5%, obtaining a sample of 197 students. For the second year we worked with a population of 370

students with a confidence level of 95% and a margin of error of 5%, obtaining a sample of 190 students. And in the third year we worked with a population of 350 students with a confidence level of 95% and a margin of error of 5%, obtaining a sample of 184 students. As part of the participatory research, Microsoft's Kodu Game Lab was used as a software resource to be used at school during the three years in fifth grade of basic education with children and young people, developing the ability to design, program and later use their own video games in the classroom to mediate pedagogical processes. The research carried out was of a mixed type, as a technique for obtaining information, a documentary analysis of performance levels in mathematics and natural science, an observation protocol and a verification test in the creation of video games, which verifies the skills acquired in mathematical logic and environment, was used as a reference for the validity of these instruments as proposed by [33] and Cronbach's Alpha [34].

Figures 6 and 7 show the low levels of performance in the areas of mathematics and natural sciences in fifth grade. Kodu has been used in schools as a didactic resource to mediate pedagogical processes. Researchers and young researchers from the Fisvir, Educational Innovation and Innovative Leaders research seedbeds, with support from Microsoft MVP [35], worked in institutions in the department of Huila for three years in a process of formation, training in the design and development of video games in Kodu, where the children were authors of their own video games, attending to the needs and contexts that improve their performance levels in the areas of knowledge that need to be strengthened. Table 3 shows the characterization of the participants, making it clear that they belong to educational institutions in the public sector:

**Table 3.** Characterization of participants

| Description | 1st year | 2nd year | 3rd year |
|---|---|---|---|
| Sample | 197 | 190 | 184 |
| Age | 8 to 11 years | 8 to 12 years | 9 to 11 years |
| Sex Female | 118 | 101 | 90 |
| Sex Male | 79 | 89 | 94 |
| Stratum 1 | 98 | 87 | 102 |
| Stratum 2 | 99 | 103 | 82 |

**Source:** Own work.

The research variables used in the verification of the creation of video games can be found in Table 4.

**Table 4.** Operationalization of variables

| Variable | Operationalization (categories included) |
|---|---|
| Creativity | The child presents innovative design ideas in the video game that produce original solutions. |
| Environmental issues | The child evidences in the video game the environmental theme relevant to the environmental competence. |
| Mathematical process | The child evidences the mathematical process in the video game relevant to mathematical logic competence. |
| Use of the sofware | The child evidences appropriate use of the Kodu Game Lab programming language. |
| Adequate design | The child evidences the appropriate design of the worlds with the respective characters and accessories suitable for programming their behaviors and rules of play. |

**Source:** Own work.

For each variable, the significance level according to the criterion met is associated with: low = 1, acceptable = 2 and high = 5, according to the video games created with Kodu Game Lab.

For the development of the training process, the STEAM methodology is used to strengthen Knowing, Doing and Being and performance.

# 3. RESULTS

For the training process of children and young people in video game design it was necessary to perform the validation of the instrument by obtaining the internal consistency index through the calculation of Cronbach's Alpha:

$$\alpha = \frac{k}{k-1}\left[1 - \frac{\sum Vi}{VT}\right]$$

**Figure 8.** Equation Cronbach's Alpha.

Where "k" represents the number of items, "Vi" the variance values for each item and "VT" the total sum of the scores, obtaining α=1, considering this result as a good consistency of the verification test instrument.

The purpose of working with video games is to develop mathematical logic and environment based on topics related to behavior, pedagogy, environment and care and conservation involving mathematical processes.

The research participants used Kodu texts and the Internet to document the games they created (texts, videos, games, official Kodu website).

Figure 9 presents the aspects to be developed in the training course, including aspects of: Kodu generalities, mathematical logic and creativity, environment and conservation.

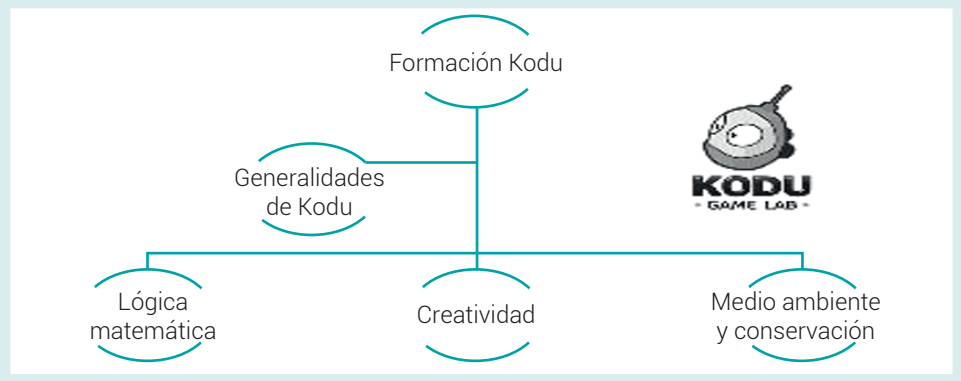


**Figure 9.** Kodu training program.
**Source:** Own work.

The results obtained from the verification test in the creation of video games made by the children are shown in Table 5.

**Table 5.** Results of video game creation

| Result | 1st year | 2nd year | 3rd year |
|---|---|---|---|
| Under | 70 | 74 | 79 |
| Acceptable | 97 | 89 | 80 |
| High | 30 | 27 | 25 |

**Source:** Own work.

For the statistical analysis, the video games with acceptable and high criteria in compliance with the proposed research variables are used as a reference, as presented below.

**Table 6.** Statistical analysis of the research variables

| DESCRIPTION | 1st year | 2nd year | 3rd year |
|---|---|---|---|
| Median | 2.53 | 3.06 | 3.14 |
| Variance | 0.60 | 0.40 | 0.33 |
| Standard Deviation | 0.77 | 0.63 | 0.58 |
| Coefficient of variation | 0.31 | 0.21 | 0.18 |

**Source:** Own work.

According to the above table, the representative years in terms of the degree of participation and development of the mathematical logic component and environment during the design of video games with all the requested criteria, was in the 1st year, with a mean was 2.53, variance of 0.6, standard deviation 0.77, with a coefficient of variation of 0.31.

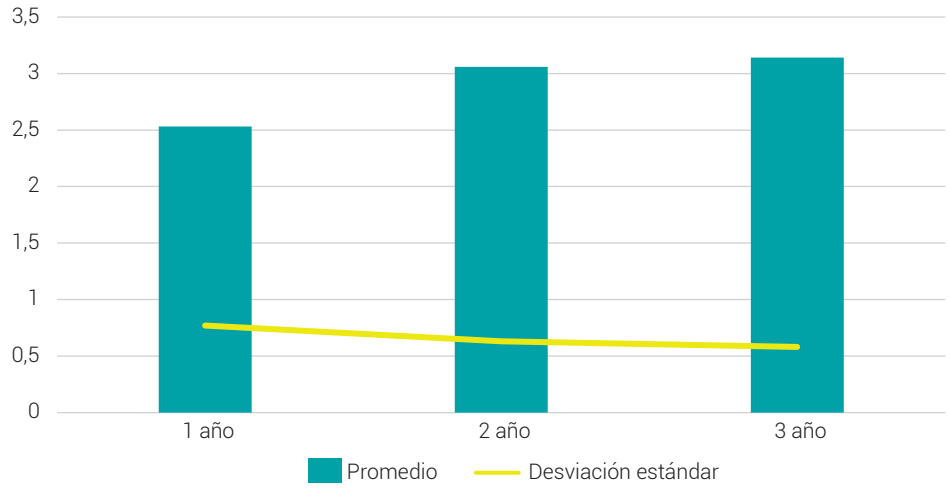


**Figure 9.** Comparison of results in terms of average and standard deviation.
**Source:** Own work.

Significant progress is observed in the results obtained due to the fact that in the 1st year the competencies were evaluated with an average of 2.53, increasing these competencies progressively in the following two years, reaching an average of 3.14; in addition, the standard deviation decreased.

The video games developed in Kodu can be considered a didactic resource, because when used in education it has helped learning and in training; as demonstrated in the field of treatment of learning problems it has helped to solve problems, answering issues related to school, drugs, family, moral aspects, etc. Video games can increase motivation for learning various subjects such as mathematics, science, and education as a whole [36].

Logical-mathematical games promote the understanding and use of mathematical content, as well as the development of logical thinking, favor the development of self-esteem, relate mathematics to a fun-generating situation, allow the development of collaboration and teamwork, and encourage the performance of mental calculations.

# 4. DISCUSSION AND CONCLUSIONS

In science, video games allow students to become aware of environmental care and conservation. The analysis of the relationship between ecosystem and culture in general is the environment in which an organization operates, which includes air, water, soil, natural resources, flora, fauna, humans, and their interrelationship. In this context, the environment extends from within an organization to the global system.

For the coming years, we intend to continue with the project involving the STEAM methodology, and by means of an instrument to assess the levels of competencies and performance using Kodu in children and young people who could benefit from this process.

**Table 7.** STEAM methodology, competencies from Knowing, Doing and Being and performances.

| Methodology | Competence | Performance |
|---|---|---|
| **S: Science** | Know | The children acquired knowledge about the environment and the factors that pollute it, the different components of an ecosystem and the relationships that are established in them. They understood the changes and problems that occur in nature due to human action and the way in which living beings interact with each other. They learned about activities aimed at improving living conditions. |
| | Make | Children learn to apply scientific thinking (posing questions, ways of proceeding, evaluation strategies, inferences, etc.) to enable them to understand and solve problems about the natural and technological world - designing a video game to solve an environmental problem. |
| | Be | The children learn to value the environment, to propose strategies to conserve and take care of it, they approached reality in a scientific way. |
| **T: Technology** | Know | Children will acquire techniques to search for, obtain, process and communicate information and transform it into knowledge, including the use of Information and Communication Technologies as generators and transmitters of knowledge and communication, developing digital competence - publishing the video game.- |
| | Make | Children acquire skills related to multimedia and ICT applications for searching, selecting, recording and processing or analyzing information from traditional sources (books, dictionaries, atlases, social media, etc.). |
| | Be | Children demonstrate a positive attitude towards new information and communication technologies as a potential source of personal and social enrichment. |
| **E: Engineering** | Know | The child identifies, formulates and solves an engineering problem by conceiving, designing and developing a video game solution to an environmental problem using the Kodu programming language. |
| | Make | The child learns to effectively use the Kodu programming language, techniques and tools of application in engineering, contributing to the generation of technological developments and/or technological innovations - a video game -. |

*(continúa)*

*(viene)*

| Methodology | Competence | Performance |
|---|---|---|
| **E: Engineering** | Be | The child acquires skills to work in teams, communicate effectively with peers, act ethically, responsibly and with social commitment, considering the economic, social and environmental impact of their activity in the local and global context, to learn continuously and autonomously, to accept that mistakes can also be learned from mistakes and to act with an entrepreneurial spirit, to be a leader and often to improvise a solution. Development of communicative competence. |
| **A: Art** | Know | The children will acquire basic knowledge of the main techniques, resources and conventions of the different artistic languages, as well as of the most outstanding works and manifestations of cultural and environmental heritage. |
| | Make | Children learn to appreciate cultural facts in general and artistic facts in particular. This implies having those skills and attitudes that allow access to its various manifestations, as well as thinking, perceptual and communicative skills, sensitivity and aesthetic sense to be able to understand them, value them, get excited and enjoy them. |
| | Be | The children reach an attitude of appreciation of the creativity implicit in the expression of ideas, experiences or feelings through different artistic media, such as music, literature, visual and scenic arts, or the different forms acquired by the so-called popular arts. In addition, through the design of the video game (cartoon or story board) they acquired the ability to transform ideas into actions, learning not to attack their classmates, to communicate, to interact, to decide in a group, to take care of themselves, to take care of the environment and to value social knowledge. |
| **M: Math** | Know | Children will acquire the ability to use knowledge and management of basic mathematical elements (different types of numbers and their operations, measurements, symbols, geometric elements, etc.) in real or simulated situations of everyday life, and the implementation of reasoning processes (logical thinking) that lead to solving problems or obtaining information in a logical and creative way, allowed the child to develop the competence of learning to learn. |
| | Make | Children will acquire the mathematical logical thinking skills necessary to apply those skills and attitudes that allow them to reason mathematically, understand a mathematical argument and express themselves and communicate in mathematical language, using the appropriate support tools, and integrating mathematical knowledge with other types of knowledge to provide a better response to life situations of different levels of complexity |
| | Be | The children modified their attitude towards the study of mathematics, they had fun with it and valued its use in the solution of an environmental problem, they lost the environment towards its study. They showed favorable disposition and progressive security and confidence towards the programming of the video game. |

**Source:** Own work.

Kodu is a language that invites teachers and students to design and develop their own video games. It offers an easy and fun programming environment, while making them excited about computer science (programming), mathematics (mathematical logic) and natural sciences (culture in terms of the care, conservation and preservation of the environment).

The programming software used for the creation of video games was Kodu game lab, which allows the development of mathematical logical thinking in children, the foundations of computer programming, oriented to the development and conservation of the environment, in the area of mathematics and natural sciences.

Kodu enables children, youth and adults to create, innovate and build their own digital tools adjusted to their contextual needs to mediate and dynamize their daily work. This makes them creators and producers of their own tools instead of consumers of them.

The video games used in the classroom as a mediating tool for pedagogical processes favored the strengthening of mathematical logic and environment using Kodu.

Video games by themselves have the ability to motivate and trap children in the game, it is the teachers' obligation to play the game before taking it to the classroom to reorient its use and achieve its pedagogical objective in a fun way that attracts and motivates the child towards learning, taking advantage of the technological skills that the child has and making use of the new Information and Communication Technologies (ICT) in education.

The use of video games in the classroom breaks the paradigm of using the classroom as a traditional scenario for the appropriation of knowledge. The development of logical-mathematical competence and the learning of natural sciences focused on the environment implies the acquisition of strategies to solve problems in an autonomous and critical way in the face of the current reality in this globalized world.

Appropriate monitoring of learning is important, with dynamics to develop knowledge, skills and attitudes, strengthened with evaluation tools and techniques that show good learning.

The STEAM methodology is suitable for young researchers in higher education who assume the role of inclusion engineers, transmitting knowledge to children or young people in basic and secondary education institutions who develop competencies using video games.

Finally, it can be said that neither the teacher nor the student needs to be an engineer to design and program video games as a complement to their teaching-learning processes. The implementation of video games to mediate learning processes applies to any course and no matter the age of the learner (child, youth or adult), with the addition that the design and programming of video games motivates students to acquire lifelong learning.

# 5. LIMITATIONS

This article is the product of research carried out in an educational institution in the city of Neiva, where young researchers, in their role as inclusion engineers within higher education, worked on video game design through Kodu, for three years in a teaching-learning process of Mathematics and Natural Sciences in primary school with the STEAM methodology.

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