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Application of ICT in blended learning educational models: A systematic review of literature

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Abstract

This article identifies the trends and impact of applying information and communication technologies (ICT) in the blended learning educational model, also known as blended learning, which proposes to make an integration between virtual and face-to-face oriented classes in classrooms. In this research, there are taken into account results and experiences in different educational areas, emphasizing mediation with ICT. Blended learning has achieved great impact thanks to the interaction between teachers and students, generating positive results in the teaching and learning process. The methodological aspects used with blended learning, based on the use of ICT to develop both online and virtual activities, allow the participant to develop cognitive, competitive, critical and constructive thinking skills for problem solving. Through this systematic review of literature, the importance of the use of ICT within this methodology is acknowledged, as it allows a dynamic and adjustable learning process, making it a pioneer in educational environments because of its great effectiveness and interaction.

Key words: Virtual learning, student, training, model, ICT

Introduction

The current educational processes are focused on being more effective and updated every day, therefore the tendency in the implementation of ICT in training processes. As a result, from this initiative arises the need to apply new learning models. This article presents the benefits of blended learning (b-learning) educational model, highlights the applicability of ICT tools within this process, and provides an analysis in different areas. Different articles related to blended learning were taken into account, which were searched in several databases such as Scielo, IEEE, Google Scholar, Proquest, and Science Direct. Subsequently, a selection was made according to the relationship with blended learning, attempting to determine in what way it has been applied and how the scenarios have been implemented under this modality in different contexts. This article focuses on both a research and indignation processes about related experiences to blended learning modality, in order to carry out an analysis on the characteristics, methodologies, conceptualization, importance, and advantages of the modality, highlighting the applicability of ICT in this educational model. Blended learning allows and promotes autonomous, self-regulated and collaborative learning (Ruiz Bolívar, 2008), and it is also recognized as a mixed learning that considers face-to-face and virtual sessions. This practice leads to interactivity and motivation due to the collaborative work of students and teachers.

In order to develop these activities, both a university and a virtual environment must be taken into account, and a blended learning space is also needed to allow students to express their concerns about the contents established during the course (Gámiz Sánchez & Gallego Arrufat, 2016). In addition, an analysis is made to blended learning modality and compared with the e-learning modality, although it is stressed that the mixed learning is not the perfect solution to the e-learning modality. There are also findings where mixed learning obtains 90% satisfaction from students and teachers from different academic contexts (Estrada Lizárraga, Zaldívar Colado, Mendoza Zatarain, Nava Pérez, & García Sánchez, 2013).

Conceptualization

This modality is literally known as blended learning due to the learning way, which combines face-to-face teaching with online teaching, and whose main idea is the appropriate media selection for each educational need (Sanz, Madoz, Gorga, & González, 2009), (Camacho, Chiappe Laverde, & López de Mesa, 2012). An analysis of the application of ICT in blended learning model (Liu & Zhao, 2010) was carried out, showing that through these tools, learning processes can be oriented to different areas or fields (BakarNordin & Alias, 2013) in both higher and secondary education, focusing on Mathematics, English, Medicine, Engineering, and Pedagogy in the case of caregivers (babysitters or children teachers), (Güzer & Caner, 2014), (Sánchez Olavarría, 2014), (Cerón Peralta, Gómez Zermeño, & Abrego Tijerina, 2014). The areas of knowledge in which they have been applied include Engineering, Health, Mathematics, Biology, Social Sciences, etc.

The mediation with ICT in blended learning modality is carried out on virtual platforms, institutional websites, and learning management systems (LMS) through

virtual forums, e-mail, collaborative work on online tools, videoconferences, among others. (Contreras Bravo, González Guerrero, & Fuentes López, 2011) (Navas Granados, 2011) (Georgsen & Lovstad, 2014).

In Vásquez Lopera & Arango Vásquez, 2011, it is argued that the presence of ICT in schools has generated a notable increase in the learning evolution. Blended learning is an emerging educational modality; in other words, it is an adaptation process (Ramirez, 2008) that allows cognitive skills development and critical and constructive thinking that are related to decision-making and day to day life problems solution (Catalano, 2014).

Advantages

Blended learning modality has a great appropriation ease in terms of the developed topic during the formative processes, as this model is linked to the ICT applicability. Through these tools used in the educational learning process, a high level of satisfaction is achieved among the participants. It is with this perspective that (Ruiz Bolívar, 2008) shows a percentage of student satisfaction of 80.78 in relative frequency, that is, the acceptability of the implementation of b-learning in the classrooms.

Learning is authentic and innovative; it focuses on collaborative work, that is, the tutor and the apprentice acquire a great interaction regarding the completion of tasks during the course (Pascal, Comoglio, & Fernandez, 2012), (Antúnez Sánchez, González Espinosa, Soler Pellicer, Rodríguez Rodríguez, & Haub, 2014). It manages to adequate to the needs of each student for being (autonomous learning). It acquires a variety of resources to learn in several situations and technologies. There exists a possible equality of learning opportunities, flexibility, and adaptability. In addition, it orientates the critical thinking development and decision making through observation, participation, reflection, shared knowledge forms and thinking that enables interaction and eases learning enrichment (Maldonado & Etcheverry, 2013). It provides communication among the participant and student, allowing to indicate orientations, information, mentoring and promoting the interchange, and learning among all the participants (Makhdoom, Khoshhal, Algaidi, Heissam, & Zolaly, 2013).

It improves the capacity in terms of the practice and applicability of the knowledge (that has been) seen, and also integrating a great experience in interaction and teamwork that leads to the appropriation of their knowledge, generating management and quality of education, strengthening decision making, efficiency and effectiveness in the performance of formative processes (Slechtova, Vojackova, & Voracek, 2015).

Characteristics

The learning model is virtual since it is related to virtual environments; in the same way, face-to-face learning is linked with educational classrooms. It includes face-to-face modality, so that the students clarify doubts and the teachers can reinforce more the programmed contents during the courses. It has the purpose of offering greater flexibility in the apprentices, that is to say, it focuses on educational comfort, where they can learn in a dynamic and influential way, obtaining a positive result. During the process of learning, there is a physical separation between teachers and students. In this modality, the students or apprentices employ independent learning.

The main characteristic of blended learning is that it is adjustable in educational environments, emphasizing the development of cognitive skills, improving comprehension and application of acquired knowledge, facing future problems, decision making, appropriation of ICT management, time flexibility, information access, communication speed, and content updating and development. The modality constitutes a set of characteristics given by traditional learning such as face-to-face classes and online learning. Given this, it becomes dependent and complementary.

Applicability

It has been demonstrated by Joyes and Ellison (2013) that blended learning is the most appropriate teaching method at all levels of education, since it covers different areas of formative processes. In this way, it facilitates students and teachers to understand and comprehend the content of the courses. These processes are performed using MOOC (acronym for Massive Open Course Online) (Nakayama, Mutsuura, & Yamamoto, 2016), handling Python programming language and Script, in which students emphasize algorithmic thinking (Rodmunkong, 2015) through computer games (Barik, Everett, Cardona Rivera, Roberts, & Gehringer, 2013).

Table 1 indicates the different technological tools used during the experiences and research of the implementation of blended learning in classrooms. It highlights the relationship of the methods and activities carried out for the learning and teaching process.

This modality gives rise to teaching processes transformation from being master (classes) to dynamic

(activities); in this case, face-to-face and virtual activities that motivate students to make the process collaborative using online platforms such as Willow, WebCT (Perez Marin, Santacruz, & Gómez, 2012), Moodle (Monguet, Fábregas, Delgado, Grimón, & Herrera, 2006), Edmodo, Mini Blog, presentation videos, online exercises (Wai & Kok Seng, 2014), social networks (Yeen-Ju, Mai, & Selvaretnam, 2015) and online games, conferences, and tutorials (Thien Wan, 2015).

Theoretical and practical training are evaluated by different tools. Students carry out activities through the Moodle platform and face-to-face classes. The latter, for example, can be combined with materials written in electronic format (electronic books or readings in PDF files, or also in virtual spaces, such as videos) (Contreras Bravo, González Guerrero, & Fuentes López, 2011) under the application of ICTs, resulting into learning grabbing without remaining in the technological advance alone and finally, to acquire knowledge through mixed learning (Herradón Díez, Blanco Cotano, Pérez Yuste, & Sánchez Fernández, 2009).

This model was also implemented in higher education, more specifically, there is the case of an Engineering Faculty students who interacted using an educational platform, e-mail and virtual forums where students express and resolve their concerns. During a research experience in the field of Computational Physics, the computational tool eTextBook was used to support the development of techniques (Landau, Paez, & Bordeianu, 2013). Among the findings, there was a new technology called Podcasting applied to the improvement of teaching and learning. This tool also allows the distribution of audiovisual files (Thien Wan, 2015).

Evaluation of blended learning process

Blended learning modality gives rise to an interaction between teachers and students in which it is necessary to use Virtual Learning Environments (VLE) and several technological tools to accomplish various sections of the proposed activities in the courses. At the time of face-to-face discussions, students can discuss specific topics previously discussed online.

Apart from that, an evaluative research called "Academic Performance Matrix" was carried out by means of an advanced course on construction of research instruments, applied to the doctorate program of a rural institute in Venezuela. It included the participation of 26 graduates and university professors, aged around 42 years, who teach semi-virtually. The following results were obtained.

In the academic performance, it was obtained that 95% of the participants memorized the units of the content carried out during the course, 90% considered that all of the objectives proposed in the course were achieved, 42% answered that the learning level was excellent, and 96.25% answered that their learning expectations were met (Krasnova & Demeshko, 2015). Leadership strategies, decision-making strategies, and power relations strategies were applied in the interactions mediated by EVA, where it was analyzed the complementary or symmetrical relationship that was made evident in the interpersonal relations and how students perceived or assumed the role of leaders in a group activity. (Hinojo & Fernández, 2012), (Vásquez Lopera & Arango Vásquez, 2011).

Likewise, (Hinojo, Aznar, & Cáceres, 2009) from the *Universidad Nacional de Lomas de Zamora* highlight blended learning experience to determine the university academic performance through virtual environments. To achieve that, they consider the perception of the student and the degree of satisfaction with the academic offer in *blended learning* modality whose result is satisfactory and accepted. They work with regular courses of engineering careers that participate in an I+D project that incorporates ICT. In addition, the blended experience is presented articulated with an LMS (Dunwell, et al., 2011), in which it is intended that students develop computational thoughts and artificial intelligence through the programming language Python and Script using exercises and video games, allowing them to relate theoretical concepts to day-to-day practice (Barik, Everett, Cardona Rivera, Roberts, & Gehringer, 2013).

The project, led by (Pascal, Comoglio, & Fernandez, 2012), aimed to achieve the following results: a) To relieve the digital vestiges in the platform in order to characterize the interactions that take place between the student and the didactic material and the teacher and the student, b) to identify, analyze and characterize the uses made by students and teachers about the digital tools present in the Virtual Learning Environment, and (c) to describe and compare the academic performance of students in the different virtual classrooms and determine if there is an association between them and the dynamics of the use of the VLA , their beliefs and level of satisfaction with the educational offer and to evaluate the existence of common characteristics that allow to

Table 1. Implemented tools in the *blended learning* educational model

Tools	(Pascal, Comoglio, de Fernandez, 2012)	(Gonzalez, Mariño, 2006)	(Ali, Joyes, & Ellison, 2014)	(Sivakumar, Namasivayam, Al-Atabi, & Ramesh,	(Lungu, 2013),	(Makhdoom, Khoshhal, Algaidi, Heissam, & Zolaly, 2013),	(Wai & Kok Seng, 2014), (Lau, y otros, 2010), (Dunwell, et al,
	(Cerón Peralta, Gómez Zermeño, & Abrego T ijerina, 2014)	(Vásquez Lopera & Arango Vásquez, 2011),	(T hien Wan, 2015),	(Kennepohl, 2013)	(Yeen-Ju, Mai, & Selvaretnam, 2015), (Chaiyama, 2015),	(Nakayama, Mutsuura, & Yamamoto, 2016)	(Sorden & Ramírez Romero, 2012) (Wannapiroon, 2014)
		(Navas Granados, 2011)	(Rajini, T iwary, & Ganapathy, 2011),		(Rajini, T iwary, & Ganapathy, 2011),		
E-mail	X	X	X	X	X	X	X
Web institutional platform	X		X		X		
Moodle	X	X				X	
Online forums	X				X		
Social media	X	X	X	X			X
Blogs, mini blogs				X	X		
Online surveys	X				X		
Microsoft (Word, Power Point, Excel)	X	X			X		X
Language Programming Programs			X				X
Edmodo				X			
Virtual laboratories				X			
Conferences	X		X			X	X
Online games							X
Podcasting						X	X
MOOC						X	

Source: the authors

stablish some typology. By virtue of the participants, it was demonstrated that in *blended learning* modality, classroom and virtual learning strategies complement each other satisfactorily. The classroom learning mode during blended learning strategy favored direct interaction both in the participants and in the teacher. It also provided information, clarification of doubts and feedback allowing the discussion of topics of interest regarding the set out objectives in the course. During the development of this modality, it was found the need to use forums, communication via email with course participants and teachers, participation in chats and online information gathering.

The experiences of blended application in educational environments are not only aimed at students, but they can also be implemented for teachers or tutors. Training was given to teachers aged 35 to 50 years, for whom it was difficult to use ICT in the training programs they run. However, this experience allowed them to train themselves as suitable teachers in the applicability of ICT in the classroom (Catalan, 2014). Within the English area, blended learning has also been implemented through language modules that allowed the development of skills such as Listening, Speaking, and Writing (Lungu, 2013) (He & Zhu, 2013).

The blended experience was analyzed in the educational laboratories where it is wanted to apply, study and explore alternative ways of using them (Kennepohl, 2013). In the pedagogical environment, it was found that blended learning is applied to kindergarten teachers who did not know about the ICT tools. Therefore, they did not know the communication and teaching skills that promote their use. They were informed that the pedagogy goes hand in hand with the application of ICT, which allowed them to be more effective regarding the academic performance of the children (Janthon, Songkram, & Koraneekij, 2015).

B -learning vs. E- Learning.

These learning models acquire some similar characteristics, among them the physical separation between the teacher and the students, incorporation of ICT tools, tutoring and independent learning. This section determines why blended learning obtained more acceptability in educational models than e-learning (Estrada Lizárraga, Zaldívar Colado, Mendoza Zatarain, Nava Pérez, & García Sánchez, 2013). First, the e-learning model, better known as electronic learning, will be defined; this is based on distance learning through the incorporation of ICT tools (Turpo Gebera, 2009); and as emphasized in this review article, the concept of b-learning is blended learning that includes ICT tools for better development of learning processes.

In the e-learning modality, the result was a low learning level due to the fact that the learning process was a long-distance and traditional one that did not include dynamic processes, which caused a high dropout rate. The interaction between teacher and students was lost since the distance support tutorials were not sufficient to clarify the doubts of the apprentices (Antúnez Sánchez, González Espinosa, Soler Pellicer, Rodríguez Rodríguez, & Haub, 2014). As for blended learning modality, excellent results were obtained since it allows students to interact more with their peers and teachers. Considering that not all the sessions are virtual, some of them are face-to-face gatherings. Time flexibility is highlighted as it is centered on the learner.

Discussion

Thanks to the analysis that was carried out during the processes of study and research of the different experiences with blended learning, the following aspects were identified: a high academic performance has been achieved when blended learning model has been implemented, which allows a great relationship between students and teachers. If an interaction between these elements is achieved, there will undoubtedly be great communication, that is to say, a dynamic process. Several general aspects are identified which have similarities not only with a blended experience but also in different aspects that are characterized by having similar aspects and advantages. Within the general aspects, blended learning stands out as an educational model that allows a high academic performance in the training processes implemented in the different educational areas. They allow both the learner and the teacher to obtain great benefits in their training, since it is linked to the applicability of ICT and it is adjustable to the educational needs. The research carried out highlighted the following aspects:

Table 2. Characteristics of blended learning Model

General aspects	(Pascal, Comoglio, & Fernandez, 2012),	(Antúnez Sánchez, González Espinosa, Soler	(Estrada Lizárraga, Zaldívar Colado,	Camacho, Chiappe Laverde, & López de Mesa,	(Krasnova & Demeshko, 2015),	(Hinojo & Fernández, 2012),	(Cerón Peralta, Gómez Zermeño, & Abrego	(Ali, Joyes, & Ellison, 2014)	(Wai & Kok Seng, 2014),	(He & Zhu, 2013),	(Kennepohl, 2013),
High teaching and learning performance	X	X	X	X	X	X	X	X	X	X	X
Appropriation of the topics seen in the training process	X		X		X	X	X		X	X	
Teacher-student interaction				X		X					X
It allows a dynamic and adjustable learning process	X	X	X	X		X			X		
Cognitive skills development, critical and constructive thinking.	X	X						X			
Blended learning experiences in higher education		X			X			X		X	
Easy participative communication among students and participants		X					X				
Blended performed by the Math area teacher (training)				X							
Outstanding interface by its organization and tracking friendly for Blended modality courses.			X								
Blended Learning based on Kolb experiential learning in the Health area.				X							
Time flexibility, access to information, communication speed, and content development and updating.	X	X	X		X						
Virtual learning environment based on free software (Moodle) for blended learning process.		X			X						X
Skills development as analysis, reflection, and decision making capacity.							X	X			
ICT high implementation	X	X	X	X	X	X	X	X	X	X	X
It allows future problem facing to solve									X		
It allows team work.		X		X			X	X			
Done in the English area.										X	

Source: the authors

Conclusions

Blended learning, a form of semi-virtual learning that goes in hand with the Information and Communication Technologies, is applicable to different areas of knowledge, and it allows the definition of accessible virtual environments with innovative schemes.

The analysis of the several educational experiences about the implementation of blended learning modality highlights the positive impact and adjustability to the environment where it is developed. For these reasons, it has been considered a great educational advance that articulates different techniques, technologies and tools such as educational platforms, virtual forums, e-mail, social networks, blogs, mini blogs, conferences, video games, among others.

The students or participative entities also give their favorable opinion about blended learning modality, highlighting it as effective and productive during their training. It is adjustable for those people who do not count with a normal schedule due to their workload, and it contributes key aspects in the different levels of training.

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