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Khan Academy: Estrategia metodológica para el aprendizaje de las gráficas de funciones trigonométricas

Khan Academy: Methodological strategy for the education of the graphic of trigonometric functions

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ABSTRACT

The investigation was aimed at determining Khan Academy's effectiveness as a methodological strategy for second year students' learning in relation to graphs of trigonometric functions at general high school. It was developed from a mixed methodological approach. The learning of trigonometric functions was very satisfactory and the average of the course was $9.77 / 10$, up to standard minimum score required for the approval of the school year, that is, $7/10$. As a result, the use of Khan Academy was directly related to the highest scores on standardized boards, being a very interactive and motivating tool, since its structure and functionality provided a dependency between the student and mathematics, generating a sense of commitment, self-regulation and responsibility, which was materialized with achievements in their learning and academic results.

Descriptors: Educational software; educational technology; mathematics; equations. (Palabras taken from the UNESCO Thesaurus).

INTRODUCTION

Mathematics is a subject that creates difficulties in learning and causes a lack of interest in students. The curricular programs focus on complying with content, without considering their quality. Teachers limit themselves to repeating the topics periodically without taking into account the students' concerns, needs and interests that arise during the training process, applying 19th century methods.

In this regard, authors such as (Caballero-Jiménez & Espínola-Reyna, 2016) mention that in the State of Mexico, despite the fact that education has a competency model, teachers continue handling traditionalism with their students. For this reason, they are forming subjects that are reproducing concepts, laws and theories, which are not previously analyzed or discussed, but are learned without acquiring skills that allow the student to develop competencies that serve them in professional life. All this constitutes a great concern for the educational community, the authorities and the government; because they realize that there is not a technological and scientific progress, which influences economic improvement at the personal, municipal and especially national

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level.

In Ecuador, both in basic and high school levels, learning in the Mathematics subject has been focused on memorizing and repeating rules, laws and concepts given in class, without considering tools that facilitate students' reasoning. This reality, possibly, avoids overcoming numerical illiteracy and generating skills that allow students to be competent and to function in the mathematical world.

At the Dr. Gabriel Sánchez Luna School, located in the Cojitambo Parish, Azogues Canton, Mathematics teachers at the time of the classes on graph of trigonometric functions, consider the blackboard as the unique resource and the use of colored markers to try to differentiate the main graphs as a strategy. Such a situation denotes the traditional view that they assume with the teaching-learning process, which does not arouse interest or importance in the subject matter. That is why the teachers must provide the necessary support in the teaching processes of mathematical subjects. It will correspond to him to be a mediator with the appropriate use of tools for the development of learning and the overcoming of difficulties, which are evident in the performance of their students. Consequently, (Saltos-Cedeño, et al., 2020) presents the use of technological tools to support the learning strategy as an option.

As such, the Ecuadorian curriculum stipulates that the use of Information and Communication Technologies [ICT] is essential to develop the subject of trigonometric function graphs for the second year of high school, (Ministry of Education of Ecuador [MINEDUC], 2016). In this sense, the Khan Academy platform is a tool that can play an important role around the mathematics learning strategy, to improve teaching practice and develop skills in the students of that year.

Currently, learning mathematics is a challenge for each of the students both at the basic level and at the high school level, because there is a variety of topics, some accessible for learning and others few viable. The contributions of (Méndez-Burguillos & Leal-Huise, 2018), suggest that traditionally the graph of trigonometric functions is taught only through lectures and with the use of school guides as a support for student learning. In

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this sense, it is important to change the teaching- learning of these contents through the incorporation of technological platforms in which students may interact according to their own interests (Muñoz-Vázquez, et al., 2020).

For this reason, the teacher must stay updated regarding the use of means and resources that may be feasible to achieve the educational objective. Therefore, according to (Sánchez-Luján, 2017), implementing teaching plans based on the generosity of ICT, for the various forms of learning, would create a correlation between the mathematical concept and its application in a favorable way to specific situations. As a result, it is important to generate an environment that may allow the student to generate a predisposition to learn not only mathematical concepts, but also self-management skills with ICT for achieving competencies.

Khan Academy is a platform whose objective is to provide digital education worldwide regardless of social classes. Authors such as (Silva, et al., 2017) refer that it has an extraordinary number of videos for educational purposes in various subjects, from History to the extensive storage of mathematical exercises, measuring data in real time problems that students present at the time of assimilating knowledge. Therefore, ICT and the Khan Academy platform are a complement of viable tools essential to generate change in teaching by teachers (Arroyo-Carrera, et al., 2020).

In this view, (Díaz-Perera, et al., 2018) express that the use of this resource in the Mathematics teaching allows students to adopt new learning scenarios in virtual platforms, improving their attitudes and their school performance. Hence, it is necessary to open new lines of application of Khan Academy in different topics such as trigonometric functions so that students can graph, not through traditional techniques to which they are accustomed, but through virtual platforms in this technological age.

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METHOD

The research had a mixed methodology approach. Regarding the quantitative part, the study was explanatory with a pre-experimental design of a single group. In this sense, the Khan Academy platform was used as a treatment strategy to teach trigonometric functions, prior application of a pre-test and a subsequent post-test, in order to compare their results by calculating the Student's t test (Hernández, et al. , 2014).

Regarding the qualitative part, the focus group with 6 students was used to interpret the results obtained. As a consequence, categories emerged in relation to the students' perception about the Khan Academy platform (Hernández, et al., 2014).

RESULTS

According to the data collected in the pre-test, the frequency of incorrect responses was 58 and the frequency of correct responses was 29. Likewise, with the post-test, after the treatment with the Khan Academy tool, 85 correct answers were obtained, and a minimum frequency of 2 incorrect answers.

The results showed that the traditional class in the subject of Mathematics, learning and academic performance is a challenge for each of the students, because there is no adequate motivation or methodology to address topics of difficult study. On the contrary, when the class becomes innovative, the learning frequencies have a very noticeable change. Therefore, Khan Academy is a valid methodological strategy for learning the graphs of trigonometric functions.

The progress registered in a class on the graph of trigonometric functions, before the intervention with the Khan Academy platform, was $\bar{X} = 1.00$ (3.33 / 10) and after of its execution was $\bar{X} = 2.93$ (9.77 / 10). In consequence, there is a very significant increase, according to the statistical test, $\bar{X} = +1.93$ (+ 6.44 / 10), that is, an academic achievement on a specific topic in a math class.

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In the focus group interview with the objective of determining how the Khan Academy strategy influences learning, it was possible to corroborate, through the perceptions of each of the students, that the platform is an effective methodology when addressing specific topics of the Mathematics subject.

Qualitative results analysis

Analysis Unit: Technology and Education

Category: Using Khan Academy platform

Segment:

-Relating technology with education is important. Adaptation to technology is easier from an early age, where students are individualized, but they also show us great diversity and learning styles, generating a great understanding of different themes.

□ The aforementioned relationship is necessary because students and young people adapt quickly to the field of technology, in this way, learning is faster and more effective.

□ Technology facilitates student understanding due to its immense number of tools such as: applications, videos, images, etc.

□ Khan Academy is considered a methodological strategy for learning, because it mainly motivates students to pay more attention, see the class easier, and also experiment with a new method or study strategy.

□ Through the Khan Academy application we have seen and analyzed procedures, in which we have participated as students with assessments and tasks, where the teacher becomes a support for learning, and mathematics an element for research.

-This Khan Academy application helps us to understand, analyze, and perform exercises faster and easier.

The methodological strategies must have logic that allow not only participation but also analysis to reach a clear understanding of the subject within an educational platform.

Platform Features

□ For students to access it, the content must be coherent, possess logic and clarity, so that it may be understood and put into practice.

□ Among the characteristics of a strategy, the analysis constitutes one of them, since it focuses on identifying principles and procedures that allow enriching learning processes, promoting a motivating space and strengthen attitudes and affection.

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Analysis unit

Learning mathematics

Category:

Trigonometric functions graphs

Segment:

- ☐ Khan Academy platform facilitates graphs of trigonometric functions in a clear, concrete and precise way.
- ☐ The Khan Academy application strengthens the learning of the graphs of trigonometric functions due to the style that this platform has.
- ☐ Performing the graph of trigonometric functions is easier with the Khan Academy methodological strategy, since there is greater recruitment of students and even improves the relationship with their teachers.

Category:

Performance

Segment:

- ☐ The performance has improved notably when using Khan Academy due to the fact that it arouses greater interest and dedication to the subject, causing greater ease of understanding, especially, learning correctly in a short time.
- ☐ Khan Academy encourages self-learning by advancing at the pace of each one and also allows evaluating the level of knowledge to initiate a discovery and exploration of new knowledge obtaining better results.
- ☐ Learning is easier and we can understand better with the tools that the platform has, such as videos, examples, hints to solve exercises, which facilitate obtaining a good score and, therefore, high academic performance.

Analysis Units and Categories

Use of Khan Academy platforms

It is very important to relate technology to education, since today's students are digital natives, so the adaptation to this medium is much easier. The use of Khan Academy provides a series of benefits since it contains videos and images that improve the ability to reason, understand and be more efficient with respect to the topics covered. In this research, due to it was a platform that, specifically, offered explanations, solved and

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proposed exercises to answer; it constituted a methodological strategy that sparked interest in the subject of Mathematics.

Platform Features

Educational platforms specifically Khan Academy is a methodological strategy that has characteristics to motivate the student by the clarity of the topics and logic; it encourages the student to discover, understand its operation and encourage participation; It also makes learning active and interactive by helping the student build their own knowledge.

Graphs of trigonometric functions

The construction of graphs of trigonometric functions occurred in an easier and faster way through Khan Academy, since it is a platform, which as a methodological strategy, allows learning in a different way through videos and with many practical exercises, so the students get a better understanding by strengthening learning.

Performance

Developing the process of teaching the graphs of trigonometric functions mediated by the Khan Academy platform allowed students to participate and study at their own pace, using the appropriate time and space to keep interacting with the program and achieve good engagement. Thus, Khan Academy motivated dedication, encouraged understanding and above all facilitated the process of solving exercises with the method that the application has, generating a high academic performance with respect to the subject of graphs of trigonometric functions.

Discussion of results

The results obtained clearly show that the execution of the Khan Academy platform as a methodology for learning the graph of trigonometric functions, achieved the deployment of significant learning in high school students. As a way to validate the premise, the results are submitted for discussion with reference to authors and research on the subject:

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The Khan Academy tool or platform was used as a methodological strategy for learning the graph of trigonometric functions. Consequently, the data indicated that the performance of the students has increased notably, which agreed with the study carried out by (Díaz- Perera, et al., 2018) where there was a very significant group average above the minimum passing score.

Considering that the learning of mathematics must be exercised in daily life, and that technology allows access to constantly enable educational platforms; the Khan Academy, as a platform, is an ideal available option that may be used at any time so that students enter self-confident, motivated and without any fear. In addition, it encourages constant learning, by having characteristics that adjust to the current reality of students such as video, images, etc. This argument is in agreement with (Ramírez-Ochoa & Vizcarra-Brito, 2016), because they affirm that the intervention of the platform increases student performance by being evaluated in such a way that they are already adapted.

All the aforementioned shows that students strengthen the construction of knowledge when they have the ability to exercise self-regulation; that is, when they may attend the course or class under their own dosage criteria, in relation to energy, time and resources; likewise, when they may maintain interested, active and interactive, seeking the path of discovery. These characteristics are decisive for generating significant learning at the moment of facing new themes of mathematics, which can be used at any stage of later life. For these reasons, the use of the Khan Academy platform in high school students is proposed as a methodological strategy for learning the Mathematics subject.

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PROPOSAL

The implementation of the Khan Academy platform as a methodological strategy for learning the graph of trigonometric functions of the Mathematics subject is based on four basic aspects: planning, execution, monitoring and evaluation, in order to improve academic performance in high school students. .

Description of the aspects:

Planning: It is a key part of the process, since before the implementation of the Khan Academy educational platform; the teacher must carefully examine the design of their classroom planning; that is, what is related to the current national curriculum, the digital resources to be used and the methodological strategy. Since it is a facilitator of the process, aimed at developing objectives through a challenging and motivating environment, the teacher must analyze the resources and the platform tools they have, navigating from 5 to 10 minutes to assign the documents, videos, exercises and final evaluations carefully. Then they may integrate them in the classroom planning for the development of the pedagogical process, taking into account that the most outstanding characteristic is online learning.

Execution: The implementation of Khan Academy plays a very different role in the students compared to the traditional class. In this case, the teachers must facilitate the learning process through practical support, considering that they are not the only ones who possess the knowledge; thus, motivation and dynamics totally change. Therefore, after seeing the new topic, the teachers are the ones who ask their students to practice on the platform for about 20 minutes, to solve one of the requested exercises. To do this, learners become more independent by taking on challenges and satisfying their needs and interests, acquiring self-control of their own path and learning experience because they make use of supporting documents, interactive videos, images and graphics that allow them to live their reality, facilitate their adaptation to the handling of complex subjects and visualize in several dimensions. Furthermore, such tools allow the teachers not to spend valuable class time by drawing formulas or figures and even

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solving exercises on the blackboard, thus worrying less about management and resources.

The exercises at Khan Academy teach students responsibility and self-discipline as they are now the ones to complete them. Some will even solve a second exercise that the teachers request, others may be stymied in the first exercise, but having a clue or video available to see and review the concept. The prizes that are obtained serve to motivate them to gain points as many as possible, and have as proof that they will be increasingly mastering mathematical skills.

Monitoring: In a traditional class of the Mathematics subject, students may observe and even develop various exercises; however, the teachers could not ensure who really solved, and who copied the correct answers. With Khan Academy, the interaction of students with mathematics radically changes, since it makes it easier for the teachers to monitor in the "Activity" tab and through their profile on the platform, they may track individually and clearly observe the progress and summary of such activity.

The platform offers a bank of exercises in a random way, which influences the students by discarding the copy level, since they will not be able to observe their partner in the answer mark; therefore, they have to complete a totally different exercise, being forced to solve it on their own. In addition, they will not be able to randomly mark the answers to the exercises in order to fulfill their obligation, since it requires the correct answer before continuing.

Assessment: The "Gamified" style of Khan Academy may break the anxiety of a traditional standardized test, where the students not only learn and respond with the objective of passing the academic year; but rather with the desire to master skills. They feel that by using this platform they are committed to the content, they are faster and better when solving problems, as well as their score is exceeded, because the tasks are appropriate to learn equitably and without frustration and boredom.

This resource allows students to know if the answer is correct or incorrect immediately; but if they continue using similar strategies in spite of knowing that the first one was not

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appropriate, they will continue receiving reprimands, so they will be forced to look for other ways to solve their resolution procedures quickly. Students are able to perceive that they will not only listen, seek information and respond in a timely manner, but also they will think critically, logically and creatively. Finally, the teacher will review the reports provided by Khan Academy, and if they exceed a score greater than 70%, they will be able to address a new topic; otherwise, if the score is less than 70%, the student may continue practicing in the next class, thanks to the variety of exercises that it has.

CONCLUSIONS

KhanAcademy allowed students to set their own pace of study and learning, according to academic level. In addition, breaking traditionalism with an electronic device changed the perception towards the Mathematics subject, since it generated a vigorous commitment in the students, where the videos and images motivated them to take over the subject.

Considering the results, the learning of the trigonometric functions was very satisfactory because the average of the course was $9.77 / 10$, which was located above the minimum score required for the approval of the 7/10 school year. In other words, the use of Khan Academy was directly related to the higher scores in standardized tests; therefore, it has been a very motivating and an interactive tool that has allowed a close relationship between the students and mathematics; besides, it has created a sense of commitment, self-regulation and responsibility, acquiring achievements in the learning and academic results.

Finally, Khan Academy allowed individualized follow-up with each of the students in real time; likewise, it facilitated help to those who were stuck and supported those who wanted to deepen the content. The students were motivated all the time, showing interest in each exercise. The points and prizes awarded by the platform were incentives to empower the students to analyze the problems and their solutions; in addition, it helped students develop specific skills for evaluations necessary to graduate and even

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to enter college.

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