Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v10i19.561

Artículos Científicos

Experiencias del modelo de la Red de Comunidades para la Renovación de la Enseñanza-Aprendizaje y el uso de TIC móviles en la UAEMéx

Experiences of the Model of the Network of Communities for the Renewal of Teaching-Learning and the use of mobile ICT in the UAEMéx

Experiências do modelo da Rede de Comunidades para a Renovação do Ensino-Aprendizagem e o uso das TIC móveis nos UAEMéx

Irma Eugenia García López
Universidad Autónoma del Estado de México, México
galiuaemex@gmail.com
https://orcid.org/0000-0003-0935-2275

Resumen

La experiencia educativa de planeación e innovación del modelo de enseñanza-aprendizaje de la Red de Comunidades para la Renovación de la Enseñanza-Aprendizaje (Recrea) tiene como objetivo fundamentar el diseño instruccional sobre tres ejes de transformación y planeación de la práctica docente: *1)* pensamiento complejo, *2)* investigación-docencia y *3)* tecnologías de la información y la comunicación (TIC). El objetivo del artículo es presentar el enriquecimiento del modelo de Recrea a partir de la incorporación de las TIC desde la práctica docente, particularmente la paquetería de Google. Para lo cual, se analiza a la unidad de aprendizaje titulada "Agua" de la Licenciatura en Administración y Promoción de la Obra Urbana (LAPOU) de la Universidad Autónoma del Estado de México (UAEMéx), durante los ciclos escolares 2018A y 2019A. El estudio hace uso de estadística descriptiva sobre el aprendizaje mediante las calificaciones obtenidas, y una encuesta de percepción sobre uso de las TIC en estudiantes. El principal hallazgo fue el comportamiento típico de los estudiantes y la falta que hace de herramientas que les permitan colaborar entre ellos; otro aspecto son las plataformas que permiten realizar análisis estadísticos oportunos para mejorar el proceso de aprendizaje-

enseñanza. En síntesis, la incorporación de las TIC posibilita la creación conjunta de nuevos entornos educativos que exigen nuevos roles y perfiles en el proceso de enseñanza aprendizaje.

Palabras clave: aprendizaje, diseño instruccional, modelo educativo, TIC.

Abstract

The educational experience of planning and innovation of the teaching-learning model of the Communities Network for the Renewal of Teaching-Learning (RECREA) aims to support the instructional design on three axes of transformation and planning of teaching practice: 1) complex thinking, 2) research-teaching and 3) information and communication technologies (ICT). The objective of the article is to present the enrichment of the RECREA model from the incorporation of ICT from the teaching practice, particularly the Google's tools. For which, the "Agua" learning unit of the Bachelor's Degree in Administration and Promotion of the Urban Work (LAPOU) of the Autonomous University of the State of Mexico (UAEMéx), during semester school year 2018A and 2019A, is analyzed. The study makes use of descriptive statistics on learning through the obtained qualifications, and a perception survey on the use of ICT in students. The main finding was the typical behavior of the students, and the lack of tools that allow them to collaborate with each other; another aspect is the platforms that allow timely statistical analysis to improve the learning-teaching process. In short, the incorporation of ICT enables the joint creation of new educational environments that require new roles and profiles in the teaching-learning process.

Keywords: learning, instructional design, educational model, ICT.

Resumo

A experiência educacional de planejamento e inovação do modelo de ensino-aprendizagem da Rede de Comunidades para a Renovação do Ensino-Aprendizado (Recreação) visa basear o desenho instrucional em três eixos de transformação e planejamento da prática de ensino: 1) pensamento complexo, 2) ensino-pesquisa e 3) tecnologias da informação e comunicação (TIC). O objetivo do artigo é apresentar o enriquecimento do modelo Recrea com base na incorporação de TICs da prática de ensino, particularmente a parcela do Google. Para o qual, é analisada a unidade de ensino intitulada "Água" do Bacharel em Administração e Promoção do Trabalho Urbano (LAPOU) da Universidade Autônoma do Estado do México (UAEMéx), durante os ciclos escolares 2018A e 2019A. O estudo utiliza estatística descritiva sobre o aprendizado através das notas obtidas e uma pesquisa de percepção sobre o uso das TIC nos

alunos. A principal descoberta foi o comportamento típico dos alunos e a falta de ferramentas que lhes permitam colaborar entre si; Outro aspecto são as plataformas que permitem análises estatísticas oportunas para melhorar o processo de ensino-aprendizagem. Em resumo, a incorporação das TIC permite a criação conjunta de novos ambientes educacionais que exigem novos papéis e perfis no processo de ensino-aprendizagem.

Palavras-chave: aprendizagem, desenho instrucional, modelo educacional, TIC.

Fecha Recepción: Julio 2019 **Fecha Aceptación:** Noviembre 2019

Introduction

As the work of Cobo (2009) demonstrates, in the definition of information and communication technologies (ICT) there are different perspectives. That is, it is not a clearly defined and unique definition, but, on the contrary, it is enriched by the diversity of disciplines that address it. In the same work it is mentioned that even when the definitions of ICTs focus on electronics, information technology and telecommunications as the main reference framework, this is not the only one (Cobo, 2009, p. 307).

Technology, as an isolated conceptual element, refers to the implementation of knowledge; At this point it has been discussed about utilitarianism, functionalism and others such as equifunctionalism in the reasons or circumstances for which such knowledge is applied. With the above it is meant that the debate has not yet been undermined despite having an operational definition of technology, since the controversy of complexity is immersed in the discussion. Technology in the current context may mean for many, as recorded by the study already cited by Cabo (2009), computer tools or telecommunication media, but this may be due to the rise of cybernetics in the 1940s; However, the notion of technology has been present since primitive societies.

The temporal factor of societies has not gone unnoticed (the technologies of the present are much more and better than those of just a few years, and surely this trend will continue to grow), even the bias of considering technologies only as “computers and mobile phones ”, Despite being a broader definition, it has not affected technological development. This is due in large part to the fact that a) the philosophical discussion is still alive (utilitarianism, functionalism or teleology) and b) computer science is finding a source of knowledge with an unprecedented abundance.

A report from the International Data Corporation [IDC] (2017) illustrates the rapid growth of information. This document mentions that in 2006 alone 1288 x 1018 bits were created, captured or replicated, which is equivalent to 161 exabytes, or 161 billion gigabytes, equivalent to 3 million times the information of all previously written books. The amount of information that is generated every day and its rapid growth is overwhelming.

Communication is in the background of all this. So that any type of communicative interaction that occurs between two or more elements, namely people, machines, hospitals, or any analytical unit, generates information, some of them globally. Two of the theoretical perspectives of communication that address the phenomenon are in systemic and cybernetics. Of the first interest that any interaction or communication between elements that form sets generates a system; while from the second it matters that you can study the control of any system. Thus, ICTs are built from two non-exclusive disciplinary fronts, one focused on the relationships of elements and their geography, and another focused on finding what makes a system be controlled or behaved in a certain way.

ICT, then, includes both the most essential knowledge and the most innovative. And in the case of education, it focuses much of its attention on how to incorporate these, since it is not yet clear or how all relations of elements occur or how knowledge transfer is controlled or governed, especially in an environment with global changes, accelerated and growing. Each small-new advance of communication affects multiple disciplinary areas, to points where the teaching-learning process is at the mercy of communicative models. To illustrate the problem, Luhmann (1996) invites us to reflect on social systems and their differences with physical systems: while in physicists the transfer can be mass or heat, in social systems the transfer is communicational. In this way, Luhmann (1996) criticizes the notion of knowledge transfer, because for a transfer to exist there must be a loss in the element that transfers, thus, when there is social communication, as in the classroom, the issuer does not lose consciousness to give it to the recipient, but it happens a complex communication process that has been given the name autopoiesis (Maturana y Varela, 1980; Maturana y Guiloff, 2006; Rodríguez y Torres, 2003).

One of the main challenges of higher education is to rethink the roles of educators in order to develop digital skills: informational and media for the professional development of the student. The incorporation of ICT in the educational process has different edges from which it is possible to address the phenomenon. One of them is that, as part of the challenges of complexity, both in the learning process and in teaching-teaching, the acquisition of technological tools can present multiple benefits or be a labyrinthine path of development. In this regard, the work of Merriënboer and Kirschner (2010) has inspired many in the

development of models and methodologies related to the way in which complexity should be approached from education. These authors propose 10 steps for complex learning, taking as axes the four components of the instructional model (4C / ID), as shown in table 1 (Merriënboer y Kirschner, 2010).

Tabla 1. Contingencia entre los componentes del plan 4C/ID y los 10 pasos para lograr el aprendizaje complejo

Componentes del plan del 4C/ID	**10 pasos para lograr el aprendizaje complejo**
Tareas del aprendizaje	1. Diseñar tareas de aprendizaje
	2. Secuenciar clases de tareas
	3. Determinar objetivos de desempeño
Información de apoyo	4. Diseñar información de apoyo
	5. Analizar estrategias cognitivas
	6. Analizar modelos mentales
Información procedimental	7. Diseñar información procedimental
	8. Analizar reglas cognitivas
	9. Analizar conocimiento previo o prerrequerido
Práctica de parte de las tareas	10. Diseñar prácticas de parte de las tareas

Fuente: Merrënboer y Kirschner (2010)

For its part, the model of the Network of Communities for the Renewal of Teaching-Learning (Recreation) (Ministry of Public Education [SEP], 2017), as shown in Table 1, operates three transformation axes: 1) complex thinking, 2) teaching-research and 3) use of ICT through the planning of teaching in a subject. The design links the purposes, teaching-learning strategies, the programming of activities and their evaluation. The model operates with complex learning tasks / projects in increasing order of complexity; incorporates identification of knowledge and procedural and practical information to develop skills necessary to solve problems, achieve learning and autonomy in students.

Recrea's planning steps (SEP, 2017) include from the context of the subject in the curriculum to the presentation to the student. This sequence is the teacher's guide to develop skills in the student, while doing educational research on the teaching-learning process. They are summarized as follows:

1. Purpose of the subject.
2. Complex tasks / projects.
3. Content information.
4. Support and mediation.
5. Evaluation.
6. Presentation to students

In the three previous models there are certain degrees of freedom that allow ICTs to be incorporated; By inserting these tools into the teaching process and seeking to execute the proposed 10-step model, results that deserve to be highlighted are achieved. This article aims at the construction of models that include the new ICT specialized in education, particularly in 1) implementation of mobile technology, 2) implementation of cross platform technology and 3) digital administration of education.

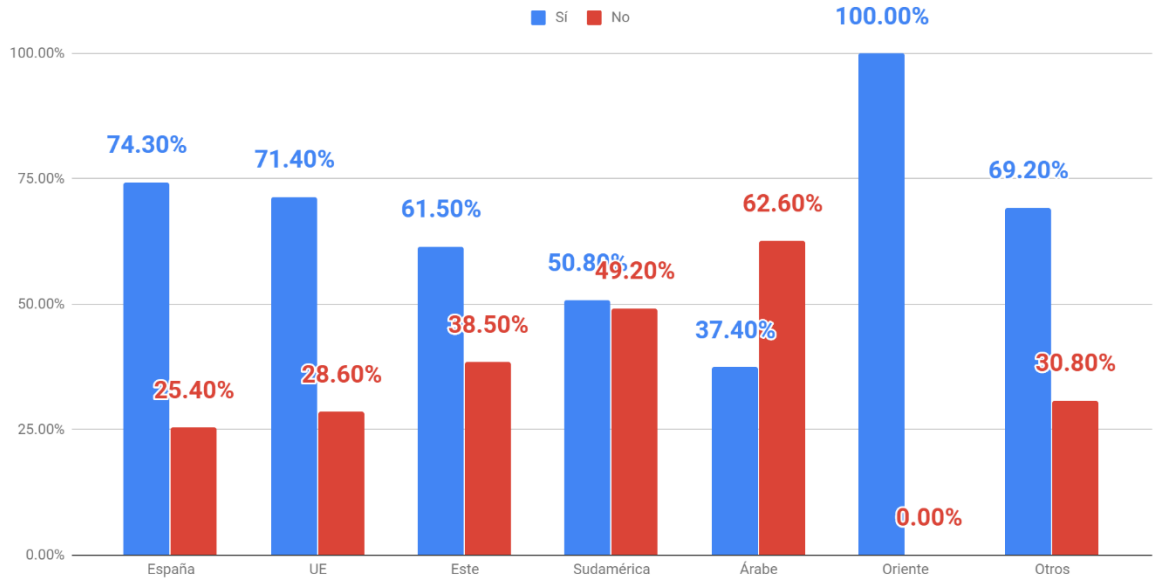
Learning to differentiate the structural, contextual and circumstantial

From the so-called education systems, models such as Merriënboer and Kirschner (2010) and the Recrea model (SEP, 2017) are executed, where technological elements and improvements in communication are incorporated; However, together with the experience of education, there are lessons shared with the incorporation of technology in different social systems. This means that the same complications and experiences that the incorporation of ICT in education leaves us are presented in a general plan for a host of other complex systems (hospitals, government offices or companies). The consulting firm Magdalena Claro (2010, p. 5), in collaboration with the Economic Commission for Latin America and the Caribbean (ECLAC) and whose project was funded by the European Union, explains that the barriers in the implementation of ICTs, particularly in education, are determined by "existing conditions, practices and beliefs", that is, they are related to the "school context."

However, being clear that the determinants of the successful incorporation of ICTs are somewhat contextual, it is difficult to differentiate this from what is structural. The contextual is the label under which the complexity is hidden, which involves the structure and makes it difficult to understand. Also, its implementation is functional in relation to its context.

An illustrative example of the complexity of a context can be gathered from the research carried out by Ballesta and Cerezo (2011) in Murcia, Spain. From this study, when applying a representative survey in the Murcia school district, different levels of importance can be perceived regarding the use of technologies in school environments. While in all other cases ICT is given great importance, parents of South American and Arab origin are not so much. Here the contextual is transmuted into cultural determinants shared between these strata who emigrated and now demand the educational service in this city in southeastern Spain [to learn more about the context of the Arab world and how ICTs have developed, consult Touati (2008)], as shown in figure 1.

Figura 1. Importancia de las TIC en el proceso de enseñanza-aprendizaje según el país de procedencia de la familia



Fuente: Ballesta y Cerezo (2011)

In other contexts of developing countries, an important part of the discussion focuses on the availability of ICTs, as reported by the World Economic Forum in The Global Information Technology Report 2015 (Dutta, Geiger and Lanvin, 2015). One of the central issues from this edge is the role played by mobile devices with internet access (smart phones or smartphones), which had not been considered before. Although some developing countries still focus on mobile-phone signal coverage to make calls or send SMS text messages, the lack of Internet availability in countries with lower incomes reaches 90% of the population, and 60% if all countries are considered (Dutta et al., 2015). However, as the same document reports,

the growth in coverage is increasingly accelerated, mainly due to the lowering of ICT and mobile technology.

This new opportunity with mobile devices is part of the factors that motivated the study of Herrera-Batista (2009), who analyzes, among other things, the phenomenon of availability in context: the National Autonomous University of Mexico (UNAM). Among its findings, Herrera-Batista (2009) refers to users preferring the Google platform (93%) over others such as Yahoo! (6%) to search for information. However, the study by Malik and Mahmood (2009) shows that in the university context in Punjab, Pakistan, Google (97%) appears as the most frequent, yes, but is closely followed by Yahoo! (72%), according to the response of the participants when asked to indicate their favorite web browsers, where preferences are not always so marked. Thus, availability not only refers to the offer of certain services or infrastructure, it behaves differently in web computing, because with Internet you have access to almost any search engine. Finally, there are, at least in this document, two levels of discussion regarding accessibility to ICT: 1) Internet access and 2) user preferences.

On the one hand, internet access is increasingly wide thanks to the commercial reach of mobile devices. And, by extension, increasingly complex to observe and measure. The National Institute of Statistics and Geography [INEGI] (2018) reports that in 2017 Mexicans over the age of five who access the internet (71.3 million users) are 63.9%. Of these, 89.7% access through a smart phone, while 33.1% access by computer and 32.8% by laptop, among others. Even more: of these people who access the internet through their cell phones, 86.8% do so using the mobile connection of their device, and only 13.2% use it via the Wi-Fi connection (INEGI, SCT & IFT, 2018).

In the same way, internet access can be perceived with other indicators, such as the same INEGI (2019)[1] reports through the National Statistical Directory of Economic Units (DENUE): until the 2016 updates, there are 2243 cybercafes in Mexico, with an average of 70 per entity, and a standard deviation of 124.5. Particularly, the State of Mexico concentrates 30.63% of cybercafes, according to DENUE (INEGI, 2019), followed by Puebla with 10.12%, and this in turn of Guanajuato with 9.90%. If the 2010 Population and Housing Census of INEGI (2010), the rate of cybercafes per 10,000 inhabitants, the State of Mexico at the top with 0.453, followed by Guanajuato (0.405) and Puebla (0.393), are taken as a basis thus the presence of cybercafes is related to the population, as shown in table 2.

[1] La referencia al final del documento incluye el enlace que da directo a la descarga de la base de datos (última actualización consultada: 2016). Los *cibercafés* están bajo la categoría "Servicios de acceso a computadoras", con el código de la clase de actividad SCIAN 561432.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Tabla 2. Cibercafés por entidad que figuran en el DENUE (INEGI, 2016**)**

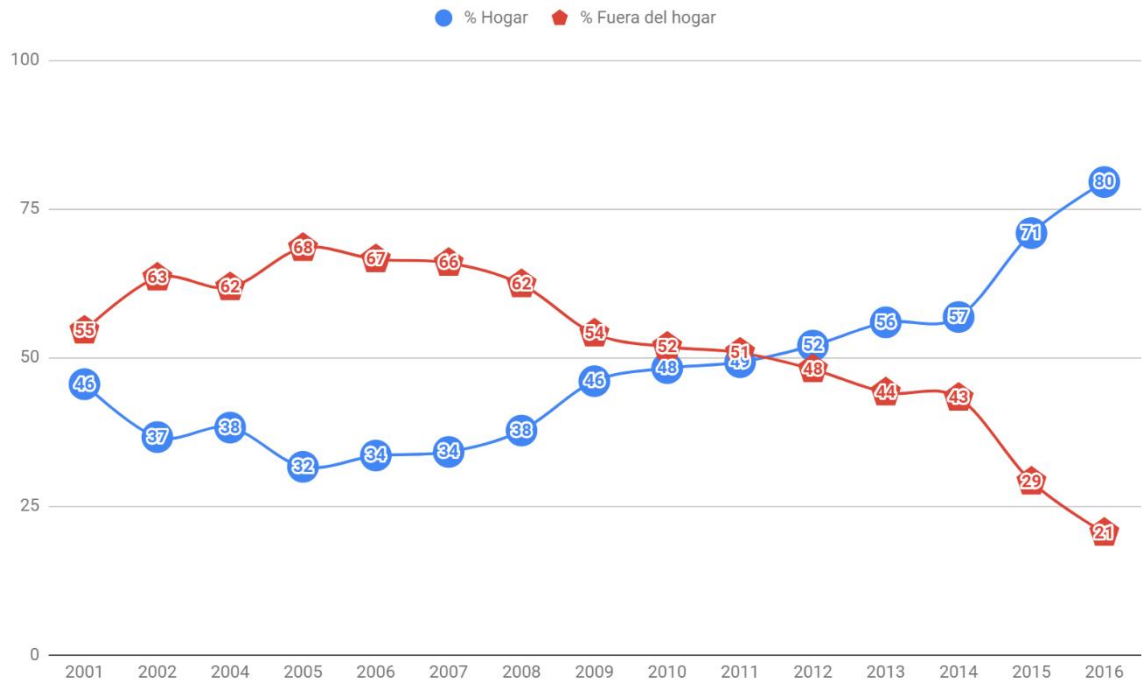
Entidad federativa	Unidades económicas de "Servicios de acceso a computadoras"	Porcentaje del total	Lugar de mayor a menor
Aguascalientes	10	0.45 %	23
Baja California	10	0.45 %	23
Baja California Sur	1	0.04 %	28
Campeche	5	0.22 %	27
Chiapas	73	3.25 %	10
Chihuahua	29	1.29 %	14
Ciudad De México	125	5.57 %	4
Coahuila De Zaragoza	16	0.71 %	20
Colima	9	0.40 %	24
Durango	13	0.58 %	21
Guanajuato	222	9.90 %	3
Guerrero	52	2.32 %	11
Hidalgo	99	4.41 %	6
Jalisco	123	5.48 %	5
Ciudad de México	687	30.63 %	1
Michoacán De Ocampo	75	3.34 %	9
Morelos	49	2.18 %	12
Nayarit	22	0.98 %	17
Nuevo León	31	1.38 %	13
Oaxaca	31	1.38 %	13
Puebla	227	10.12 %	2
Querétaro	17	0.76 %	19
Quintana Roo	23	1.03 %	16
San Luis Potosí	90	4.01 %	8
Sinaloa	8	0.36 %	25
Sonora	6	0.27 %	26
Tabasco	21	0.94 %	18
Tamaulipas	24	1.07 %	15
Tlaxcala	12	0.53 %	22
Veracruz	93	4.15 %	7
Yucatán	31	1.38 %	13
Zacatecas	9	0.40 %	24

Fuente: INEGI (2019)

However, according to the 2016 National Survey on Availability and Use of Information Technology in Homes (ENDUTIH), the State of Mexico also ranks first with 3.65% of the population aged six years or older with common cell phones (no Internet access); It also occupies the first place with smart phones with 10.8% (INEGI, 2016). These figures show that both the presence of smart phones and Internet cafes are related to the population. In summary, the State of Mexico may be housing more than 30% of Internet cafes in Mexico and more than 10% of smart phones, where by 2010 a total population of 15 175 862 inhabitants was censored (INEGI, 2010).

Regarding point number two, user preferences, the general trend in Mexico also has many nuances, however, the one that can attract the most attention is the change in places of internet access. While before there were more people accessing the internet outside the home, now they are the least (see figure 2).

Figura 2. Porcentaje de usuarios de Internet, según lugares de acceso, 2001 a 2016



Fuente: INEGI (2016)

User preferences also go through other structural factors. Talking about familiarity or previous experience with certain computer environments can clarify why certain ICTs are preferred over others, but can also be explained by analyzing the market or policy-regulatory provisions (impositions) in a jurisdiction or computer system, such as reform Mexican of 2013 to telecommunications.

The transfer of successful models must take this into account, since the determinants of a successful incorporation of ICT in an educational center, or by a teacher, may be hidden in the complexity of the (changing) context in which the observer. For example, Becker's (2000) study criticizes Cuban, who, in 1985, presented the difficulties for the implementation of ICT. Becker in the United States in 2000 no longer observed these problems in the results of his survey; however, the same Becker survey can be applied today and pour a new critique. For example, it would not be surprising to observe a decrease in the knowledge and use of e-mail by favoring other technologies that had not been contemplated such as the use of mobile messaging (for example, WhatsApp, Facebook Messenger or Google Hangouts) or other means of communication as school platforms, which can favor / hinder educational objectives. Once again, the Herrera-Batista (2009) study is illustrative in pointing out how its sample of UNAM students prefers to use Messenger (75%) than email (16%) to organize and agree on team activities.

On the other hand, many teachers in circumstances of insecurity prefer that their students do not know their particular telephone number for mobile messaging or the username on their web social network, even though it is argued that communication can improve. There may also be social structures in pedagogical practices that lose their objective by forcing the use of ICT in an activity, such as emphasizing the use of certain parcels, such as the exclusive use of certain statistical packages instead of giving more emphasis to the teaching of statistics, the use of AutoCAD software instead of favoring technical drawing and drawing plans by traditional methods in certain communities. That is, implementing certain ICTs is not always the most appropriate for the context, or the circumstance; on the contrary, the context will have to determine the characteristics that these tools should have.

Identify good practices, as defined by Claro (2010), in educational models is the discussion that is intended to be addressed from the analysis in the incorporation of ICTs, particularly from 1) the implementation of mobile technology, 2) the implementation of cross platform technology (3 platform) and 3) digital education administration.

This article adds to the criticism of the lack of interest on the incorporation of mobile ICT and gadgets in education. The proposal is to find that these have cross-platform integration (cross platform) for use in different devices and that they are accessible in different contexts and circumstances through web technology. In the same way, he joins Behar and Mishra (2015) when pointing out that the transfer of ICTs should be provided to the teacher, so that one of the priority areas in the author's context is to improve student administration and generate information Give feedback to the system.

Recrea Model: ICT to the teacher before the student

The Recrea project is a policy proposal of the Mexican Government arising from the Undersecretary of Higher Education, coordinated by the General Directorate of Higher Education for Education Professionals and the General Directorate of Higher University Education, technically supported by seven normal schools and seven universities State public. Thus, it is promoted as a public policy by the Mexican Government.

As already mentioned, the project aims to improve the teaching-learning process from three central axes: 1) complex thinking, 2) teaching-research and 3) ICT. Under this scheme, the development of educational quality in institutions of higher education is sought. However, something that is implicit, but it should be noted, is that it is based on the transfer to teachers, so that they can make use and transmit it to the generations of students.

The above is necessary to mention and emphasize because in the line of action of ICT for education, emphasis has been placed on student transfer programs: having electronic classrooms, ensuring that all students have computer equipment, or that they are trained, among other examples. The report of the 2015 World Economic Forum, in its chapter 1.7, Behar and Mishra (2015) suggest that the transfer of ICT to students has not achieved the expected scope, and they invite the transfer to be made to teachers.

The reasons why a change of strategies is proposed are multiple, but among them it should be noted that ICTs are becoming cheaper (and in some cases they are free), mainly in developing countries. The scenario of cheap and increasingly accessible ICTs causes the strategies to address their incorporation to change: administratively it is a better strategy to focus efforts on the improvement of existing human resources than to invest in the transfer of technology in students, which runs the risk of not being used or outdated.

In the same order of ideas, the educator, as a fundamental part of the educational process, becomes ambassador of the use of ICT. In higher education, the subject teaching model predominates, where the teacher guides the content of the learning unit. With the mastery of content, acquisition of skills and free choice for the management of ICT in the classroom, the teacher would be able to develop new pedagogical strategies to the extent that he assimilates these technologies and knows the abilities of his students and has as base the pedagogical objectives.

However, as will be seen more in the conclusions, the lack of accessibility occurs in the teacher's freedom to choose platforms or software, or even from the lack of capacity development. If contemporary technologies are considered to be the latest generation, the old

generation was dominated in Mexico by the development of educational platforms in universities; Thus it can be estimated that each public university in Mexico has its own educational platform, but in essence very similar. These custom-made platforms differ substantially from the current technological capabilities of large companies; Both trained teachers and young students encounter a hostile technological scenario by joining public universities in Mexico.

Some generations find it inconceivable how certain multimedia files cannot be attached to the university platform, or for example, they assume that you can work as a team on the same document or presentation without the need to be sharing versions by email. On the other hand, the teacher with processes and technologies of past generations replicates this model and reproduces it in his students, not necessarily by choice, but by administrative disposition.

On the other hand, trained teachers, regardless of their age, can cultivate new ways of addressing or solving problems in the student. Letting yourself be guided by the concerns of the students and cultivating complex thinking is easier with ICT, so that the teacher guides on the content, and the students are purposeful with the methodologies. A trained teacher, in short, is not one who knows all the platforms, procedures or masters a programming language; but he who is willing to apply knowledge (technology) and assimilates it, which allows him to incorporate it in different scenarios, not only in the classroom, not only in certain pedagogical activities, but in his daily life.

Beyond saying if it is good or bad, it is more difficult for a young man, who has only used Google Maps, to reach his destination using a map plane, or for a cartographer to arrive using only Google Maps. For the same reasons, it is more preferable to ensure that a university professor is accessible to ICTs than to take experts in them (or students) and make them architects, doctors or pedagogues.

On the other hand, there is a lack of compatibility between systems, inherent in the development of any system, such as educational systems, so it is common that rules, patterns and norms that achieve the assimilation of the elements that make up a system are socially developed. , call this structural irritability (Luhmann, 1996), which ranges from the aspect of constituting behavioral norms to cultural or market patterns. Here the role played by academies, schools or groups within an educational center is essential, since their coordination also corresponds to the computer level: the compatibility of information systems, as well as considering the appropriate channels. The educational administration should not be a task that is done lightly, it can actually represent the success or failure in the implementation of a model thanks to the incorporation of ICT.

Method

This paper explores the implementation of ICT in the learning-teaching process in an exploratory way. The above focuses on the evaluation of three dimensions: 1) implementation of mobile technology, 2) implementation of cross platform technology and 3) digital administration of education. The technology implemented was Google Classroom, an educational platform that integrates the applications of the Google Suite G Suite, where there are word processors, presentations, drawings, videos, among others.

Justification

With the implementation of Google Classroom (and the rest of Google's web applications) the three dimensions mentioned above are evaluated. In the selection of ICT, different aspects were taken into account, mainly the familiarity and gratuitousness of Google in the context of the Autonomous University of the State of Mexico (UAEMéx). With this ICT, the use of mobile devices of different brands and operating systems is achieved; It also allows the use in computers and gives tools that facilitate the evaluation process, qualifications and reporting.

It is worth mentioning that the UAEMéx has an open source educational platform called Moodle. This platform allows the delivery and qualification of activities, at the same time that it integrates the administrative registry for the generation of certificates and certificate of qualifications (Kardex), and is mandatory, because in this way the educational administration system is fed. Moodle, however, has failed to incorporate the latest technological development, resources that are being integrated into the academic daily of the university. Finally, the university platform is widely used for distance education, however, it is commonly used to record grades.

The clearest examples of this lag regarding ICTs is that the Moodle platform does not have the possibility of having shared documents or environments that allow several participants to work on the same document, without generating different versions of the same document, which causes redundancy in the transmission of information as tasks and corrections. Another less obvious example is that the new utilities offered by artificial intelligence or machine learning in the processing and search of information are not exploited. This can be useful in many scenarios (such as combating attrition or suicide), but the discussion focuses on developing technical skills in teachers to improve the administration of education, in search of patterns in information, in records Academic and sociodemographic surveys of students.

As highlighted previously with the study by Herrera-Batista (2009), it is inferred that the use of Google as a web browser is predominant in the Mexican context, so that the incorporation of the already specified parcel can be more easily assimilated than other options For example, the Microsoft package, which, although they also have mobile and cross-platform functionality, have licensing costs, unlike Google. One of the solutions sought by incorporating Google's G Suite for Education in teaching practice was to streamline the file transfer process and improve the quality of feedback.

Object of study

For the research it was necessary to compare statistical information on the academic performance of two groups on the same learning unit, called "Water", of the Faculty of Architecture and Design of the UAEMéx. Once the Google platform is used, the evaluations are collected and then imported to the Moodle platform of the UAEMéx, so as not to affect the institutional administrative process.

Because of the way in which the scientific finding takes place, a database is chosen that focuses on the characteristics of the student groups: their evaluations and a perception survey. At the end it is complemented by a survey of other teachers who have used the parcel.

Tabla 3. Características de los grupos

Generación	**N**	**Uso de G Suite**
2018A - 1	17 Estudiantes	Sí
2019A - 1	21 Estudiantes	Sí
2019A - 2	18 Estudiantes	Sí

Fuente: Elaboración propia

For the exercise of evaluating academic performance, the analysis was concentrated on the following variables: grades of 1) first partial, 2) second partial 3) final and ordinary.

For the teacher survey, the form was distributed through the Recrea network, by email, and the following axes were emphasized: 1) educational platform; 2) mobile technology; 3) Use of ICT with students, and 4) problems in the administration of education.

Instrument: Perception Survey

A perception survey was conducted on the students of the 2019A-1 and 2019A-2 groups. This survey obtained 39 answers, which represents 100% of the students that make up the groups. The form for the survey consists of 10 items on a Likert scale, where the respondent indicates how much they agree or disagree with the statements presented and the following style: “I consider the use of Google Classroom and ICT views in the learning unit… ”

For the 2019A-1 and 2019A-2 groups, a perception survey on the use of ICTs was applied, particularly the experience left by the use of the Google Classroom platform and pedagogical activities that involve the use of technological tools. The respondent is presented with 10 statements, which he qualifies by means of a five-level Likert scale ranging from “Strongly agree” (1) to “Strongly disagree” (5). It should be reiterated that all the statements begin as follows: "I believe that the use of Google Classroom and the ICT seen in the learning unit ...". The perception survey attempts to measure three dimensions in the use of the tools in question: (A) Pedagogical tasks and activities, (B) Administration and organization of the learning process and (C) Processes and types of learning. These are distributed as follows:

- “I believe that the use of Google Classroom and the ICT seen in the learning unit…”:
    - (A) Tasks and pedagogical activities:
        - (A1) ... They favor my learning reinforcement tasks.
        - (A2)… improve the elaboration of academic works.
        - (A3)… helps to modulate the effort I dedicate to academic work and tasks.
    - (B) Administration and organization of the learning process:
        - (B1) ... They allow me to efficiently organize and systematize my academic work.
        - (B2)… enable me for a better organization of knowledge.
        - (B3)… allows me to optimize the time management I dedicate to the study.
        - (B4)… facilitates the possibilities of teamwork.
    - (C) Learning processes and types:
        - (C1) ... strengthen the development of critical and reflective thinking.
        - (C2)… provides the search for resources that support academic tasks.

- (C3)… increases the possibility of autonomous learning.

Results

This section presents the results of the grades and survey of perception of students exposed to Google Classroom and the use of ICT in learning activities. It is noteworthy that in the results of the qualifications homogeneity is obtained in the groups and with passing averages in all cases; The perception survey, on the other hand, is worth emphasizing that, from the students' perspective, the challenges lie in how ICTs allow to better manage and organize the learning process.

Results with the students

In total, the academic performance of 56 students, consisting of a group in 2018 (17 students) and two groups in 2019 (39 students), of the "Water" learning unit at the Faculty of Architecture and Design of the UAEMéx was analyzed . In the population studied, there were three cases of students who did not give enough for the right to test during the course of the unit; when the case occurs without rights, it is left blank so that it is not considered during the calculations; In total there are five lost data distributed in the 2018A (one female and one male) and 2019A-1 (male) groups. Its distribution by sex is mainly female in all cases: the 2018 group with more than 80% female population, the 2019 groups have an average of 61% of women.

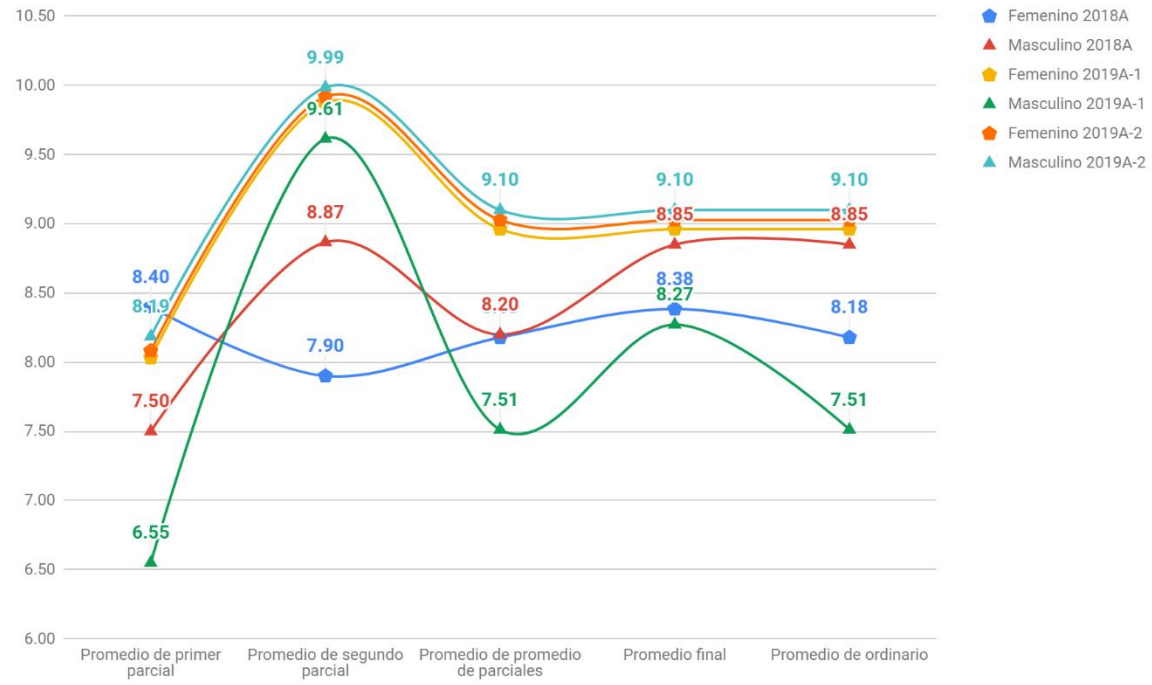
Tabla 4. Distribución de alumnos por sexo y grupo

Grupo	Femenino	Masculino	Suma total
2018A	14	3	17
2019A-1	13	8	21
2019A-2	11	7	18
Suma total	38	18	56

Fuente: Elaboración propia

Once adjustments have been made for students who were not entitled to exam (two male and one female), the difference between men and women does not seem significant or relevant. Note that the groups that present a more pronounced curve are those where the three cases of students without rights are presented, as can be seen in the following figure 3.

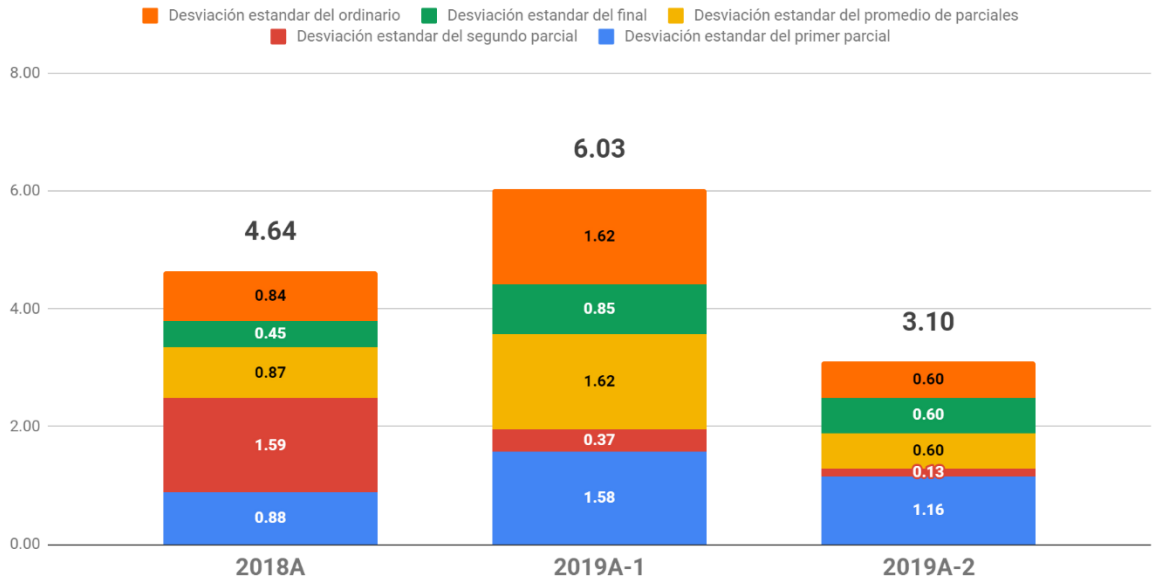
Figura 3. Promedios de calificaciones por sexo y grupo



Fuente: Elaboración propia

The analysis highlights that the 2019A-1 group is the most dispersed in the ratings, since the population standard deviation, accumulated from the ratings, gives a total of 6.03, followed by the 2018A group with 4.64; while the 2019A-2 group is the most homogeneous with 3.10. It is noteworthy that in the groups of 2019 the first part obtained results that moved away more than the average, while for the group 2018A this happened in the second part. In the same order of ideas, the ordinary's qualifications in the 2019A-1 group are the most dispersed, as shown in the following figure 4.

Figura 4. Desviación estándar poblacional por periodo de evaluación y grupo



Fuente: Elaboración propia

To mention that in the analyzed period the three students who were not entitled are the same cases of failure, otherwise all students get an average passing grade of 8.57 (N = 55) and a population standard deviation of 1.19 in their grade of the ordinary exam.[2] The group with the worst average is 2018A with 8.26, followed by 2019A-1 with 8.40. The best average is 2019A-2, with 9.05.

In both the first and second partial, final and ordinary of the 56 students, there were 13 failing or non-right grades accumulated in six individuals (four male and two female). That is, 10.71% of the students had some failing grade at some time; however, the three individuals who did not pass the subject (without right) accumulate 77% of the failing grades of all 56 students studied. It is estimated that these cases of failure are isolated, and although they affect the averages, the results indicate that they do not necessarily affect exposure to the rest of their peers. Of the other three cases that had some failing grade, but approved the subject accumulate the remaining 23%, and their failing grade is given exclusively in the 2019A-1 group during the first part; In these cases, their recovery is significant for the second quarter and the three obtain an average passing grade of 7.3.

[2] Cuando el alumno alcanza una calificación superior a 5.9 se considera aprobatoria. Los estudiantes que lleguen a la evaluación final con una calificación aprobatoria tienen derecho a un examen ordinario en donde pueden mejorar su calificación. No todos acceden a presentar un ordinario, por lo que su calificación final pasa a ser la del ordinario.

Indicators of the perception survey on the use of ICT

For the exercise, an indicator is proposed as follows (table 5): for each dimension analyzed (A, B and C) the Likert scale is used to give the lowest score of -2 to “Strongly disagree” and the higher than +2 points to "Strongly agree". The maximum possible grades per reagent would be the result of multiplying +2 points by the 39 students (78 points), while the maximum possible grades per dimension would be (A) = 78 x 3 = 234, the same for (C), while for (B) the maximum possible rating is 312, since it has 4 reagents (78 x 4). So, in the theoretical assumption that the 39 students answered “Totally agree”, it would be obtained from dimension (A) 78, because it has three reagents, so if I divide 78 by 78 it will give 1, which is equivalent to 100% of affinity; otherwise, they all give a value of -2 and would give a possible theoretical minimum of -1 or -100% affinity.

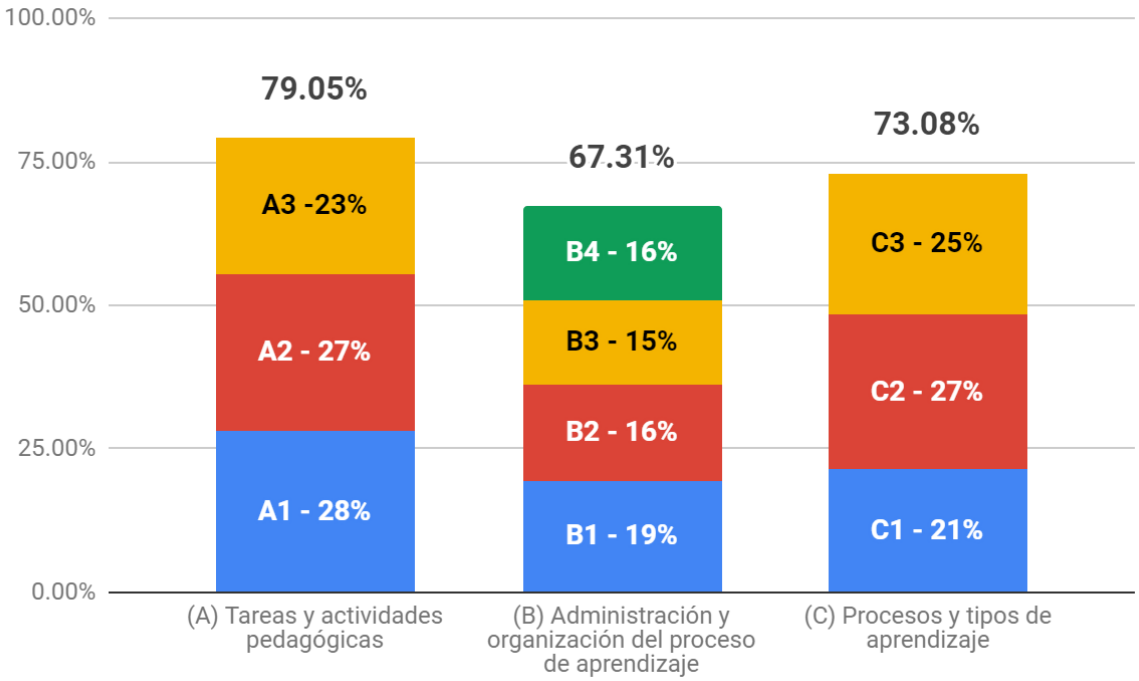
Tabla 5. Distribución de Likert para la encuesta de percepción a estudiantes

-2	-1	0	+1	+2
Totalmente en desacuerdo	Desacuerdo	Indiferente	De acuerdo	Totalmente de acuerdo

Fuente: Elaboración propia

From the results of the indicator it is highlighted that the dimension (B) Administration and organization of the learning process corresponds to the one with the lowest score, with 67.31% affinity, followed by (C) Processes and types of learning, with 73.08% affinity ; and the best rated is (A) Tasks and pedagogical activities with 79.05% (figure 5). While, of those, reagent (B3) “… allows me to optimize the administration of the time I dedicate to the study” is the one with the lowest affinity, with 58.97%.

Figura 5. Percepción sobre uso de TIC por dimensión y proporción de cada dimensión



Fuente: Elaboración propia

To consider that the maximum percentage of possible proportion for (A) and (C) is 33.33%, and for (B) it is 25% per reagent. So by adding the maximum we would get 100% possible for each dimension. The best rated reagent is (A1) "… favor my learning reinforcement tasks" (84.62% of reagent affinity), followed by (A2) "… improve the elaboration of academic works" (82.05% of reagent affinity), followed by (C3) "… increases the possibility of autonomous learning", as summarized in table 6.

Tabla 6. Resultados de la encuesta de percepción sobre el uso de las TIC

Dimensión	**(A) Tareas y actividades pedagógicas**			**(B) Administración y organización del proceso de aprendizaje**				**(C) Procesos y tipos de aprendizaje**		
Reactivo	A1	A2	A3	B1	B2	B3	B4	C1	C2	C3
Lugar	1	2	6	4	7	10	8	9	3	5
Indicador por reactivo	84.62 %	82.05 %	70.51 %	78.21 %	66.67 %	58.97 %	65.38 %	64.10 %	80.77 %	74.36 %
Indicador por dimensión	79.05 %			67.31 %				73.08 %		
Proporción reactivo/dimensión	28.20 %	27.35 %	23.50 %	19.55 %	16.67 %	14.74 %	16.35 %	21.37 %	26.92 %	24.79 %

Fuente: Elaboración propia

It can be considered that similar results are obtained from the survey in the two groups (2019A-1 and 2019A-2), they obtain a difference of +/- 6.31% on average per reagent, five reagents are shown that exceed the average difference; Three reagents stand out: (B4) "… it facilitates the possibilities of teamwork" has a difference between the responses of the groups of 23.41%: for the 2019A-1 group it has an affinity of 76.19%, for 2019A-2 the reagent is related in 52.78%; the second place of differences between groups is the reagent (B3) "… it allows me to optimize the administration of the time I dedicate to the study", with a difference of 21.89%, where again the 2019A-1 group reports more affinity with 69.05%, while the 2019A-2 group is 47.22%; the third case is the reagent (C2) "… provides the search for resources that support academic tasks" with a difference of 15.87%, since the 2019A-1 group reports affinity of 88.10%, while the 2019A-2 is 72.22 %.

Discussion

It should be noted that, in effect, there is a significant number of educational platforms that receive their name in English as a learning management system (LMS) and are systems installed on servers that operate on a network (internal, local or Internet). Among the offer there are many that are open source, which means that anyone can access them, use them and manage their educational center, that is, they are free; There are also paid. What stands out is that many of the available cases are not updated as quickly as those that are encouraged by the market, which is why Google Classroom is chosen as a platform. In many cases, the Google service is offered as free to educational centers, or at the individual level for the teacher, without affecting the use of other official educational platforms, which are generally only used to raise partial and final grades. Of the limitations of the study is the important number of LMS and that there is still much field of study.

From teaching-research, it can be said that it is clear that this platform allows for the generation of timely and potentially potential reporting. This information in the hands of the teacher can lead to adjustments in the learning unit or in his teaching style, detect possible defections. From the results of the case studied, it can be said that it is necessary to analyze in more detail the learning units that are represented in the first part, since the averages are generally low, or strengthen teamwork with ICTs so that the survey of perception achieves more sophisticated results. Of the strengths of the study is that in its realization the same educational platform LMS (Google Classroom) generated statistical information that allowed to support the study.

In the same order of ideas, it is noted that the Recrea model (SEP, 2017) focuses its attention on the work of aulic, where the student is the protagonist to induce an approach to the generation of knowledge through inquiry, which generates a dynamic of questions and search for explanations or solutions for yourself. The teacher can incorporate practices to generate online skills in their students: teach to search efficiently and effectively, as well as verify the integrity of the information. For this to happen, it is necessary for the teacher to know the ways of conducting web searches,[3] not only know the search engines; It is also necessary that the validation of the information be considered: who are the authors? Are they an authority in the area? Is the content tendentious or does it try to impose a perspective? Is another point of view

[3] Algunos reconocerán esto como *búsquedas avanzadas* en motores de búsqueda como en las bases de datos científicas. Sin embargo, cada vez más buscadores permiten a sus usuarios sofisticar sus búsquedas por medio de comandos especiales o accediendo a ciertas partes de la página. Para el caso de Google como buscador web, además de los filtros y herramientas de búsqueda, están los *modificadores* que son símbolos o palabras que se añaden a la búsqueda para dar resultados más precisos. Se pueden consultar los modificadores de Google en el siguiente enlace: https://support.google.com/websearch/answer/2466433.

necessary? the information is hosted in a .com or in an .org ?, among other guiding questions. As for the area of opportunity, it is in the uncertainty of the complex, since there are no universal or general methodologies to address this type of phenomenon.

A rewarding experience with the Google parcel has been that search engines within word processors (Google Docs) and presentations (Google Slides), at least, mainly yield results with a Creative Commons license, that is, they can be used for not infringe copyright, also for videos and other multimedia documents available to teachers and students.

As for complex thinking, the approach requires methods that allow working from the holistic perspective, which incorporates a pedagogical-didactic construction with new perspectives that generate multidisciplinary, dynamic tools, with synthetic and qualitative vision, co-produced by the subject, which as a product of Learning understand and develop your own criticism.

Conclusions

In summary, it is observed that the development of digital skills consists of three elements: 1) the infrastructure and connectivity available in an organization; 2) teacher training and uses in ICT, and 3) their incorporation into the educational process. The results indicate that, far from ending the discussion in this regard, it is necessary to segment the phenomenon to address it strategically in future work.

Similarly, it is emphasized that mobile technology raffles these three elements in the development of digital competence: The evidence suggests that this type of technology is accessible and present in the context; that more and more individuals connect and communicate thanks to her; that individuals, who were previously technologically isolated, are acclimatized to the technological lag by smart cell phones; It was also discovered that finding educational platforms at the forefront incorporates these benefits in computers, servers, cell phones, tablets and any platform with internet access; and that mobile technology, being present in daily use, can be more easily introduced to the educational everyday and in its process; however, it is not yet known exactly how.

References

Ballesta, J. y Cerezo, M. C. (2011). Familia y escuela ante la incorporación de las tecnologías de la información y la comunicación. *Educación XX1*, *14*(2), 133-156. Recuperado de http://e-spacio.uned.es/fez/eserv/bibliuned:EducacionXXI-2011-14-2-5050/Documento.pdf.

Becker, J. H. (2000). Findings from the teaching, learning, and computing survey: Is Larry Cuban right? Revision of a paper written for the School Technology Leadership Conference of the Council of Chief State School Officers. Washington, D.C., January, 2000. Retrieved from https://www.researchgate.net/publication/49610024_Findings_from_the_Teaching_Learning_and_Computing_Survey/fulltext/00b5228e0cf245659d02d481/49610024_Findings_from_the_Teaching_Learning_and_Computing_Survey.pdf?origin=publication_detail.

Behar, A. and Mishra, P. (2015). CTs in Schools: Why focusing policy and resources on educators, not children, will improve educational outcomes. In Dutta, S., Geiger, T. and Lanvin, B. (eds.), *The global information technology report 2015: ICTs for Inclusive Growth* (pp. 79-86). Geneva, Switzerland: World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GITR2015.pdf.

Claro, M. (2010). *La incorporación de tecnologías digitales en educación. Modelos de identificación de buenas prácticas.* Santiago, Chile: Comisión Económica para América Latina y el Caribe. Recuperado de https://repositorio.cepal.org/bitstream/handle/11362/3772/S2010481.pdf?sequence=1&isAllowed=y.

Cobo, J. C. (2009). El concepto de tecnologías de la información. *Benchmarking* sobre las definiciones de las TIC en la sociedad del conocimiento. *ZER - Revista de Estudios de Comunicación*, *14*(27), 295-318. Recuperado de https://www.ehu.eus/ojs/index.php/Zer/article/view/2636/2182.

Dutta, S., Geiger, T. and Lanvin, B. (eds.) (2015). *The global information technology report 2015: ICTs for Inclusive Growth.* Geneva, Switzerland: World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GITR2015.pdf.

Herrera-Batista, M. Á. (2009). Disponibilidad, uso y apropiación de las tecnologías por estudiantes universitarios en México: perspectivas para una incorporación innovadora.

Revista Iberoamericana de Educación, 48(6), 1-9. Recuperado de https://doi.org/10.35362/rie4862130.

Instituto Nacional de Estadística y Geografía [INEGI]. (2010). *Censo de Población y Vivienda 2010*. México: Instituto Nacional de Estadística y Geografía. Recuperado de https://www.inegi.org.mx/programas/ccpv/2010/.

Instituto Nacional de Estadística y Geografía [INEGI]. (2016). *Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares 2016*. México: Instituto Nacional de Estadística y Geografía. Recuperado de https://www.inegi.org.mx/programas/dutih/2016/default.html.

Instituto Nacional de Estadística y Geografía. (2019). Directorio Nacional de Unidades Económicas. México: Instituto Nacional de Estadística y Geografía. Recuperado de https://www.inegi.org.mx/app/descarga/?ti=6.

Instituto Nacional de Estadística y Geografía [INEGI], Secretaría de Comunicaciones y Transporte [SCT] & Instituto Federal de Telecomunicaciones [IFT]. (20 de febrero de 2018). En México 71.3 millones de usuarios de internet y 17.4 millones de hogares con conexión a este servicio: Endutih 2017. Comunicado de prensa. Recuperado de https://www.inegi.org.mx/contenidos/saladeprensa/boletines/2018/OtrTemEcon/ENDUTIH2018_02.pdf.

International Data Corporation [IDC]. (2017). *The Expanding Digital Universe. A Forecast of Worldwide Information Growth Through 2010.* Massachusetts, United States: International Data Corporation.

Luhmann, N. (1996). *Introducción a la teoría de sistemas: lecciones publicadas por Javier Torres Nafarrate* (1.ª ed.). México: Universidad Iberoamericana.

Malik, A. and Mahmood, K. (2009). Web search behavior of university students: a case study at University of the Punjab. *Webology, 6*(2), 1-14. Recuperado de http://www.webology.ir/2009/v6n2/a70.html.

Maturana, H. R. and Varela, F. J. (1980). *Autopoiesis and cognition: The realization of the living.* Dordrecht, Netherlands: Reidel Publishing Company.

Maturana, H. R y Guiloff, G. (2006). En la búsqueda de la inteligencia de la inteligencia. En Maturana, H. y Luzoro, J. (eds.), *Desde la biología a la psicología* (pp. 15-35). Santiago, Chile: Universitaria.

Rodríguez, M. D. y Torres, J. N. (2003). Autopoiesis, la unidad de una diferencia: Luhmann y Maturana. *Sociologias,* (9), 106-140. Recuperado de http://www.scielo.br/pdf/soc/n9/n9a05.

Secretaría de Educación Pública [SEP]. (2017). Red de comunidades para la renovación de la enseñanza-aprendizaje en educación superior. Recuperado de http://cursos.acetlatinoamerica.org/recrea/mod/lesson/view.php?id=1&pageid=1&startlastseen=no

Touati, K. (2008). Les technologies de l'information et de la communication (TIC): une chance pour le développement du monde arabe. *Géographie, économie, société*, *10*(2), 263-284.

van Merrënboer, J. J. y Kirschner, P. (2010). *Diez pasos para el aprendizaje complejo: Un acercamiento sistemático al diseño instruccional de los cuatro componentes.* México, Veracruz: Universidad Veracruzana. Recuperado de https://core.ac.uk/download/pdf/55535948.pdf.