

An Open Educational Resource: Khan Academy for Mathematics and

Science Assement in Engineering

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Abstracts: One of the great opportunities of education today is to implement the use of mobile devices in their learning and evaluation processes. Technology gives us the opportunity to access quality information at the right time we need it, a situation that teachers must seize designing intervention strategies that integrate the use of an Open Educational Resource (Khan Academy) and mobile devices in the teaching-learning process and evaluation of Mathematics and Basic Sciences. The methods and procedures used in this research were qualitative and quantitative. Academics and attitude toward the subject results were compared. The results will determine if the strategy used favors learning and disposition towards the subjects through the use of these devices.

Key words: mobile devices, Khan Academy, assessment in mathematics, gamification

1. Introduction

Today, technology provides us with a unique opportunity to access quality information and in amounts never before in history had access were in the process of school, learning itself must take advantage to the maximum. It also has the potential students "Z Generation" technology natives who have grown up in a virtually connected world, where mobile devices and applications are part of our society.

From the new math curriculum for the high school level (Cantoral, 2017) it is promoted to favor the construction of mathematical knowledge in contextual situations, to promote the application in problem solving and the use of Information Technology and Communication (ICTs).

There are recent research that shows the use of technology as a teaching tool: authors like Rodriguez and Pierson (2014) present the use of Khan Academy in Chilean classrooms innovating in education to increase student participation in mathematics, Rodriguez (2015) shows the use of Khan Academy as an Open Educational Resource (OER) in a math class and Jara (2016) proposes the integration of mobile devices as a teaching strategy for studying mathematics at the high school level.

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The aim of this research is to show the application of an educational intervention strategy through mobile devices, which allows the integration of an Open Educational Resource (Khan Academy) in the teaching-learning and assessment of mathematics and science Engineering.

2. Problem Statement

Technological advances change the experience of interaction of the subject with the materiality of their environment, encouraging the creation of new paradigms in the development of epistemological knowledge. Likewise, they also generate profound changes in the dynamics and structures of social interaction, affecting their cognitive development processes shaping individuals.

The development of the "Information Age" and later the "Society of Knowledge" put the scope of the world's population the privileged opportunity to access quality information and quantities than ever before in history access were in the process school learning. Through Information Technology and Communication (ICT) it was blurring the gap in access to knowledge, as in previous eras classes was a "class privilege". The most extensive use of ICT have generated it — with a platform for the democratization of knowledge.

According to Prensky M. (2001) the rapid development of ICT (compared to the timing of the typical development of humans) promoted the formation of a generation of individuals who were born and grow around the activities involved and relevant to the use digital tools, whom he called "digital natives"; Meanwhile, those who were born in the previous technological paradigm and had to adapt to the use of such technologies called them "digital immigrants". Such differentiation is not an irrelevant question, since those who make responsible population group of the educational structure of a social group (teachers and administrators) may be part of a technological paradigm different from that of the population group that will receive the educational effort (students).

The final years of the twentieth century and advanced so far in the current century show that one of the current problems of education is that, besides being conceived as tedious something boring from young students who are receiving (digital natives), reflects underutilization of the teachers (immigrants digital) mobile devices as an educational tool, even though the use of ICT by young people today is one of its main strengths, we should use it to the maximum.

Between the generation of digital natives, such technologies have gone to play a role of "tool" (used as support in carrying out work involving human effort, but always keeping the vision of being external to the subject) to fulfill a function "prosthesis" (given that are fast becoming "part of the body" and "artificial extensions of the same" to potentiate their ability, projecting its use to the point of becoming "technology-dependent"). Those born after 2000 have been called "Z Generation", which have grown in a crisis environment, in which technology has developed at full speed, making the internet in its reference to time information, consume and interact. The report "Z Generation: The last generation gap", Ortega I., Soto I. and Cerdan C. (2016) state that "digital natives have a natural ecosystem of smartphones and tablets, communicate by whatsapp and bring technology into their genetic code. We are in the 'homo digitalis', the latter species in evolutionary theory."

According to Prensky M. (2001), among the fundamental characteristics of the Z generation that must be taken into account to propose an educational intervention strategy according to their interests, set out the following:

• They want to receive the information in a fast and immediate, which means that the content should be

presented in a timely and concise.

- They are used to work in dynamic multitasking and parallel processes (for example, watch a movie while reviewing their social networks).
- Organizers like to use diagramming, among others, to graphically stimulating creativity and better perception of content.
- They tend to function better and perform better when working with virtuality support provided by the network.
- Because they have grown in the context of rapid time feedback gives Network, they tend to seek activities that will provide immediate response to strengthen the awareness that they progress, which gives them immediate satisfaction and reward.
- They tend to be highly intuitive, so quickly they manage to be experts in understanding technology.
- They prefer to educate themselves in a playful way to undergo the rigor of traditional work. They want their activities generate constant emotions, otherwise the will for the boring consider.
- Finally, in line with the points made by Sartori, are part of a culture of "Homo Videns", so they prefer the graphical information from texts, transforming them into individuals who do not read, so their capacity for abstraction and understanding it has been impoverished (Sartori G. & Tarín J., 1999).

Given the difference of conceptual positions at the time of approaching reality, teachers and parents propose that the irrational use of technology and mobile devices by students today are some of the reasons behind performance under academic and reproof indices presented in the school today. Besides this, it is underlined that the digital connectivity is a fundamental element of modern society, which has modified the traditional schemes of human interaction (including education level).

Historically, the way each generation approaches to technology innovations of their time can translate into a generation gap. Currently, this problem, the wireless internet is evident in the various forms of interaction in contemporary social life digital with students against their teachers, and ease of access to the internet (both wired from PCs academic use vs. from the use of mobile devices, especially). The interesting thing about this lies problems that can reverse the irrational use of mobile devices through the responsible use them in the classroom during the teaching-learning and assessment of mathematics and science in engineering students.

In the case of the Mexican context, currently the plans and curricula from primary and secondary education superior contemplate the application of Information Technology and Communication (ICT) in the teaching-learning, which requires teachers be updated use and implement strategies that integrate classroom. While it is true that students have — mostly — mobile devices, it is also true that their use for use as a teaching tool is minimal. Young people of Z generation use them mostly for social networks, rarely using e-mail; even if it is possible to realize its potential to enhance their learning processes.

There are recent studies showing the use of technology as a teaching tool. Authors like Rodriguez and Pierson (2014) presents the use of Khan Academy in Chilean classrooms innovating in education to increase student participation in mathematics, Rodriguez (2015) shows the use of Khan Academy as an Open Educational Resource (OER) in a class math and Jara (2016) proposes the integration of mobile devices as a teaching strategy for studying mathematics at the high school level.

The authors of this study have been conducting investigations with longitudinal students who entered the 2018–2019 and 2019–2020 school years at the Academic Unit of Basic Science and Engineering (UACBI) of the Universidad Autónoma de Nayarit (UAN), which by their age range covering the characteristics to be considered

as part of the Z Generation. students have wireless Internet access by the institution and, mostly, have smart phones, electronic tablets or computers portable.

3. Research Problem

How to achieve the integration of an Open Educational Resource (Khan Academy) through the use of mobile devices in the process of teaching, learning and assessment of mathematics and science in engineering?

4. Bibliographic Review

4.1 Open Educational Resources (OER)

For this topic is prevailing three basic concepts that we must consider, mobile devices, OER and Khan Academy. "Mobile device is a type of small computer, processing capabilities, Internet connection, memory, designed specifically for a function, but can perform other more general functions" (mobile device, n.d.). The second, OER, which UNESCO defined as "any educational resource (including maps curriculum, course materials, textbooks, streaming videos, multimedia applications, podcasts and any material that has been designed for teaching and learning) that is fully available for use by educators and students, without any need to pay royalties or licensing fees" (Butcher, 2015, p. 5).

Finally Khan Academy is a non-profit organization that was founded in 2005 whose mission is to "provide a free world class education for anyone anywhere" (Khan Academy, 2019), presents tools for parents, teachers and students, as well as exercises videos and practice, where participants have personalized learning and allows them to learn at their own pace.

To highlight the use and benefits of OER, Butcher (2015) describes the skills necessary for institutions to effectively take advantage of them and also presents some specialized search engines to find the appropriate OER. Within the first we can emphasize the following:

- Knowledge of the defense and promotion of OER as a vehicle to improve the quality of learning and teaching in education.
- Knowledge of licensing content.
- Knowledge of the design and development of programs, courses and materials.
- Knowledge management networks/consortia of people and institutions working cooperatively on several projects to improve teaching and learning.
- Knowledge of monitoring and evaluation.
- Communication skills and research in order to be able to share information about the OER.

Concerning the second point on the appropriate privileges OER three aspects:

- Pick a specialized search engine, among which are: Alliance for Mediation Exchange with Global Learning Objects, Folksemantic, DiscoverEd, Creative Commons Search and Consortium OCW (Open Course Ware Consortium).
- Locate a suitable repository, among which are: OpenLearn, Meded PORTAL, MIT OCW, Open Educational Resources China (China Open Resources for Education - CORE), Search AgEcon (AgEcon Search) and Teacher Education in Africa Saharan (Teacher Education in sub-Saharan Africa).
- 3) Use directories, among which we have: OER Commons, Commonwealth of Learning (Commonwealth of Learning) and OER Africa.

Recent research shows that the use of mobile devices is an educational advantage, which promotes learning and provides an opportunity to design intervention strategies using OER, Khan Academy is an area we can find that allows its use from a webpage to computer and from mobile applications.

4.2 Theories that Support It

This can primarily support OER two theories that stand out because their methods are active:

Sociocultural theory of Vygotsky, which is a theory that has important contributions regarding influencing society on individual development, because as presented Carrera and Mazzarella (2001) emphasizes the interaction between the development of people and culture in the They are living, that is, consider the context of the individual. This theory states that all learning at school is accompanied by experiences before entering school phase, thus learning and development are interrelated from the first days of life of the child. Referred two evolutionary levels: the actual and potential evolutionary level, the first leads to the second with the help of fellow shared experiences. What kids can do it with the help of "others" in a sense, it is more indicative of his mental development what they can do for themselves.

The other theory is Connectivism, which is defined as a learning theory for the digital age (Siemens & Fonseca, 2004) and is characterized by the influence of technology in the field of education where learning occurs in different scenarios, including communities of practice, personal networks and task performance in the workplace. Relevance in learning the connection between networks is a primary feature of the Connectivism and is what differentiates it from traditional learning theories.

It is imperative, integrate into the globalized and interconnected world of young people, preparing them to interact with people anywhere and solve their socio-demographic context and work collaboratively, because learning is also generated in the classroom, in society which they are included, giving you the sense of relevance.

5. Methodology

5.1 Khan Academy for Mathematics and Science Assessment in Engineering

As mentioned above, it is important to consider the behavioral characteristics of Z Generation to propose an educational intervention strategy that is appropriate to their interests. From the analysis of its features, he was chosen as Khan Academy as an auxiliary resource for the evaluation of Mathematics and Science in Engineering, as:

- It is an Open Educational Resource (OER) which was designed specifically to be used for educational purposes, from a perspective of self-managed work of the student but allows the accompaniment of the teacher during the development process.
- It allows the student to receive information in a fast and immediate. Presents the theoretical basis of the topics and then proposes practical exercises to check your understanding. The contents are presented in a timely and concise, and the student accessed through different systems of representation through texts, audios, videos and exercises.
- Activities are brief and are raised for students transit from one activity to another, in dynamics that favor the interest is not lost.
- When appropriate, during the theoretical presentations graphic organizers and mind maps are used, among other visual resources. The creators of the platform have struggled to graphically stimulate creativity in students and promote better perception of content.

- When tests are performed, the response times are immediate. If the student does not reach the level of proficiency in a subject, it is sent to review the theoretical reference by a video and strengthening exercises. Evaluation rubrics to identify the different levels of performance of the subject (with difficulties, needs practice, Practiced, Level 1, Level 2, Dominated). Likewise, brings the total minutes of activity on the platform, the minutes devoted to video review, the minutes devoted to the development of skills, medals won by activity and finally Points earned. All this strengthens the awareness that the student progresses, which will report immediate satisfaction and reward.
- The educational platform is highly intuitive, so students quickly manage to be experts in understanding the actions that must play within it.
- Use a model playful instruction, seeking to generate the proposed activities of graduates challenging levels (which are complicated enough to be a challenge, but commensurate with the level of development to allow be achieved). This allows the student to remain in constant voltage of challenge-achievement that gives you the constant thrill of success attained without reaching abandonment of frustration or consider them boring.
- To compensate for the limitations of a predominantly visual culture, where exercise is minimal reading, using a blended learning strategy where the work of abstraction and understanding in the classroom strengthen activities in the OER is proposed.

To review or evaluate the efficiency of Khan Academy intends to compare academic results (feeling of students after watching videos and solving exercises online, in addition to the final grade) and attitude (satisfaction survey) to the following subject of using the strategy. The results allow to determine whether the strategy employed teacher promotes learning and disposition towards mathematics.

With this is considered a qualitative study on the perception of students using the platform Khan Academy in their learning (math and science) and a quantitative with the results in this area. You can take into account the following instruments:

- The reports generated by Khan Academy on the use of resources per student (tasks performed and points earned). In reviewing reports recommended three indicators, such as: connection (time), tasks performed and points earned.
- 2) Satisfaction Survey on Khan Academy and support in learning. The survey can design faculty (Academy) of the area or group of teachers of the institution if they require general use of it.
- 3) The results (impact on learning) on lists of scores for the subjects where strategy is employed.

It is important to mention and analyze before implementing the strategy, the following questions: How has behaved, in which it is based and what results has historically been the use of mobile and Khan Academy devices in the process of teaching, learning and assessment Mathematics and Science in Engineering? How currently involves the use of mobile devices and Khan Academy in the process of teaching, learning and assessment of mathematics and science in engineering? How to design an intervention strategy that allows evaluation in the process of teaching and learning of Mathematics and Science in Engineering by introducing Khan Academy? And finally how to validate the relevance of the proposed intervention aimed at engineering students?

To do this, it is also important to collect and access the following:

- Identify the use of mobile devices and Khan Academy in the teaching-learning and evaluation of Science and Mathematics in Engineering.
- Identify whether students and institutions have the resources and infrastructure needed to implement the

strategy.

- Design and implementation of the strategy with the integration of mobile devices and Khan Academy in the teaching-learning and evaluation of Science and Mathematics in Engineering.
- Validation of the strategy designed by a group of teachers or experts in the field.
- Data collection and statistical analysis of information obtained in evaluating the strategy.
- Implementation of the proposed strategy.

6. Results, Evaluation and Conclusions

6.1 New Scientific, Theoretical and Practical Contributions

In all areas contemplated Khan Academy allows you to generate reports of the work done by each of the registered students in addition to the time (minutes) used in platform and the tasks and activities carried out.

In the case of Mathematics and Science in Engineering offers the following courses:

- Diferential calculus
- Integral calculus
- Differential equations
- Multivariable calculus
- Linear algebra
- Biology
- Chemistry
- Physical
- Electric engineering

It also presents, high school courses to strengthen math skills and some computing, economics and finance.

The lies novelty in the use of this OER together with mobile devices to evaluate the teaching-learning quickly and reliably, a task that students were unaware, killing evil or little use of these devices in education.

Education is a complex process, and according to Morin (1999) in his book seven complex lessons in education for the future, which shows the complexity of education from the evaluation processes and teaching and learning, can relate that science and Mathematics Engineering, where the teacher in his educational practice, uses the scientific-technological tools at its disposal to achieve learning and skills of their students.

Some of the results can be validated through satisfaction surveys where you can consider the following aspects:

- 1) The motivation that causes the use of Khan Academy to learn science and mathematics.
- 2) The tasks and activities assigned on the platform are chords or had agenda items of the curriculum.
- 3) Improve results with the use of Khan Academy.
- 4) That so attractive and easy access and management is the platform as a learning tool.

Using Khan Academy allows students improve their math and science learning experiences and share them with their peers. Learning through gamification is a characteristic of our youth (Z Generation), and always looking for meaningful learning experiences and motivating.

In the implementation of the strategy can be observed the following aspects: motivation and interest in learning unit, progressivity in learning, better academic results and ultimately self-regulation or metacognition, results similar to those proposed by Martinez (2016) with the fundamental pillars of educational gamification.

In addition to the collegial work is important training and retraining teachers to achieve satisfactory results. Among the possible limitations that may exist for the use of any OER we are:

- Lack of teaching skills in technology management.
- Lack of internet connectivity.
- Lack of adequate institutional infrastructure for the use of students/teachers
- Lack of adequate mobile devices.

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