

Effectiveness of an ICT-based intervention to support the management of the teaching-learning process in Peruvian universities

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Abstract

Objective: To analyze the effectiveness of an ICT-based intervention to support the management of the teaching-learning process.

Methods: A pre-experimental study was conducted. It involved 241 university students from five faculties (142 males) between 16 and 35 years old. A questionnaire validated by experts was created to evaluate the management of the teaching-learning process.

Results: The results report the significant effectiveness of the intervention in terms of increasing personalization, space-time accessibility, administration of information, collaborative work and monitoring, which are practices in the management of the teaching-learning process.

Conclusions: The ICT-based intervention for the management of the teaching-learning process was effective.

Keywords: Teaching-learning, university students, web 2.0, higher education, management of the teaching process.

Introduction

Higher Education has experienced expectant moments in Peru. On the one hand, the changes in economy and management of information are demanding professionals with new and specialized skills and, on the other hand, the new policies and state directives are looking for an increase in the academic quality to make professional work appropriate to the needs of the country.

The University Law N° 30220 published in 2014 and the different approaches to educational university models establish some key elements in higher education: the curriculum, adequate infrastructure, support services, and the students and teachers; the latter two being the main actors in the field of management within the learning process. The educational system faces important challenges; for this purpose, it should evaluate the principles and educational objectives and innovate its teaching methodologies and organizational systems. In addition, it should carry out the reorganization of a new student-teacher relationship and the teaching-learning process itself, and a restructuring of the curricular contents. Besides, it should make a critical review of the mental models that have inspired the development of educative systems (Ossa, 2002).

The new teaching approaches and teaching-learning processes include, for example, the student-centered approach, the flipped learning approach, *e-Learning*, and PLEs (Personal Learning Environment) among others (Rojas & Tezén, 2015). These new approaches or educational strategies have found a support channel in the Information and Communication Technologies (ICT) where it should be taken into consideration that the teaching act responds to a binomial that is also composed of learning. Then, to make a real contribution, technology should direct the didactic and pedagogical objective towards its use (Fandos, 2005).

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2014), declares that the ICT can be very useful tools for the diversification of teaching and learning. The ICT can provide a teaching-learning environment for students and teachers, configuring new environments and scenarios for training with significant characteristics (Domingo & Marquès, 2011), for example: expanding the information supply and the possibilities of personalized guidance and monitoring; eliminating spatial-temporary barriers; facilitating collaborative work, self-learning and enhancing interactivity and flexibility in the learning environment, as well as facilitating the collaborative creation of knowledge. The ICT can be great facilitating resources; they can enrich and improve the teaching-learning process and help to achieve educational objectives of a training program; however, this will be accomplished only if they are correctly used; that is, if they are correctly integrated.

The ICT integration in teaching has been subject to some elements such as the advance of technology, the didactic and pedagogical debates and the educational police route. These aspects have highlighted and defined the ICT integration as a non-systemic and non-standard process with different rhythms, which has been evident in the educational systems during the last decades. The Latin American countries have made great efforts to create educational models that integrate the ICT for more than 10 years; some of these countries have educational projects for the implementation of sustainable technologies like in Brazil- *PROINFO*, Chile-*Enlaces*, Costa Rica- *PIE*, and Mexico- *Red Escolar* (Espejo et al., 2014).

In Peru, the reports of the National Household Service (ENAH0) pointed out that there is an increase in people's access to ICT. Their impact is observed in the widespread use of cell phones, computers and Internet access, which has increased by 79.7 % in homes at a national level. Furthermore, 67.2 % of people between 17 and 24 years of age

use the Internet and the people that is receiving university education reaches the 85.2% (Instituto Nacional de Estadística e Informática (INEI), 2013). Likewise, 94 % of the adult population surveyed in Lima considers that the Internet favors study and learning practices; therefore, the use of ICT is very important in educational environments (Blumen et al., 2011).

Within ICT, we find Web 2.0 tools which highlight a change in the paradigm of the conception of the Internet and its functional qualities, giving up their marked unidirectional relationship and being more oriented to facilitate maximum interaction among users and the development of social networks (Zambrano & Medina, 2010). Therefore, we conducted a diagnostic study which was based on the participation of first-year and second-year students in tasks that include the use of Web 2.0 tools for the development of their academic activities. We found that 77.3 % students felt confused in the use of technological tools within the educational context, demonstrating their limited knowledge and the high level of confusion regarding the use of Web 2.0 tools.

Thus, starting from the problem of inexperience in the selection of educational information technologies, we proposed to select a set of Web 2.0 tools that were able to satisfy the main needs in the management of the teaching-learning process in higher education which can further instruct and accompany university students in their use; the ICT that were identified, evaluated and selected are defined in the integrated framework with Web 2.0 tools (*MTIHW2.0*).

A framework is a standardized group of concepts, practices, guidelines, and criteria focused on a particular problem that can be used as reference in a specific field and can be used to face or solve new similar problems. The definition of framework appeared and was first used in the field of software engineering; however, it is currently used in other fields such as biology, mechanical engineering, psychology and administration (Ávila et al., 2010; Castro-Contreras, 2007; Dios-Giraldo, 2014; Landinez et al., 2009; Ministerio de Educación, 2015).

The *MTIHW2.0* (figure 1) was developed after the selection of ICT according to the main needs for the management of the teaching-learning process in higher education, integrating them among themselves. Such needs were obtained from a previous study. The technologies that were integrated in the *MTIHW2.0* compensate the needs for research management, information management, communication, collaboration, evaluation, monitoring and virtual classroom.

In this study, the teaching-learning process was developed using the *MTIHW2.0* in a group of university students during an academic course. According to the arguments presented, the objective of this research was to analyze ICT-based intervention to support the management of the teaching-learning process.

Methods

Participants

The intentional sample was composed of 241 first-year university students (142 males and 99 females) 16 to 35 years old of a private university in the city of Lima. They were studying Computer Sciences and Research Techniques (55 students from the Faculty of Engineering and Architecture; 49 from Theology, 48 from Health Sciences; 54 from Management and Administrative Sciences and 35 from Human Sciences and Education) ($M_{\text{age}} = 19$ years).

Instrument

A questionnaire was developed and validated. First, the opinions of 10 experts were taken into account to determine whether the content of the instrument was consistent, precise and easily understandable to all respondents. For the quantification of findings, Aiken's V coefficient ($V = 1.00$; $p < .05$) which measures the degree in which the items reflect the contents of the areas involved in the construct in an adequate proportion was applied (Escurre, 1988; Galicia et al., 2017). In the second place, a pilot test was conducted in students of another university of Lima with the aim of evaluating the validity of the construct and the precision of the instrument. The evaluation of the validity was performed through an exploratory factor analysis (EFA) which evidenced that adaptation measures were acceptable (Kaiser-Meyer-Olkin Test ($KMO = .83$, Bartlett $p < .01$). Keiser statistical analysis was used to establish the number of factors from which 5 were reported, where the total percentage of explained variance was 59.5%. The reliability of the instrument was obtained using Cronbach's alpha, which was acceptable ($\alpha = .77$).

The instrument is composed of 33 items distributed in 5 dimensions. The first dimension is personalization and its items are: 1, 2, 3, 4, 5, 6, 7, 8 and 9; the second dimension is time-space accessibility and the corresponding items are: 10, 11, 12, 13, 14 and 15; the third dimension is collaborative work which includes the following items: 16, 17, 18, 19, 20 and 21; the fourth dimension is the management of information which is composed of items 22, 23, 24, 25, 26, 27 and 28; and the fifth dimension is monitoring which includes items 29,30,31,32 and 33. This instrument presents Likert scale responses (1-5 rating) and the following response options: never, almost never, sometimes, almost always, always.

Intervention

The research proposal was approved by the Ethical Committee of the Peruvian Union University, where the study was conducted. The students received information about the aims of the study on the basis of an informed consent; they were also explained that the participation was voluntary and confidential; collaboration was also requested. Then, a multi-phase and multi-method training program was implemented for *MTIHW2.0*

1. Two-hours workshops: Introduction to Web 2.0 tools in general by means of group sessions carried out in laboratories of the university. These workshops were addressed to students from different specialties and levels of computer knowledge.
2. Face-to face courses: They include 4 sessions of 4 hours each for every professional school.
3. Face-to-face personalized tutorials: they were developed in two days in which the students, depending on the availability of the schedule, asked for advice. The schedules were arranged in advance using Google forms which can be easily accessed from their cell phones.
4. Personalized virtual tutorials: Different methods were used for its implementation because there were students with low, average and advanced knowledge of the use of computers. Therefore, personalized virtual tutorials were carried out through videoconferencing using Google Hangouts, video tutorials that were recorded and shared using portable storage devices or also by the YouTube channel created for this purpose.

The students who accepted to participate actively in the different sessions of the program were monitored through a virtual Google

classroom where they could also use support materials, attendance control and others; depending on the sessions carried out in extra-class activities.

In short, the general structure of the *MTIHW2.0* intervention program was addressed to university students of all specialties, with the following strategies: introductory workshops, face-to face courses, face-to-face personalized tutorials, and personalized virtual tutorials. Likewise, support tools such as video tutorials, motivational speeches, dynamic classes and virtual classes were used during follow-up and monitoring.

Procedure

A pre-test was applied before the beginning of the program. When they had completed the program, a post-test was applied according to their group. Due to the number of participants and the different faculties in which they were studying, professional academic schools and the dates and times, some groups finished earlier and others finished later. Then, a database was created to analyze the variables studied (independent variable, integrated framework with Web 2.0 tools, dependent variable, support given to the management of the teaching-learning process) and to examine the descriptive characteristics such as age, gender and faculty.

Preliminary to data analysis, approximation to normality was evaluated using different strategies: magnitude of asymmetry and kurtosis expecting values between +/- 1.5 and *the most extreme absolute difference* associated with Kolmogorov-Smirnov Z test, where lower values than .30 indicate a non-significant distance from normality (Dominguez-Lara, 2018b). The analysis was carried out from an approach which assesses the magnitude of the effect (Dominguez-Lara, 2018a) between dependent groups. A Glass' s delta variance that considers the use of the standard deviation of the group previous to the intervention (pre-test) was used for the denominator function.

Results

Normality test

The dimensions of the variable used for the Support given to the Management of the Teaching-Learning Process are reasonably

closer to normality considering the magnitudes of the distributional statistics as well as the statistical D-test associated with the statistical Z-test. Regarding the comparison between punctuations *before* and *after* intervention, a significant improvement is evidenced in all areas evaluated (Table 2).

Discussion

The aim of the study was to analyze the effectiveness of an ICT-based intervention to support the management of the teaching-learning process. The results indicate the presence of a significant impact in the framework that supports the management of the teaching-learning process in university students.

These findings are similar to those reported by Montenegro (2013) who found that the implementation of ICT in the teaching process potentiate the improvement of learning. Likewise, the study emphasizes that e-learning training is a suitable methodology for professional training (Vélez, 2011). In this sense, it is evidenced that the adequate selection of *Web* tools and their integration in a framework that is further carried out by an implementation plan, leads to a better familiarization of the students with virtual environments. A study conducted with Spanish university students identified that communication space and collaborative knowledge in the relationship between students and teachers achieved a great impact in the management of the teaching-learning process. Thus, the management and integration of information and communication technologies in educational institutions were considered as the guiding integration elements that stimulate the management groups (Marín & Donoso, 2014). A type of mixed training program that combines some face-to-face classes with the use of a virtual platform significantly increases the learning process (Soto et al., 2014).

In addition to learning, the integrated framework also showed a significant impact on the management of information. This finding is important considering that, in a study conducted with Ecuadorian students, it was found that they were not fully competent in management, generation and spreading of information with ICT. The study demonstrated that they were competent only in Internet browsing and communication via e-mail, messaging and chats (Humanante-

Table 1. Intervention program

Activity	Objective	Session structure
Phase Workshop (2 hours)		
Induction	Motivate the use of the tools in a general way showing the virtues of the tools and how they are integrated into the integrated framework with tools for web 2.0 (IFTW2.0)	<ul style="list-style-type: none"> • Application of the pre-test • Brief description of each of the apps that are part of the IFTW2.0 • Show integration between web 2.0 tools highlighting benefits of integration.
Phase 2: 4-session in-person course		
Session 1	Virtual Classroom and tools for communication and monitoring of evaluations	Cloud technology, institutional Gmail, contact groups, hangout for calls and video calls, YouTube channel activation, Google Classroom
Session 2	Web tools for information management	Google Drive, Mendeley and YouTube playlists, subscriptions.
Session 3	Web tools for research management	Mendeley Google Forms Google Sheets
Session 4	Web tools for collaboration	Google Drive Docs Facebook Groups Classroom Mendeley Hangout
Phase 3: Personalized in-person and virtual tutoring		

Table 2. Descriptive, distributional and normality analysis

	Descriptive analysis		Distributional and normality analysis				
	M	SD	g1	g2	Z	D	Delta
Customization-Pretest	2.362	0.305	-0.079	0.017	1.432	0.092	5.845
Customization-Posttest	4.142	0.354	-0.212	0.299	1.61	0.104	
Accessibility of time and space-Pretest	2.075	0.361	0.632	0.731	2.165	0.139	4.904
Accessibility of time and space-Posttest	3.845	0.605	-0.121	-0.11	1.176	0.076	
Collaborative Learning-Pretest	1.941	0.354	0.125	0.271	1.494	0.096	4.957
Collaborative Learning-Posttest	3.694	0.575	0.206	-0.001	2.029	0.131	
Information management-Pretest	2.006	0.362	0.957	3.21	2.059	0.133	5.111
Information management-Posttest	3.855	0.549	0.11	-0.391	1.769	0.114	
Monitoring-Pretest	1.976	0.305	0.07	0.311	2.067	0.133	6.627
Monitoring-Posttest	3.994	0.601	-0.701	2.448	2.874	0.185	
Management Support in Teaching-Learning-Pretest	2.072	0.178	1.383	4.735	1.61	0.104	10.315
Management Support in Teaching-Learning-Posttest	3.906	0.459	0.249	0.251	1.514	0.097	

Note: M: mean; SD: standard deviation; g1: asymmetry; g2: kurtosis; Z: Kolmogorov-Smirnov Z; D: most extreme absolute difference.

Ramos et al., 2018). The use of *Web* tools allows to recover, control, store and convey the information obtained facilitating, to some extent the performance of academic tasks, achieving competences that will help the students in their process of learning to learn and in the generation of knowledge (Arévalo et al., 2014).

Regarding monitoring within the teaching-learning process of university students, the study showed a significant impact on the students, providing an easy follow-up of their academic activities and the information they had obtained. In this way, they had a better monitoring of their academic activities and a better quality of feedback. These results are similar to those reported in a sample of Ecuadorian students (Santamaria-freire et al., 2015), who showed satisfaction and a reduced student dropout thanks to the monitoring of activities and the solution of problems related to their academic activity, which provided an increase in the interaction between the student and the teacher, achieving better results.

Similarly, significant differences were found between pre- and post- tests with regard to time-space accessibility. That is, the use of ICT helps to achieve academic works at all times and in all places. Likewise, the use of these tools allows us to approach problems in time and helps us to solve them, considering that they can be used at any time (Marín & Donoso, 2014).

Regarding collaborative work, the program had a significant impact. These results are similar to those reported by a Spanish study which stated that the students improved the development of collaborative skills and significant learning, providing an interrelation between students and teachers, demonstrating an active participation, motivation and commitment to working and developing the proposed skills more effectively than in other educational experiences (García et al., 2014).

Once the literature review was completed, we identified that one of the strengths of this research was the first study in which we analyzed the effectiveness of an integrating Web 2.0 tools for the management of the teaching-learning process within the Peruvian university context. Likewise, the intervention improved the students' skills and practices of using ICT, opening new forms of instruction and providing a new vision for research and innovation through the participative communication in research networks, leading them to be more productive in their performance as students (Grosbeck, 2009). Furthermore, the sample (number of students), compared to other research studies of this type (pre-experimental), is very representative.

In conclusion, the ICT-based intervention to support the management of the teaching-learning process was effective, considering that it improves the perception of the students' skills.

The limitations of the study are that only students of different specialties of a private university in Metropolitan Lima participated in it and that the differential implementation of the ICT in the professional field of each of the specialties (related to the students' interests) was not taken into account.

Finally, we recommend to carry out similar research studies that include control groups so that the magnitude of the effect could be analyzed more accurately, which will ensure a higher degree of validity of the results.

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