



Serie Investigation

ICT, INNOVATION IN THE CLASSROOM AND ITS IMPACT ON HIGHER EDUCATION

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ICT, INNOVATION IN THE CLASSROOM AND ITS IMPACT ON HIGHER EDUCATION

The accelerated progress of technology in society nowadays, means that the way of carrying out formative activities in the different fields of knowledge is constantly being rethought in order to obtain more efficient, effective and innovative methods. This avalanche of changes also invades the educational environment and forces society to pose a series of questions regarding all areas of teaching. This influence in the educational field is not only limited to the impact that the development of new applications and programs has on the teaching-learning process, but also to the impact that the incursion of new technologies, techniques and software has on the curriculum, since these modify the skills required for professional practice.

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Difficulties in the teaching-learning process within the classroom and influence of ICT to minimize them

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Steven Hernando Vargas³, Irma Amalia Molina Bernal⁴

Abstract

Currently, the methodologies that implement the use of information technologies favor the teaching-learning processes in one way or another. This research analyzes some of the problems detected in the teacher-student interaction within the classroom and the support social networks and information technologies have given to minimize them. Finally, the use of ICT in the teaching process is introduced, citing specific examples of implementation of new methodologies, such as M-learning, e-learning, and the different tools used to help counteract these problems.

Key words

M-learning; E-learning; teaching-learning, ICT.

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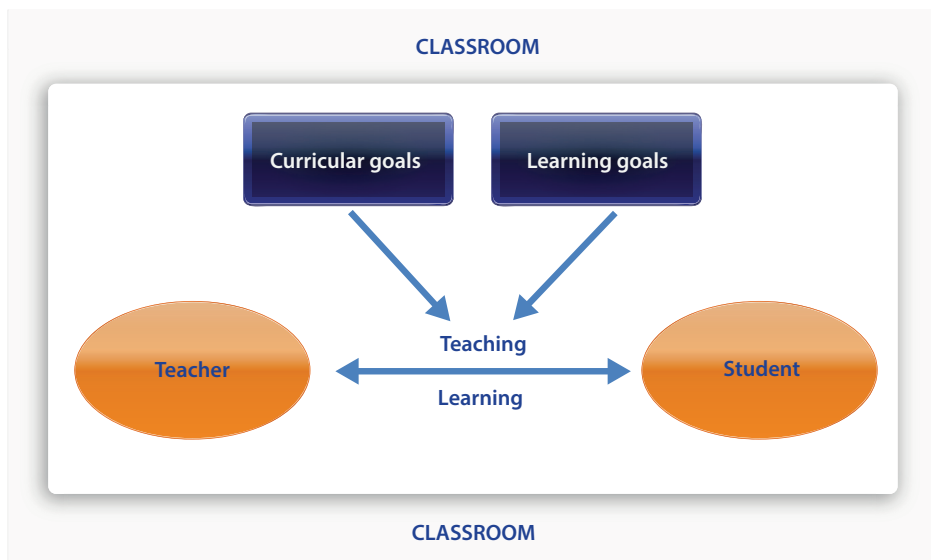
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1. Introduction

Firstly, this research analyzes the difficulties which arise throughout time in the teaching-learning process, both for students and teachers. This is done through a literature review. Next, the use of ICT and social media is examined, considering these a support in the learning process inside the classroom. Finally, the impact of ICT and social media in minimizing the problems detected in the teaching-learning process is determined.

Figure 1. Teaching-learning process



Source: Own elaboration

According to the relationship shown in Figure 1, the teaching-learning process consists of the continuous interaction between the teacher and the student in the classroom, with the teacher guiding the teaching process based on the objectives by curricula and established learning. On the other hand, the student becomes the main protagonist in the learning process (Morales, Molina, & Angel, 2017). Given that the focus of this study is the classroom, it is assumed that the teacher is the only source of knowledge to which the student has access; therefore, the work focuses on the difficulties that can be identified in this process and in the solutions proposed with ICT.

2. Difficulties in the student's learning process

The learning process of a student is influenced by a great variety of aspects like family, school, psychological and social factors (Sabina, Saéz, & Roméu, 2010; Jadue, 2002), which, in one way or another, benefit or harm the students' achievement and determines the success or failure in their learning process (Jadue, 2002). On the other hand, there are biological and socio-environmental factors that can influence negatively or positively specific areas of students such as language, writing or calculation (Sabina et al., 2010).

Bad eating habits during the aging process (Pollitt & Ernesto, 1984), problems in communication (Milicic, 2001), interparental conflict (Cosgaya, Nolte, Martínez, Sanz, & Iraurgi, 2008), parents' and the constant changing of classmates (Rodríguez, 2010) are among the family factors that negatively influence the learning process. In addition, parents' education level is another factor that contributes to the student's academic development (Sabina et al., 2010).

The academic factors that support the student learning process depend mainly on: the orientation and focus on learning, the quality of the teaching plan during the academic period, the organization of the classroom, the monitoring of the evaluation process, the feedback to student, the environment within the classroom, the availability of educational material and, finally, the innovative methodology that allows the participation of the student (Guisasola, Almudí & Zuza, 2010).

On the other hand, the psychological factors that account for the maturity of the student were found. When the student is emotionally stable, it allows creating social and adaptable competences in the education process. However, when the student presents emotional problems, their performance can be affected by problems such as depression, hyperactivity (Rodríguez, 2010), attention, perception, memory, personality, anxiety, externalization disorders (Jadue, 2002), self-esteem (Pérez, Valenzuela, Díaz, González-Pienda & Núñez, 2013).

Social factors, such as the economic level and the social environment, influence students' motivation and academic performance (Guisasola

et al., 2010). Likewise, expectations are determined by these socioeconomic factors and in turn influence the student's dedication to their education process.

Another type of difficulty is given by the lack of self-regulation that students have regarding deficiencies in the process, manifested in indifferent attitudes by the class, lack of responsibility for work (Oñorbe & Sánchez, 1996) and little effort outside class. Consequently, academic failure is found, since students know what they should do, but due to lack of motivation or gaps in pre-knowledge, they do not know how to do it (Pérez et al., 2013).

The students have difficulties in the implementation of learning strategies that allow them to consolidate adequate study habits. These deficiencies influence their ability to understand, know and assimilate new content (Pérez et al., 2013). Therefore, students have greater difficulty in understanding statements and solving problems. According to Oñorbe & Sánchez (1996), these problems are due to deficit in the use of applied terminology, failures in problem solving strategies, difficulties in reasoning, identification of key aspects (Guisasola et al., 2010), failures in cognitive and meta cognitive learning (Pérez et al., 2013), product of the student's lack of personal work (Oñorbe & Sánchez, 1996).

In addition to the classroom environment, it is also convenient to specify the importance of the student's motivation in the process. There are two ways in which this motivation can exist, intrinsic and extrinsic: it is intrinsic when the apprentice is motivated more by the experience of the process, the desire to learn from it and not by the qualification or final result. On the other hand, when it is extrinsic, there is only motivation for a "prize" or result that defines their cognitive abilities, but not their abilities in general (Polanco, 2005).

Another difficulty that arises in the teaching-learning process in university environments is given by the gaps in pre-knowledge that students have and the fear and uncertainty inherent in this transition. According to Althunibat (2015), these factors are responsible for more than 44.9% of dropout cases in the first semester of university.

Within the socio-environmental factors that affect the student, there is the little capacity to assimilate the pressure in their environment, which in some cases is translated as stress, physical fatigue or disinterest, or caused by the loss of a family member or loved one (Martínez & Díaz, 2009). In this sense, the authors comment that the students face the competitive pressure of the system that invites them to stand out from the rest, and when they do not achieve it, they experience frustration and low intrinsic motivation. However, this depends on the cultural differentiation and the perception of stress that the person has (Misra & Castillo, 2004).

Regarding genetic factors, authors Asbury & Plomin (2015) state that these influence cognitive variability among students, but do not determine academic success. Consequently, the researchers point out that each student has different educational needs that they present in a certain moment and in a different way from the rest. The genetic variability that students can have in cognitive areas of reading, mathematics and science can be found below.

Table 1. Genetic variability that the student has by cognitive area

Cognitive Area	Genetic Variability
Reading	60% - 80%
Mathematics	60% - 70%
Science	50% - 60%

Source: Asbury & Plomin (2015). (Own translation)

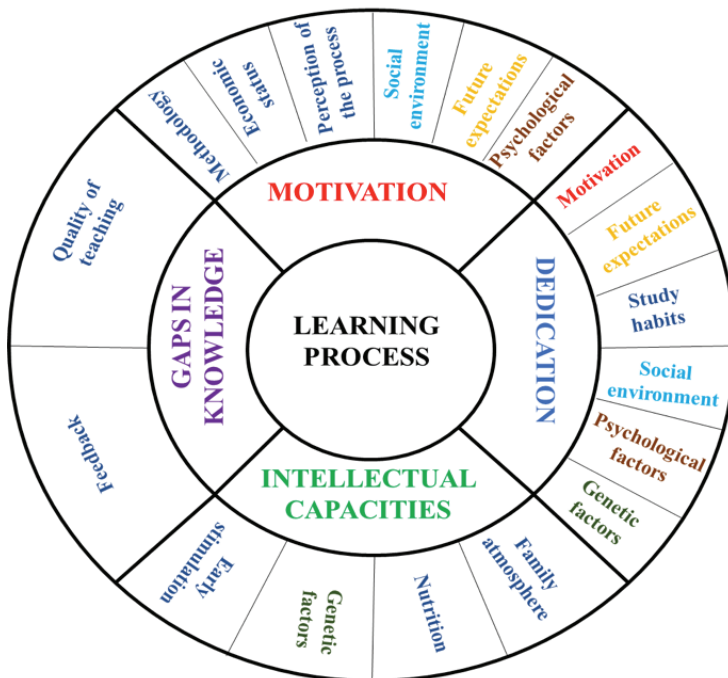
The differences in the performance of students in reading have a hereditary base between 60 and 80%. In the aptitude for mathematics, the weight of the genes varies between 60 and 70%. In science, the percentage of heritability ranges between 50 and 60%. In this way, genetic differences explain between 50% and 70% of the differences between people in terms of general cognitive skills (Language, Mathematics, Science, etc.), while differences in the quality of teaching received explain less than 20%.

Given the difficulties that are identified in the learning process of students, there are also a series of solutions that have been implemented

over time. Some could be strategies of deep, meta-cognitive approach and strategies of self-regulation, participation in academic support workshops that develop safety and satisfaction, updating methodologies and teaching techniques to teachers. According to the demands of reality, also could be used continuous pedagogical training and, finally, the participation of students, through tutoring in a space more informal and close to the teacher (Oñorbe & Sánchez, 1996; Fondón, Madero & Sarmiento, 2010). The use of these methodologies helps the student become more aware of their study processes, focused, and generates greater learning responsibility and motivation (Pérez et al., 2013).

During the development of the research, variables that directly or indirectly influence the student's learning process, set out in Figure 2, were established and analyzed.

Figure 2. Difficulties for the student in the teaching-learning process



Source: Own elaboration

Based on the previous graph, it is possible to affirm that the factors intellectual capacities, gaps in knowledge, motivation, and dedication are what determine students' success or failure during the learning process. These four factors are what the teacher can observe more easily in their interaction with the student. However, these factors are positively or negatively influenced by other secondary variables that ultimately can explain the observed behaviors.

For instance, the teacher can observe that the student has important gaps in knowledge that are supposed to have been assimilated in previous stages. However, these gaps may depend on the quality of teaching received previously, or the lack of adequate feedback. It is important to know the cause of the observable effect to carry out an adequate handling of the difficulty. If this is not done, the students' gap in knowledge regarding what is expected of them can be mistakenly attributed to lack of dedication. Therefore, the secondary variables that may be affecting the observed factors must be identified.

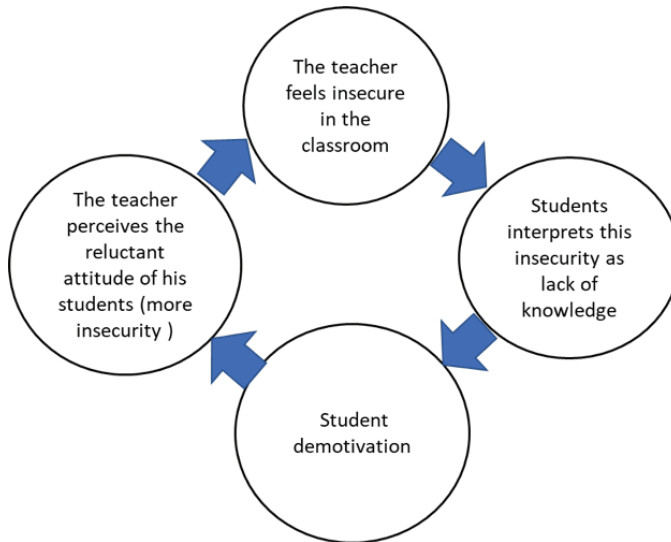
3. Difficulties in the teaching process

According to Fondón et al. (2010), one of the difficulties identified in the teaching process lies in the lack of teaching experience, reflected in attitudes of insecurity, lack of mastery of content and disconnection with professional reality. Therefore, the authors point out that, if the student perceives the insecurity of the teacher, feelings of disappointment will arise and will be interpreted as lack of knowledge. An environment of demotivation is therefore generated, and it becomes a vicious circle, as shown in Figure 3.

Another difficulty in the teaching process is the teacher's lack of pedagogy training in techniques, methodologies and content updating (Fondón et al., 2010). According to the authors, these problems hinder the ability to communicate and transmit knowledge between the teacher and the student. In addition, they hinder the correct planning and organization of the subject, giving rise to the students' dissatisfaction with the content of the class and negatively interfering with the motivation and dedication in their work as a student. On the other hand, the authors point out that

experienced teachers tend to settle in their status quo, limiting themselves exclusively to traditional teaching strategies already known.

Figure 3. Insecurity by begginer teachers can make the learning process more difficult



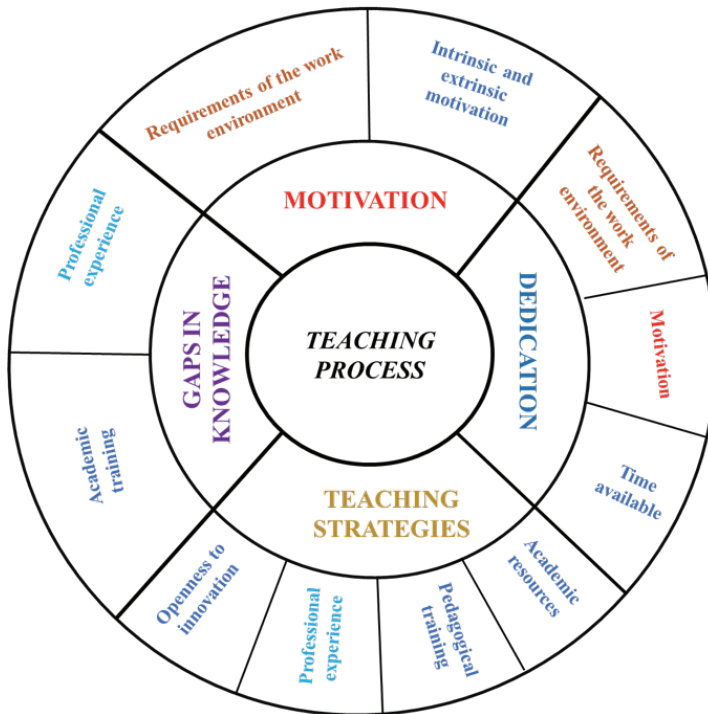
Source. Fondón et al., (2010). (Own translation)

Based on the previous graph, it can be affirmed that the factors: knowledge domain, motivation, dedication and methodological strategies can define the success of the teaching process by the teacher. These four factors are the ones that the students can easily observe in their interaction with the teacher. However, there are secondary variables that can influence these factors.

For example, it is easy for the student to affirm that they do not understand the professor. The task that must be followed in this case by the person who coordinates the teaching activity, assuming that the student puts the appropriate means, is to determine if this lack of understanding is due to a lack of mastery of the contents or methodological flaws. If it were the first case, it must be determined if the teacher has the adequate training regarding the contents and the necessary experience. If the problem is due

to flaws in the methodological strategy, the teacher should have enough openness to question and evaluate their methodology and develop optimal academic resources that are easy for students to interpret, devoting the time necessary for this dynamic. Therefore, whatever the case may be, it is necessary to identify the secondary variables observed that could hinder the teaching process by the professor.

Figure 4. Teachers in the teaching process



Source: Own elaboration

In addition to the above, directly related to methodological strategies that influence the teaching process, there are the pedagogical styles proposed by Suarez, Burgos, Molina, Corredor & Rueda (2010), which allow the analysis of the interaction that originates among the students and teachers and that affect the teaching process, as well as in the students' learning.

The styles can be evidenced in the following table, with their characteristics:

Table 2. Pedagogical styles

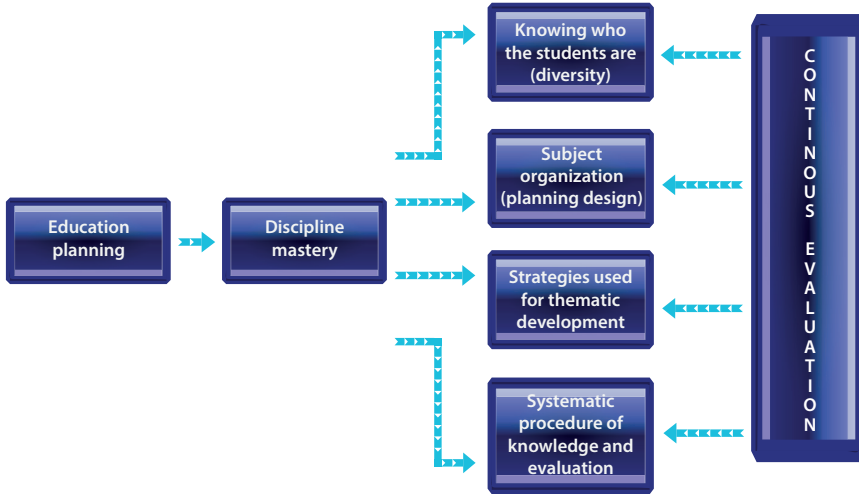
Teaching style	Style characteristics	Teacher's role	Student's role
Management	Discipline, arbitrariness, prevailing of the master class	Lead teacher	Very passive, and answers to the teacher's mandates
Tutorial	Participatory, guidelines are established and there is a process	Guide, mediator, and facilitator. Answers to students' interests and needs	Active and autonomous
Planning	Advance planning to support the diversity of activities	Plan continually to support students, keeping their intelligence in mind. Evaluate student processes	Respond and is active throughout the process
Research	Oriented to the achievement of new problems	Raises new ways of generating knowledge	Demanding in the process and produces new things

Source: Suárez et al. (2010). (Own translation)

Thus, this study describes a management style and three others (tutorial, planning and research), which are part of participative styles that are manifested by teachers at the time of teaching and are key factors for the success of good teaching.

Thus, it is determined that “teaching” has to do with a systematic, serious process, which must be transformed, evaluated, and have feedback and self-evaluation; it requires innovative strategies, creativity and must guide actions according to the contexts. Certainly, teaching requires creators; but, in addition, a good education demands of a good planning and its characteristics are reflected in the Figure 5.

Figure 5. Planning of teaching



Source: Molina (2016). (Own translation)

Teaching, as its process requires planning, constant questions –such as, what is the role as a teacher? What is the role of the students?–, knowing the organization and the sequences of the topics, acquires a crucial beginning point.

Therefore, it encompasses more complex actions than just being in front of a group exchanging information: it endorses a series of functions and practices within the teaching process that involve study, knowledge and research in order for others to learn. In order to do so, the teacher needs to develop skills that can outline the group or groups they are responsible for (Carrasco, Zúñiga & Espinoza, 2014).

4. Introduction of ICT in the teaching process

Information and Communication Technologies (ICT) are tools that can be used as support in the teaching-learning process. In this sense, the authors comment that the implementation of ICT in pedagogy and teaching didactics have a positive impact on the learning process, making it more efficient in contrast to the traditional one. Among the advantages

offered by ICT, there is the possibility that learning can occur at any time or place, as well as its easy access and management (Park & Choi, 2009).

Within the methodological strategies that are found from ICT, there is e-learning and m-learning. E-learning consists of a distance learning process using mobile, wireless and intelligent technologies. M-learning was considered the evolution of the previous method and focuses exclusively on the use of mobile devices, such as cell phones or tablets, in the teaching-learning process. The advantage of this method is that it does not necessarily have to be remote, since it can be used in person, ensuring greater efficiency and interaction with students.

To determine the impact of ICT in the learning process, significant aspects of the most used educational models (cognitive, behavioral, and constructivist) and the relationship with this technology must be taken into account (Table 3).

Table 3. Significant aspects of the most used educational models

Pedagogical model	Characteristics	ICT inclusion in the model
Cognitive	Mental abilities: perception, attention, learning, and memory, communication, understanding, and reasoning	The use of the “virtual campus” can support certain mental processes, such as: memory that provides data to compare different points of view, simulator to test hypotheses, or social environment to collaborate with other providers of tools that facilitate articulation and knowledge representation.
Behavioral	Evolution of the user in operative behavior: stimulus and response.	Software operation to perform a layout.
Constructivist	Construction of learning contents.	Work with resources such as wikis.

Source: Ávila & Riascos (2011).

According to the authors, these models seek to prepare a student climate that accelerates and activates motivation in an adequate manner, and that facilitates the development of a more important role in the learning process. The teacher can then focus on the questions that arise during the exchange.

In 2010 in Argentina, a program called *El Programa Conectar Igual* was implemented. Its main objective was to support the learning process by providing students and teachers with a netbook, in order to design new pedagogical proposals. The problems identified during its implementation were problems with the planning of the program, the perception of the teacher towards technologies, technological infrastructure problems, gaps in teacher training, the need for a more integrated implementation, unclear guidelines from authorities and conservatism of teaching practices (Zanotti & Arana, 2015). The authors point out that the use of ICT as a support in teaching methodologies presents two main results: first, some of the teachers refuse to use these tools because they fear being exposed to overcoming or disavowing by students; second, some teachers reformulate their didactic practices and strategies, taking advantage of ICT.

Similarly, Ramírez (2012) conducted a study to evaluate the impact of ICT in solving problems and collaborative learning of the subject of Calculus I. This study focused mainly on the identification of the most common problems presented in the students graduated from secondary education. Next, the use of digital platforms where students participate, investigate and solve problems was encouraged, in order to track the acquisition of knowledge of the subject. In the study, it was evidenced that the use of ICT allowed a greater role for the students in the process and a greater regulation of their work rhythm, making them more active and significant in their learning process. The methodologies supported in ICT, present a higher performance in the learning process when the student is given a protagonist role to assign their rhythm of work (Ramírez, 2012).

Meishar-Tal & Ronen (2016) conducted a workshop using a mobile application to fourth-grade students in 26 schools in a city in Israel. They previously evaluated the attitudes of teachers regarding ICT in the teaching-learning process. It started with the development of a game with

characteristics of “Gamification”, which is a technique where the player is motivated to interact in a learning environment with a specific objective, be it educational or of information. There was a previous induction for the teachers, explaining the dynamics of the game called *Looking for the treasure*. The game consisted of putting challenges to each participant that had to be fulfilled and confirmed by scanning a QR code upon arriving at the assigned station. The score was assigned from highest to lowest taking into account the time of play and compliance with the assigned activities. The dynamic was carried out with 35 teachers, 32 women and 3 men, to analyze how their attitude was like towards the methodological strategy. The results of this study were very positive and are summarized in the following conclusions by the authors:

- It was shown that when the teacher masters the tool, they transmit more security to their apprentices.
- The only important difficulty evidenced was the teacher’s concern to feel inferior to their students in the use of information tools and to lose authority in the class.
- Teachers’ perception before the study regarding the use of mobile devices was positive and it increased considerably after experimenting with the tool.
- The teachers considered that these mobile tools encourage collaboration and motivation to win, contributing to the development of new knowledge within a family environment such as that of the classroom.
- Resistance to the use of ICT is quite low in both teachers and students and this continues to decline over the years due to the use of smart devices such as cellphones, tablets, computers, etc.
- Some teachers were reluctant to use ICT in classrooms, because they had the perception that these tools fostered cheating in the classwork and that they could even be channels of cyberbullying, in addition to the distraction they may represent for the student in the classroom.

- The teacher was given the opportunity to choose their preferred teaching method, and to try to imitate it in the application, generating trust in the tool for the teacher.

On the other hand, Agnese & Lopes (2016) implemented ICT tools in a first semester course in anatomy, which consisted in the development of an app that developed all the programmatic content, inside and outside the classroom, developed mostly by simple images and little writing.

At the end of the semester, the impact on students was evaluated, which was positive, since they felt related to the tool's contents. Some important conclusions evidenced in the article are:

- Wireless connections in mobile devices have changed over time making it more viable in the teaching-learning process.
- M-learning as a methodological tool is very useful in the research and production processes of new educational contents.
- The used tool generated interest in the students, and the teachers see it as a viable way of teaching inside and outside the classroom (authors).

Aliou & Delialioğlu (2015) conducted a review study about the use of M-Learning in classrooms in 30 different teaching projects. The review focused on the objective sought, the target audience, the geospatial location and the tools used. In this study, it was found that the continent where these tools are most developed is in Asia with 57%, followed by Europe, North America, Australia and Africa. The most used methods in this teaching process were mobile applications (36.6%), text messages (23.3%) and mobile games guided by principles of gamification (20%). As a sought-after goal with the introduction of ICT, they highlighted that 33.3% of the projects focused on research-based learning and 16.6% on the learning based on the game.

Spiegel & Rodríguez (2016) conducted an investigation at the National Technological University (Argentina). A semi-open and semi-structured interview was designed, solved by first-year students and professors in engineering in order to verify the construction of knowledge in the teaching-

learning process. During the project, it was assumed that interaction with ICT is the appropriate methodology to generate mobile learning within the classroom. Aspects in the students regarding their participation in mobile technologies, the management and prior knowledge, the distribution and use of time in the development activities and the type of orientation received by the teacher in the use of this type of devices that allow to create a significant learning and integrated in the student were taken into account.

Regarding the teacher, aspects such as the type and assignment of tasks, the incentive to use mobile technology in academic tasks and the training or guidance given to the student in the use of this resource were also considered. During the development of the project, it was evidenced that, in 2012, 36% of the teachers suggested their students make use of mobile technologies for academic purposes. A year later, this percentage increased to 59%, demonstrating the appropriation and importance that ICT have taken in classrooms, despite the fact that only 13% of students say that it was the teacher who gave them their first approach to mobile technologies.

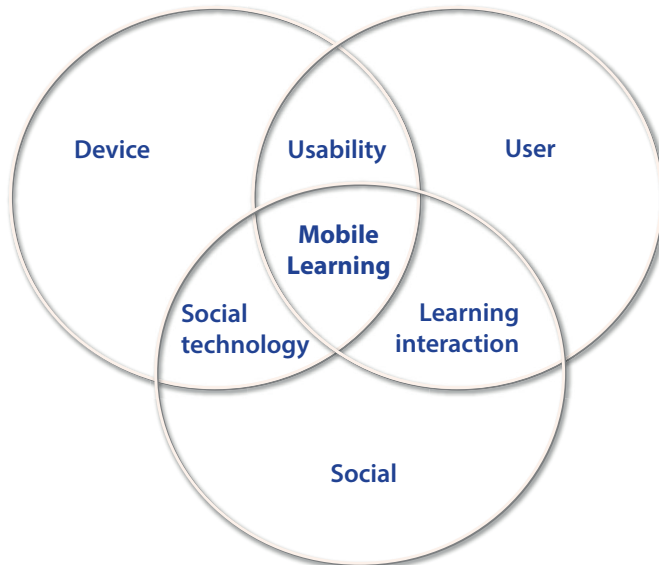
On the other hand, it was evidenced that students make greater use of audiovisual material when the teacher prepares it. Finally, although students made use of mobile technologies to study, they were considered to be only social and non-academic practices, because the design of a study plan that effectively addresses the construction of knowledge is needed, making use of the technological devices.

Sonego, Machado, Torrezan & Behar (2016) conducted a study at the Federal University of Rio Grande do Sul, based on the requirements of the academic environment regarding the study of content, teaching materials, strategies and application activities. A theoretical-practical descriptive research was carried out to expose some pedagogical strategies that contribute to the creation of applications and ICT support within classrooms. This in order to achieve an increase in autonomy, participation, interactivity and collaboration between the student and the teacher in an academic environment, since 66% of students have access to the Internet through a mobile phone. This research encourages the student to build

an application composed of a description, applicability, examples and any other type of material that they consider necessary for its understanding. Finally, the authors conclude that the construction and use of mobile applications facilitate the developing of knowledge, innovation and increase the comprehension of information by students.

Azmi, Mat, & Mohamed (2017) conducted a study that showed that students focus less on learning in the classroom. Sometimes, it can even become a slower process and negatively influence the student's motivation to learn, because students tend to communicate through high-tech devices. The objective of the study was to identify the needs and requirements of the user in m-learning, in order to establish some main aspects for the development and validation of an m-learning model that supports the professional teaching-learning process within the classrooms (Azmi et al., 2017). That is why m-learning was defined as the composition of three main aspects: the user, the device and the social aspect, evidenced in Figure 6.

Figure 6. Theoretical framework for the rational analysis of mobile education

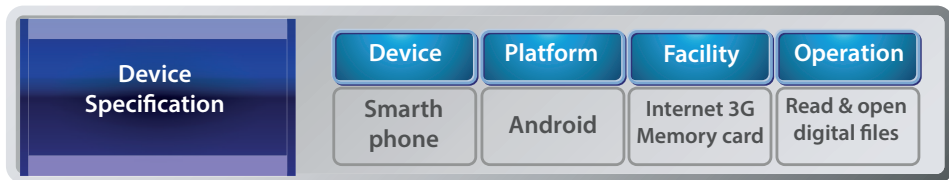


Source: Azmi et al. (2017).

On the part of the user, factors such as cognitive abilities, memory, emotions, motivation and abilities with the use of technologies were taken into account. Regarding the device, the design and functionality specifications were important, while in the social aspect, the user's abilities to interact within a system were considered. Finally, this would generate the interaction between mobile learning, interaction in learning and social technology.

In this sense, the authors disclose four parts that should be indispensable for the design of an m-learning model, presented below:

Figure 7. The four parts that constitute an m-learning model



Source: Azmi et al. (2017).

Regarding the previous graphic, the m-learning models are subject to the specifications of the devices that will be implemented in the teaching-learning process divided into a device, a platform (Apple, Android), facilities (internet connections) and functionality of the device.

Finally, Azmi, Mat Noor & Mohamed (2017) establish five steps to validate an m-learning model:

- 1) Briefly expose the method to validate the model;
- 2) Individually carry out an evaluation on the use and perception of the students of the proposed tools, methodologies and learning activities;
- 3) Students must perform activities supported by mobile technologies recording each movement and student participation;
- 4) The student will solve a questionnaire where their perception in the use of mobile technology will be evaluated;

- 5) The results will be analyzed for the measurement of each of the aspects to be taken into account by the teacher.

Because of this study, it is concluded that m-learning facilitates the transition from individual learning to social learning, to create a student-centered teaching, so that they can improve their results in the learning process themselves. In addition, these mobile tools facilitate the exchange of information, regardless of time or place.

5. Conclusions

Based on the study carried out, it is important to point out the following aspects:

- Although information and communication technologies contribute significantly in teaching-learning processes, their application is not convenient without their correspondence with curricular and learning objectives.
- Among the factors that influence student learning seen by the teacher are motivation, dedication, intellectual abilities, and gaps in expected knowledge.
- Motivation is one of the factors that most influences student learning and that has a decisive impact; for example, about dedication.
- Coinciding with the assertion of Asbury & Plomin (2015), genetic factors influence the academic performance of students, but these do not determine the success or failure of student learning.
- The factors that influence the teaching process and are perceived by the student are the teacher's motivation, his dedication, the methodological strategies he uses and the domains of knowledge.
- One of the factors that affect student learning is the pedagogical style with which the teacher assumes the teaching process. This is reflected in the teacher's role in interactions with their students.
- Another cause that hinders the teaching-learning process is the insecurity transmitted by the teacher, which, when perceived by

the student, can generate demotivation and a vicious circle in the process (Fondón et al., 2010).

- The use of ICT in the classroom, in addition to promoting learning, allows students to appropriate the knowledge given as protagonists and managers of their development.
- Finally, academic environments with the help of ICT allow, on the one hand, to contribute to the motivation of students and teachers, and, on the other, make it possible to stimulate teaching strategies in teaching-learning processes.

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