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RESEARCH ARTICLES

SPECIAL SECTION: LEARNING ANALYTICS: INTELLIGENT DECISION SUPPORT SYSTEMS FOR LEARNING ENVIRONMENTS

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Editorial

Josep M. Duart and Rosalind James

Co-Editors, *RUSC. Universities and Knowledge Society Journal*

We are pleased to present the new issue of *RUSC. Universities and Knowledge Society Journal*, which closes volume 12. The works in this issue's miscellaneous research section were published as in-press articles last May. Readers now have access to the articles in the special section too. The special section is on Learning Analytics. We are happy with the decision to open the January and July issues two months earlier by publishing the works in the miscellaneous research section as in-press articles. This allows the times between article acceptance and publication to be shortened, benefitting authors and readers alike. We are currently looking into ways of making the times between article acceptance and publication even shorter.

Special section on Learning Analytics

As a research topic and an emergent field of application, Learning Analytics (LA) has drawn the attention of scholars, pedagogy professionals, educators, school managers, administrators, political decision-makers, artificial intelligence researchers, data mining experts and learning technology entrepreneurs.

Access to the unprecedented quantity and quality of data generated by students has created new challenges and opportunities. For example, researchers can get a better understanding of how students acquire subject-related knowledge, educators can assess the effects of teaching-learning activities and interventions, and students can receive student-centred support. Available online and in real time, this support is automatically personalised as students progress through the learning process.

This issue contains four articles that deal specifically with such topics. Short introductions to these are given below, in no particular order. The first article is by researchers at the University of Huelva (UHU), Spain. They present a study analysing the relationship between the number of hours per day that university students spend on the Internet and their attitude, training, use, impact and perception of difficulties in Web 2.0 integration, as well as their knowledge and use of Web 2.0 tools in higher education. In the second article, Ángel Juan, an associate professor at the Open University of Catalonia (UOC), Spain, and Laura Calvet, a researcher at the UOC's Internet Interdisciplinary Institute (IN3), present an analysis and brief introduction to this field of research, which new researchers into this topic will find useful. The third article is by researchers at the University of Macedonia (UOM), Greece. They present a study that was conducted to analyse visual representations of student-generated trace data during learning activities, which help both students and instructors interpret them intuitively and perceive hidden aspects of these data quickly. The fourth and last article in the special section is by researchers at the Autonomous University of Baja California (UABC), Mexico. They present an analysis of the navigation logs of students enrolled in a course offered at a School of Engineering. The objective of their project was to analyse the characteristics of the students' navigation by identifying, summarising and characterising the way in which they interact with the platform. Based on the results, it is inferred that students apply different learning strategies and follow individualised navigation paths.

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RUSC. Universities and Knowledge Society Journal organised a workshop for the editors of international educational technology journals

On 9 June 2015, within the framework of the European Distance and E-learning Network (EDEN) Annual Conference, *RUSC. Universities and Knowledge Society Journal* organised the first international meeting of educational technology (e-learning) journals in the field of higher education. In attendance at the meeting were representatives of 13 of the world's most prestigious journals in this field. A list of the participating journals and more information about the event can be found at http://iewetjournals.net.

The workshop was divided into two sessions. In the morning session, which was restricted to the editors of the invited journals, there was an open discussion about current issues of the greatest concern to scientific publishing in the field of educational technology. The first issue to be discussed was quality in the journals' editorial processes. Peer review processes and the adoption of ethical and quality criteria in editorial processes were analysed in depth. The increasing importance of author support services provided by journals was then discussed. Several options were evaluated, as were their potential and scope for bringing about improvements. Journals are very interested in providing more and better services in this particular area because they help to ensure that the needs of those authors placing their trust in them are attended to properly. After that, the issue of journal sustainability was discussed. This led to considerable debate about open publishing policies and the option of applying article processing charges to authors in order to pay for editorial processes. Finally, the alternate metrics issue was discussed, as was the impact of articles on the scientific community. The editors thanked *RUSC. Universities and Knowledge Society Journal* for providing them with the opportunity to meet for the first time to develop future proposals on how to approach issues shared by all the journals.

A round table was the basis for the afternoon session, with four editors acting as speakers. The session opened with a presentation by Nick Rushby, editor of the *British Journal of Educational Technology* (BJET), who approached the topic of quality in editorial processes. Rory McGreal, editor of the *International Review of Research in Open and Distributed Learning* (IRRODL), then presented his vision of open access and the policy of publishing open content. The next speaker, Barney Dalgarno, editor of the *Australasian Journal of Educational Technology* (AJET), tackled alternate metrics and measuring the impact of research. Finally, Gill Kirkup, editor of *Open Learning* (OA), gave her presentation about the author support services that OA provides. After the four presentations, the discussion was opened to all attendees. They had the opportunity to speak to and run ideas by the four editors who had given presentations. A video of this round table can be found at Pre-conference workshop EDEN 2015_Open Round Table_9 June 2015.

The editors and researchers taking part in the meeting were very satisfied with it and thanked *RUSC. Universities and Knowledge Society Journal* for holding the event, from which emerged a commitment to organise an editors' network. The aim of this network is to enable the editors to continue to share information and improvement proposals for scientific publishing in the field of educational technology in higher education.

Finally, we would like to remind readers about our Twitter account (@ruscjournal), which now has more than 800 followers. For anyone interested in the topics covered by *RUSC. Universities and Knowledge Society Journal*, it is a valuable knowledge and information-sharing resource.

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Digital literacy for teachers in Cuban Tourism and Hotel Management Schools. Some experiences on its development

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Abstract

Digital literacy for teachers has been a widely studied topic in recent years, and several studies have been conducted featuring student-oriented ICT competency models and frameworks. This research aims to develop a teacher-oriented ICT Competency Framework for Cuban Tourism and Hotel Management School instructors, on the one hand, to have reference points or criteria to make an assessment on the actual status of ICT training and, on the other hand, to provide guidelines on ICT training for teachers. The main research method for this paper was document analysis. The proposed model states that ICT training for teachers has to be undertaken on a continuous basis. Incorporating new tools into the teachers' professional environment is a critical matter to be taken into consideration for any type of teacher training model in the 21st century. Furthermore, some examples on the main courses and training sessions that are part of the Teacher ICT Training Research Project are provided. It may be concluded that a teacher-oriented ICT Competency Framework for the context of Cuban Tourism and Hotel Management Schools was attained.

Keywords

digital literacy, digital literacy for teachers, teacher training in ICT, ICT competencies

Alfabetización digital de los docentes de las escuelas de hotelería y turismo cubanas. Experiencias en su implementación

Resumen

El tema de la alfabetización digital de los docentes ha sido estudiado extensamente en los últimos años. En estudios realizados acerca del tema se pueden encontrar diferentes modelos y marcos de competencias TIC dirigidas a los docentes. El propósito de este trabajo es elaborar un marco de competencias TIC dirigido a los docentes de las escuelas de hotelería y turismo cubanas que permita, por un lado, tener un referente de criterios para poder evaluar el estado actual de la preparación con respecto a las TIC, y por otro, orientar la formación en TIC de los docentes. El método de investigación fundamental fue el análisis de documentos. El modelo propuesto expresa que la formación en TIC de los docentes tiene que ser permanente. La incorporación de nuevas herramientas a su entorno de actuación, de manera crítica, tiene que ser un elemento presente en cualquier modelo de formación de los docentes del siglo XXI. Además, se muestran ejemplos de cursos y entrenamientos, más destacados, que forman parte del proyecto de investigación Formación de los docentes en TIC. Se puede concluir que fue posible elaborar un marco de competencias TIC contextualizado dirigido a los docentes de las escuelas de hotelería y turismo cubanas.

Palabras clave

alfabetización digital, alfabetización digital de los docentes, formación de los docentes en TIC, competencias TIC

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Introduction

New education models and paradigms are increasingly being put forward by research papers and education experts in 21st-century society. The need to update teachers and train them to address the current challenges posed by the information and knowledge culture within their teaching practice has produced several reforms and studies in various countries (Carneiro, Toscano, & Díaz, 2012).

In this scenario, digital literacy has been a widely studied topic in recent years (Bawden, 2008; Gutiérrez, 2010; Avello, López, Cañedo, Álvarez, Granados, & Obando, 2013a). In general, various theoretical models (Eshet-Alkalai, 2012) and frameworks (Guitert & Romeu, 2009; Gobierno Vasco, 2012; Riel, Christian, & Hinson, 2012; Ferrari, 2013) for ICT competency may be found in the available literature. These proposed some new competencies needed by any individual in order to perform in the digital environments emerging nowadays.

Some proposals oriented particularly towards teachers were found (Prendes, 2010; Ministerio de Educación, 2011; UNESCO, 2011; Area, Gutiérrez, & Vidal, 2012; Prendes & Gutiérrez, 2013), revealing that teacher training in ICT (or as stated by Gutiérrez (2008), the (now-digital) "new literacy campaign" for educators) is an increasingly important topic worldwide, and is being addressed in various ways and from various viewpoints. However, it is worth highlighting that this has not been true for all regions, especially in Latin America (Sunkel & Trucco, 2012), where extensive teacher training in ICT programs and continuous follow-up thereof are still needed, as posed by the dynamics of technological development.

Cuban Tourism and Hotel Management Schools have fostered ICT training for teachers within this scenario. It began with courses on the Microsoft Office Suite and later on, when networking was introduced, other courses were developed on the use of e-mail, Internet browsing and webpage design, among others (Avello et al., 2013a). Due to the moment when they were delivered and the quick development of ICT, these courses turned out to be insufficient, and lost their usefulness because, among other reasons, they took place before the 2006/2007 period. This was the period when the social web emerged and developed at a fast pace, and users (i.e., students) began taking more leadership, since the levels of interactivity and network collaboration were increased.

Some years later, during the 2011/2012 academic year, the Teacher ICT Training Project was created and designed in Perla del Sur Tourism and Hotel Management School. This project aimed to refocus and reorganize teacher digital literacy, taking into account both worldwide experiences and the criteria provided by specialists in this field as well as the teachers themselves.

This paper aims to develop an ICT Competency Framework for Cuban Tourism and Hotel Management School teachers on the basis of the above-mentioned Project's guidelines, starting with a review of various proposals found in the literature in order to guide teacher training in ICT and retaining points of reference and criteria for its assessment. Additionally, some comments are provided on the outcomes obtained from the first training actions that were taken in parallel to the drafting of the Framework.

Main references found in the literature

A teacher is no longer a beacon of knowledge, but rather a pathfinder who assists students in using the tools and resources they need to explore and attain new skills and pieces of knowledge (Páez, 2008; De la Torre & Domínguez, 2012). Therefore, in such an ever-changing environment, educators (just like any other type

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of professional) need continuous updating in order to avoid joining the ranks of the "digitally illiterate" (Area, Gutiérrez, & Vidal, 2012).

This digital literacy campaign cannot be limited to procedural knowledge on the use of ICT. As stated by Valerio and Valenzuela (2011), more than mere skills are required to use a piece of software or to operate a digital device: one needs to master a wide range of complex cognitive, motive, social, emotional and methodological skills in order to perform effectively in any digital environment (Freitas, 2010; Eshet-Alkalai, 2012). Teaching programs therefore depend on their significance as well as on teachers' motivation, disposition, training and competencies (Miratía, 2012). This process should not rely only upon teachers' willingness, but also on the level of organization, planning and control undertaken by their relevant educational institutions as part of their strategy.

The ICT competencies required by teachers in this modern information and knowledge society were summarized over a decade ago in Cabero (1999), Tejada (1999), Majó and Marqués (2000) and Marqués (2000) as follows:

- Displaying a positive attitude towards ICT as a set of cultural instruments convenient for many personal and professional activities.
- Awareness of the various uses of ICT in the context of education.
- Awareness of the use of ICT in their relevant knowledge field.
- Skillful use of ICT in their activities: text processors, e-mail, web browsing.
- Integrating ICT into their curricula as a normal practice when planning (e.g., ICT as a set of tools in the scope of their activities within their own field of knowledge, as a didactic means and a vehicle for cognitive development).
- Coming up with training actions involving ICT use by students.
- Evaluating the use of ICT.

As may be noted, these competencies —clustered in dimensions, i.e., technical, professional updating, teaching methodology and behavior— are basically oriented towards technological and didactic factors, and to a lesser degree towards training researchers by using ICT.

Area (2007), in Rangel and Peñalosa (2013), states that a complete teaching model for literacy in the use of ICT must consider the simultaneous development of four training areas or dimensions: procedural, cognitive, behavioral and axiological. This model has an evidently theoretical character, which makes it difficult to be directly implemented and, being a general proposal, it fails to address specific matters relevant to the teaching activity.

In 2008, the International Society for Technology in Education launched in the US the National Educational Technology Standards (NETS) for Teachers (ISTE, 2008), which are focused on the level of training that teachers need to undergo in order to effectively incorporate information technology into their teaching practice and into the various communicative, professional and collaborative activities in which they are involved.

As per Cabero (2004), these standards are strongly related to the competencies and abilities learners of different ages need when dealing with ICT. Therefore, many of these issues were taken into account when building the Competency Framework, since it is students who will benefit from a better training for teachers.

On the other hand, the results in Garzón's doctoral research (2009) display a digital literacy model for university lecturers based on an empirical study conducted at the Autonomous University of Chiapas (UNACH), Mexico. This model is based on four core components, as per Figure 1: (i) institutional management, (ii) technological

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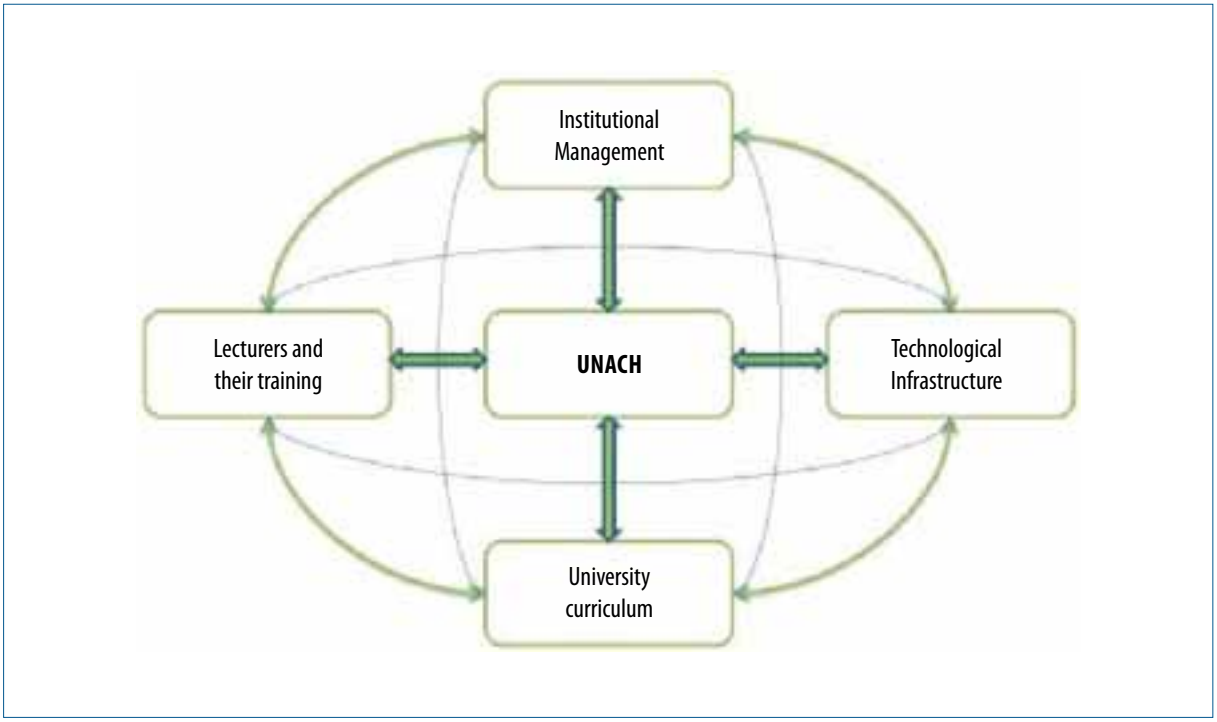
infrastructure, (iii) university curriculum and (iv) lecturers and their training. This model has a rather organizational nature and contains some factors to be taken into account when planning and implementing digital literacy for teachers.

Figure 1. Digital literacy model for lecturers at UNACH



In 2008, UNESCO released the ICT Competency Framework for Teachers (ICT-CFT), seeking to establish useful criteria and parameters for teacher training in the context of ICT and to help standardize teacher competencies in this area for the future. The project included guidelines for curricula, pedagogy, the competencies to be developed by students and teacher training.

This report was updated in 2011 as a result of ongoing cooperation efforts among UNESCO, Cisco, Intel, ISTE and Microsoft (UNESCO, 2011). The document in question features three modules for ICT competencies: (i) Technology literacy, (ii) Knowledge deepening for creative, complex problem solving and (iii) Knowledge creation to enhance innovation abilities using ICT to take advantage of knowledge itself. Furthermore, the study contains six areas or dimensions, which makes it quite broad. However, its subject matter is poorly allocated into the six dimensions, and it was found that it targets educators at all levels, in some of which research is not envisaged as a key component.

On the other hand, there is the project called *Competencias TIC para la docencia en la universidad pública española: indicadores y propuestas para la definición de buenas prácticas (ICT Competencies for teaching in Spanish Public Universities: indicators and proposals for defining best practices)*, which has been financed by the Spanish Ministry of Education (reference EA2009-0133) and is intended to improve quality both for higher education teaching and for the activities of university lecturers (Prendes, 2010).

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This project involved lecturers from various universities in Spain and its main goal was the drafting of a catalog of indicators on ICT competencies for university lecturers. This was based on the information provided to several local and international quality agencies as well as Spanish universities (Prendes & Gutiérrez, 2013).

As a result of this broad research, a structured model was proposed for organizing ICT competencies into three basic areas, consistent with the three basic professional performance areas for teachers —teaching, research and management. However, it must be noted that the area relating to research only has two indicators and, therefore, we consider that it should be further expanded, considering our teachers' considerable volume of research activity.

Seeking to effectively integrate ICT into the teaching, technical and educational institutions' management processes, the Chilean Education Ministry launched in 2006 the *ICT Competency Framework for Teachers*, which was updated later on in 2011 pursuant to the advances of the social web, also called Web 2.0 (Ministerio de Educación, 2011).

This study provides an overview of the identified ICT competencies, clustered in five dimensions:

- The teaching dimension
- The technical or procedural dimension
- The management dimension
- The social, ethical and legal dimension
- The professional responsibility and development dimension

According to the authors themselves, dimensions give rise to competencies, from which criteria emerge, and then the latter are standardized. They also state that a 'standard' is a competency that has turned into a valid reference for a given group, the Chilean Education Sector in this case. This set of standards, in spite of being teacher-oriented in general, is applicable to our context provided that, in addition to these standards, certain specific issues are considered, such as the ones relating to research.

For its part, the Basque Government released a report called *Mapas TIC para la capacitación digital del profesorado y alumnado del País Vasco (ICT Maps for digital literacy in students and teachers in the Basque Country)*, drafted as part of the Eskola 2.0 program (2009-2013) by the Basque Government Department of Education, Universities and Research.

The above-mentioned work is based on the six dimensions proposed by NETS 2008, which were re-clustered in three dimensions:

- Fluency with technology
- Learning – knowledge
- Digital citizenship

Each of these dimensions clusters a series of sub-competencies and, for each one, evaluation criteria are highlighted, since they are considered to be specific tasks that students should be able to perform.

Finally, there is the empirical study conducted by Rangel and Peñalosa (2013), where some results on the digital literacy of lecturers are provided. For their purposes, they built an instrument based on a competency profile

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organized into three dimensions: technology, information and teaching. When assessing this proposal, it may be ascertained that research-related competencies are integrated into all dimensions, mainly into the one relating to information, which in our opinion biased the results to a certain extent.

In short, by reviewing the referenced literature, several proposals oriented towards teachers at various education levels can be found. Most comprise a range between three and six dimensions or areas, and two or three domain levels. Likewise, some proposals of a more theoretical nature aimed at modeling competencies are available, as are others of a more practical nature aimed at the implementation of training. During our analysis, our attention was drawn to the fact that, in general, few proposals include the area relating to research within ICT competencies for teachers, whereas others consider it as integrated into other dimensions.

An ICT Competency Framework for Cienfuegos Tourism and Hotel Management School (EHTCF)

In order to draft the first version of the ICT Competency Framework for teachers in the Cuban Tourism and Hotel Management Schools, the following methods were used:

Document Analysis. Over 15 proposals, models and competency frameworks were reviewed, out of which the 9 referenced in the paragraph above were analyzed in depth.

Group Discussions. Group discussions were held by 6 professors distributed as follows: 2 professors from the EHTCF, 2 invited professors from other Tourism Schools and 2 lecturers from the University of Cienfuegos (UCf), Cuba, acting as consultants.

As a result, an ICT competency organization framework was drafted on the basis of three dimensions: **(i) technology, (ii) teaching** and **(iii) professional-research development**, as may be noted in Table 1. This framework was intended to be built in a practical, contextualized and simple manner to enable rapid understanding and implementation, and to reinforce the area relating to research, since this was one of the deficiencies found in the studied references and is not consistent with our setting.

Dimensions were defined as follows:

The *technology* dimension is based on issues relating to interaction with technology, effective performance in digital environments, and efficient communication and collaboration with other users. Other topics related to information security were added, which are certainly a must these days.

The *teaching* dimension comprises aspects relating to interaction, implementation and collaboration in e-learning environments, drafting and re-drafting learning resources by various means, as well as applying new didactic strategies that take advantage of ICT resources and seek to develop critical, creative and innovative behaviors in students.

The *professional-research development* dimension includes aspects for addressing information relevant to their field of knowledge, creating and participating in virtual research networks and also publishing their scientific and intellectual production.

Each of these dimensions clusters competencies in two domain levels: (i) level 1 (usage), related to knowledge, skills and values acting as support for the use of ICT, and (ii) level 2 (application–creation), including the competencies needed to design, implement and evaluate ICT actions with a reflective and critical outlook.

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Table 1. Digital literacy model for teachers

Criteria	*Dimensions*		
	Technology	*Teaching*	*Professional-research development*
Level 1 (Usage)	Working with computer systems and networks. Managing devices. Operating office software packages. Being aware of security issues relevant to IT equipment. Searching, assessing, storing, sharing and organizing information. Using Web 2.0 tools (blogs, RSS, wikis, social networks, etc.). Being aware of copyright and licensing issues.	Interacting in e-learning environments. Participating as a student in learning activities involving digital environments. Using digital resources as support for teaching, learning and curricular management processes.	Using reference management software, such as Zotero, Endnote, etc. to store and use information. Using Web 2.0 tools to participate in discussions and exchanges with teachers and researchers within their own discipline. Being aware of the impact of ICT on the subject field they teach.
Level 2 (Application – creation)	Solving network, connectivity and Internet security problems. Managing digital identities. Creating, capturing and editing digital images and videos. Developing webpages and multimedia presentations.	Implementing virtual environments and learning experiences. Drafting and/or re-drafting learning resources by various means: tutorial videos, audio, infographics, etc. Applying new didactic strategies in the classroom to take advantage of ICT resources. Creating collaborative learning environments by using Web 2.0 tools (blogs, RSS, wikis, social networks, etc.). Applying methods that foster developmental learning through ICT.	Creating and publishing personal libraries. Creating or actively participating in virtual networks dedicated to research. Creating environments for research and development by using Web 2.0 tools (blogs, RSS, wikis, social networks, etc.). Publishing their scientific and intellectual production.

Source: Own elaboration

It should be noted that, within the selected competencies, "*Participating as a student in learning activities involving digital environments*" was included since most of our teachers, due to their age and other factors, have not participated as students in courses involving the use of education technology, which limits their perspective for understanding their students' learning process in courses delivered through e-learning environments, for instance. Furthermore, this phenomenon occurs on an ongoing basis, since, in order to include new teaching tools, it is paramount that teachers learn first not only *about* the tools, but also *through* them.

Figure 2 is a graphic representation of the intrinsically cyclic nature of the implementation of the developed framework, as well as its relationship with the learning processes proposed by Benjamin Bloom and tailored by 2009 by Andrew Churches for the digital era (Churches, 2009). It becomes evident that ICT training for teachers has to be undertaken on a continuous basis. Incorporating new tools into the teachers' professional environment is a critical matter to be taken into consideration for any type of teacher training model in the 21st century, and this is based on one of the principles proposed by UNESCO: lifelong learning.

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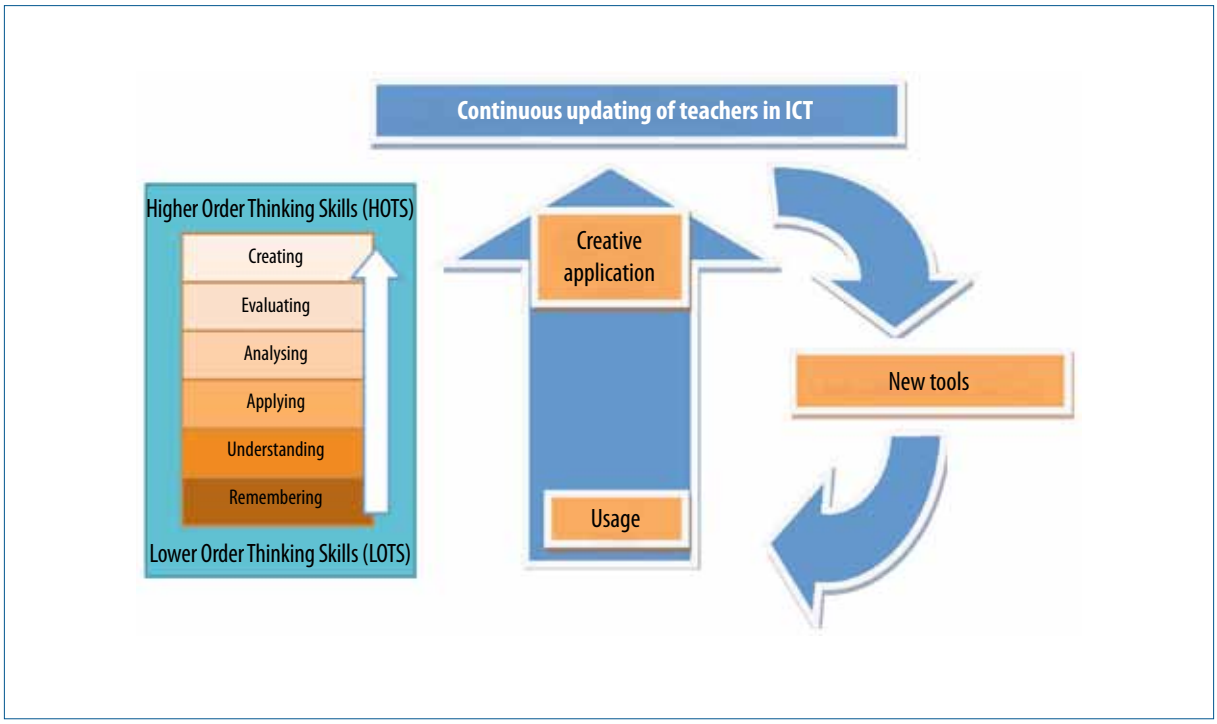
Figure 2. Cyclic nature of the model and its relationship with learning processes



In order to draft the competencies, the authors took on the general conception of *competency* proposed by Gairín (2011): "the coordinated activation and application of various elements in order to address actual professional situations", as well as the approximation to general competency in teachers made by Tejada (2009): "delivering, tutoring and assessing training actions by developing and using didactic means and resources, promoting quality in training and didactic updating".

Developments in digital literacy for teachers at the EHTCF

In the Perla del Sur Tourism and Hotel Management School of Cienfuegos (EHTCF), a series of courses and training sessions have been delivered by the IT professors as part of the Research Project for Teacher Training in ICT, registered in the EHTCF in 2011.

This project aims to provide teachers with training and updating on ICT. For this purpose, in the first working year, a first draft of an ICT Framework was produced, aimed at guiding ICT training for teachers. This was the framework introduced in the paragraph above. In parallel to the drafting of the Framework and in order to buy some time, training actions in this regard were undertaken; these were based on learning needs assessments that teachers are required to make on an annual basis.

The main results obtained from two of the training actions already completed, mainly consistent with the *teaching* and *professional-research development* dimensions within the developed Framework, are shown below.

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Training in Information Technology

This training in Information Technology contains the following modules: (i) searching for and retrieving information from the web, (ii) organizing information through Zotero (iii) and publishing research. This action is clearly consistent with the *professional-research development* dimension.

The main goal of this training session was to improve the drafting process of both graduate and postgraduate level research papers in relation to referencing, citing and organizing the references.

Twenty-three teachers participated in the three modules and achieved positive evaluations.

In order to assess the result of this training, during the subsequent tutoring process the research papers from the past two years were checked for inconsistencies in referencing, use of bibliography and compliance with the referencing standard. Additionally, a questionnaire was applied to ask teachers' opinions about the convenience of using Zotero for the drafting of research papers and theses by their students. These results are available in Avello, Martín, Díaz, & Clavero (2013b).

However, some remarks of acceptance by the teachers are given below:

"...it was easy to comply with the required referencing standard, the process being automatic once the standard was entered into Zotero."

"...it is very convenient to add citations during the thesis drafting process itself, and then Zotero inserts them directly in the References section, where they are shown already in alphabetical order or following whatever standard was selected."

Introduction to the Moodle Platform

This introductory course to the Moodle Platform features four topics and comprises the *teaching* dimension; it was delivered during the 2011/2012 academic year.

The goal of this course was to design distance-learning courses through the Moodle Platform and also start incorporating Web 2.0 tools into such courses, with the aim of achieving a higher level of leadership by and interaction among students. This was intended to widen the range of distance courses offered and improve the quality of the existing ones.

Sixteen teachers participated and achieved positive evaluations.

After completion of the course and a reasonable period of 6 months had elapsed, it was ascertained that 8 of the participants were able to set up and deliver their courses via the platform; the courses of the remaining 50%, were still incomplete, although it is worth highlighting that the overall quality in all of them had increased. For instance, one of the courses resulted in a professor achieving her master's degree in ICT applied to Education from the University of Cienfuegos (UCf), Cuba.

With regards to the other goal of the course, i.e., teachers incorporating Web 2.0 tools into their courses, such as wikis, discussion forums, blogs, RSS feeds, etc., it was verified that few courses included these features. It should be noted, however, that this was due mainly to issues with technology, restrictions and access rights.

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Conclusions

Continuous training and updating for teachers is one of the challenges in the 21st century and also one of the goals set out by Tourism and Hotel Management Schools in Cuba. In the light of this prospect, it may be asserted that some steps are already being taken and some accomplishments are being made.

On analyzing the studied proposals, along with their dimensions, competencies, criteria, levels, etc., it became evident that little attention is being given to the area relating to research, which is very important for our teachers, since they have as many hours dedicated to research as to teaching in their plans. Therefore, a first draft of the teacher-oriented ICT Competency Framework is proposed, with three dimensions: (i) technology, (ii) teaching and (iii) professional-research development, as well as two domain levels. This Framework clearly offers integral training and more accurate planning of training and self-training actions intended for teachers in Cuban Tourism and Hotel Management Schools.

On the other hand, this Framework also provides the criteria needed for ongoing evaluation of teachers' ICT competencies in their various dimensions, which may undergo modifications, since this framework will undoubtedly have to be reviewed and updated at least every two years in order to keep up with the fast developments in ICT.

It is concluded that the implementation of the proposed framework for ICT training or digital literacy for teachers needs to be cyclical and continuous. Incorporating new tools, such as social web or Web 2.0 applications, into the teachers' professional environment is a critical matter to be taken into consideration for any type of teacher training model in the 21st century.

The results from the courses show that the first teacher training actions had some impacts, mainly on the research and teaching areas. Obviously, these actions will be re-organized and planned on the basis of the Framework, which will ensure that training responds to a greater extent to the competencies required by the modern information society.

The results obtained lead to further research work, which mainly includes performing qualitative and quantitative analyses to examine teachers' competencies as per the proposed Framework, and integrating this Framework into the Overall Training Strategy for Tourism and Hotel Management Schools in the country, for which some steps were already being taken at the time this paper was submitted.

Likewise, teaching and learning trends and approaches must not be overlooked while training teachers in ICT nowadays. To this end, there are significant reports available, such as the *NMC Horizon Report: 2013 Higher Education Edition* (NMC, 2013), drafted by the New Media Consortium (NMC), and the EDUCAUSE Learning Initiative (ELI). Its aim is to identify new technologies that will have impacts on the fields of teaching, learning, research and creative expression in Higher Education over the next five years (Sangrà, 2012), and it must be seen as a resource for regular consultation by any teacher who wants to keep up to date with developments brought about by ICT in society and particularly in education.

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Assessing the impact of the "Entrepreneurs" education programme on participants' entrepreneurial intentions

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Abstract

The study of students' entrepreneurial intentions and the influencing factors is especially relevant for the development of education programmes, as is the monitoring of those programmes to assess whether they are effective and what their impact has been. Building upon insights from Ajzen's Theory of Planned Behaviour, a control-group longitudinal design was used to investigate the impact of participation in the "Entrepreneurs" programme, offered by the University of Castilla-La Mancha, in Spain, with the sponsorship of regional institutions. The methodology involved the completion of a questionnaire at the end of the course and a follow-up questionnaire six months later to establish if the effect of the course had been maintained or not after this period. The study found that participants in the programme had higher levels of self-efficacy at the end of it, and that these levels had been maintained over time. They also displayed greater entrepreneurial intention after a period of time than non-participants. However, after six months, the participants perceived greater difficulties in the environment, thus reducing the feasibility of entrepreneurship as a career option. Despite this, entrepreneurial intention was higher than for the control group and increased over time with regard to creativity. The conclusions and implications of these results are discussed in the final section of this paper.

Keywords

entrepreneurial intention, self-efficacy, environment perception, entrepreneurial attitude

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Evaluación del impacto del programa educativo "Emprendedores" en la intención emprendedora de los participantes

Resumen

El estudio de las intenciones empresariales de los estudiantes y sus factores determinantes es especialmente relevante para el desarrollo de los programas de educación, así como para el control de estos programas pues permiten comprobar su efectividad e impacto. Basándonos en los argumentos de la Teoría de la Conducta Planificada de Ajzen, se ha usado un diseño longitudinal con un grupo de control para investigar el impacto de la participación en el programa "Emprendedores", ofertado por la Universidad de Castilla-La Mancha con el patrocinio de las instituciones regionales. La metodología ha consistido en que los participantes han completado un cuestionario al final del curso y otro cuestionario de seguimiento seis meses después para establecer si el efecto del curso se había mantenido o no tras este periodo. Los resultados del estudio muestran que los participantes en el programa tienen mayores niveles de autoeficacia empresarial al finalizarlo que los individuos del grupo de control, y que estos niveles se mantienen en el tiempo. También tienen mayor intención emprendedora en el momento posterior que los individuos del grupo de control. Sin embargo, después de seis meses, los participantes perciben mayores dificultades en el entorno y reducen la factibilidad percibida del emprendimiento como opción profesional. A pesar de ello, la intención emprendedora era mayor que para el grupo de control y se incrementaba en el tiempo con respecto a la creatividad. Las conclusiones e implicaciones de estos resultados se plantean en la sección final del artículo.

Palabras clave

intención emprendedora, autoeficacia, percepción del entorno, actitud empresarial

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1. Introduction

Entrepreneurial activity is the driver of economic development at local, regional and national levels (Thomas & Mueller, 2000). In order to foster the skills needed to sustain a strong, more innovative and productive economy in years to come, many universities are encouraging students to pursue entrepreneurship education. This education is assumed to play a role in developing skills that increase individuals' employability and, therefore, calls have been made for more studies to focus on assessing the impact of Entrepreneurship Education Programmes (EEPs) (Pittaway & Cope, 2007; Neck & Greene, 2011; Martin, McNally, & Kay, 2013; Walter, Parboteeah, & Walter, 2013). Since entrepreneurship education is developing at a rapid pace, it is time to take stock and monitor the impact of EEPs in order to adequately foster entrepreneurship (Kourilsky & Walstad, 2007; Alves & Raposo, 2009).

This study evaluates the impact of the programme "Generation of Innovative Ideas and Entrepreneurial Projects Development" (which will hereafter be referred to as "Entrepreneurs") on the participants' entrepreneurial beliefs, attitudes and intentions. For this purpose, we chose Ajzen's (1987) Theory of Planned Behaviour (TPB) model as an evaluation tool to investigate potential variations in how the participants on the course perceived the environment and their entrepreneurial abilities, attitudes and intentions at the end of the course and in the medium term (six months after finishing it). Besides this, a control-group design was used to investigate the impact of participation in the programme. With this design, the research is intended to assess the effectiveness of the course in fostering entrepreneurial intention and its antecedents. This leads to two broad contributions. On the one hand, the discussion of the results for the case under study will enable academics to make decisions about the contents of their entrepreneurial programmes in order to improve future editions of their courses. On the other hand, the study evidences the need to evaluate the efficiency of the programmes in which policy-makers are investing to promote an entrepreneurial culture to make decisions that guarantee the efficient allocation of public funding.

The paper is structured as follows: in the first section, we review the literature about the importance of entrepreneurial attitude and education in entrepreneurial intention. The following sections describe the methodology used and the results obtained. Finally, the conclusions and implications from this research are presented.

2. Theoretical framework

The study was undertaken in a Spanish peripheral region, Castilla-La Mancha, where the objective of the university is to contribute to regional economic development and societal well-being of the population. In 2012, the unemployment rate was 30% for the entire population of 2.2 million inhabitants, and the figure rose to 56.7% for young individuals under the age of 25 years (these two figures were higher than in Spain as a whole, 25.8% and 54.8% respectively) (EPA, 2012). Therefore, the university has recognised the importance of preparing students to be more flexible and entrepreneurial in their attitudes as a response to an increasingly uncertain labour market. This resulted, in 2012, in the creation of the Office of the Vice-Rector for Transfer and Relationship with Firms, which aims to foster an environment in which an entrepreneurial spirit can thrive. In short, entrepreneurship has become embedded within the university, and this support is essential, especially when financial resources are constrained.

In this context, the "Entrepreneurs" extra-curricular course is offered by our university, with the sponsorship of regional institutions. The objective is to transmit to students the values of an entrepreneurial culture and help

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them to achieve the necessary education that will enable them to materialise their idea or project in a successful firm. All the students at the university and other interested individuals can take the course, which is 50 hours in length and taught over four weeks. The course is structured into three modules (Motivation, Creativity and Ideas Generation, and Developing a Business Plan). Its content is developed mainly through practical activities based on participative learning, in which the students internalise the different contents of the programme, either individually or in a group. However, once it finishes, the students are not provided with any practical activities or follow-up assistance.

When designing an EEP, the first choice is the objective of the programme that relates to our definition of entrepreneurship. Initially, entrepreneurship was conceived of as the creation of new ventures, but more recently there has been a shift towards focusing on a broader concept that understands entrepreneurship as a way of thinking and behaving (Kirby & Ibrahim, 2011). It is appropriate to adopt a broad definition of entrepreneurship focusing on developing entrepreneurial mindsets that individuals can mobilise throughout their careers, either by driving innovation within existing firms (intrapreneurship), by transforming new and old organisations into social ventures, or by creating new firms with economic purposes. According to Fayolle and Gailly (2008: 582), the "Entrepreneurs" course can be classified as a teaching programme in which the students engage in "learning to become an enterprising individual" since the aim is "helping individuals to better position themselves as regards entrepreneurship and to become more enterprising". Training programmes in this category can influence the variables that are considered "antecedents" of the entrepreneurial intention and, therefore, can be designed and evaluated according to their impact on the participants' attitudes and intentions towards entrepreneurial behaviour. That is, intention models can be used both as pedagogical guides and as evaluation tools of educative actions, aiming to develop entrepreneurial mindsets in individuals so that they can fully realise their potential through their actions. Previous literature has primarily used two socio-psychological models to explore attitudes and their antecedents (beliefs) with an impact on entrepreneurial intention. These are Shapero's (1982) Entrepreneurial Event (SEE) and Ajzen's (1987) TPB models, which are largely consistent with each other (Krueger, Reilly and Casrud, 2000). However, whereas the SEE focuses more on the individual (including a measure of the individual's proactiveness), the TPB focuses more on the environmental context (including social support for the behaviour), the latter being selected for that reason. Therefore, the hypotheses are related to how the main constructs of the model (self-efficacy, entrepreneurial attitude, perceived environmental difficulties and entrepreneurial intention) evolve in the short and medium term as a result of the impact of the course.

Along these lines, several studies point out that when individuals undergo an entrepreneurship course, their more favourable perception of entrepreneurship as a career option can be attributed, at least partially, to an increase in self-efficacy (Chen, Green, & Crick, 1998; Wilson, Kickul, & Marlino, 2007), that is, to the belief in their own abilities to develop the necessary entrepreneurial tasks. Bandura (1997) states that the sources from which individuals develop confidence in their abilities are practice, moderated levels of failure and acquired experience from observing how others develop the task (vicarious experience). Furthermore, Mau (2003) suggests that once self-efficacy in any skill is internalised by the individual, confidence encourages the individual to accept greater challenges, and succeeding in them reinforces his/her perception of efficacy, creating a spiral effect that improves self-efficacy even more. Therefore, considering that the course's practical activities based on participative learning are intended to strongly influence the perception of self-efficacy, it is hypothesised that:

Hypothesis 1: Participants' self-efficacy levels increase sometime after completion of the course.

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Values and norms predominant in the social environment may also have an influence on an individual's propensity to start a business (Etzioni, 1987). Autio and Wennberg (2010: 3) observe that "social group influences on entrepreneurial behaviors above and beyond the effect of individual-level dispositions", specifically norms of social peer groups, can have three times more impact on an individual's entry into entrepreneurship than an individual's own attitude. The attitudes and behaviour of demographically similar others can influence career choices simply through exposure. The students participating in the course are part of a social group that is clearly interested in engaging in entrepreneurial behaviour, and they forge social networks that are maintained after the course. Besides this, a spiralling increase in self-efficacy, obtained through entrepreneurship education, can cause entrepreneurial attitudes to increase over time. Therefore, we propose that:

Hypothesis 2: Participants' entrepreneurial attitude levels increase sometime after completion of the course.

However, given that the "Entrepreneurs" programme does not have a period of practical implementation of the knowledge acquired or assistance for creating their own firm after the course, we propose that participants will perceive more barriers in the environment for their entrepreneurial endeavour after the course and, therefore, entrepreneurial intention will decrease. Our assumptions are based on results obtained by Martínez, Mora, and Vila (2007), who observed that young graduates perceived that their academic institutions focused on teaching methods that paid special attention to general concepts, theories and paradigms, but not on the direct acquisition of work experience (which was not facilitated). Moreover, those who became entrepreneurs rated certain aspects of their education less satisfactorily, such as practical orientation, work experience provided and achievement of the necessary conditions to facilitate their access to the labour market. Therefore, it is proposed that:

Hypothesis 3: Participants' perceptions of the difficulties to be confronted in the environment increase sometime after completion of the course.

Hypothesis 4: Participants' entrepreneurial intentions decrease sometime after completion of the course.

Some researchers propose that matched control groups need to be incorporated into the evaluation of education programmes (Storey, 1999; Westhead, Storey, & Martin, 2001). In this research, the students who volunteered for the control group were undertaking an elective subject in Entrepreneurship within the Business Administration degree. The elective subject is taught over a four-month period, two and a half hours per week. Therefore, in case of self-selection bias, it should be present in both samples. Due to differences in the design of both courses, with the elective subject involving less intensive training and a more traditional teaching approach, we hypothesise that:

Hypothesis 5: Participants' self-efficacy and entrepreneurial attitude scores are higher and the perception of difficulties in the environment is lower than for non-participants (at both moments in time).

Hypothesis 6: Participants' entrepreneurial intentions are higher than non-participants' (at both moments in time).

The model is shown in Figure 1.

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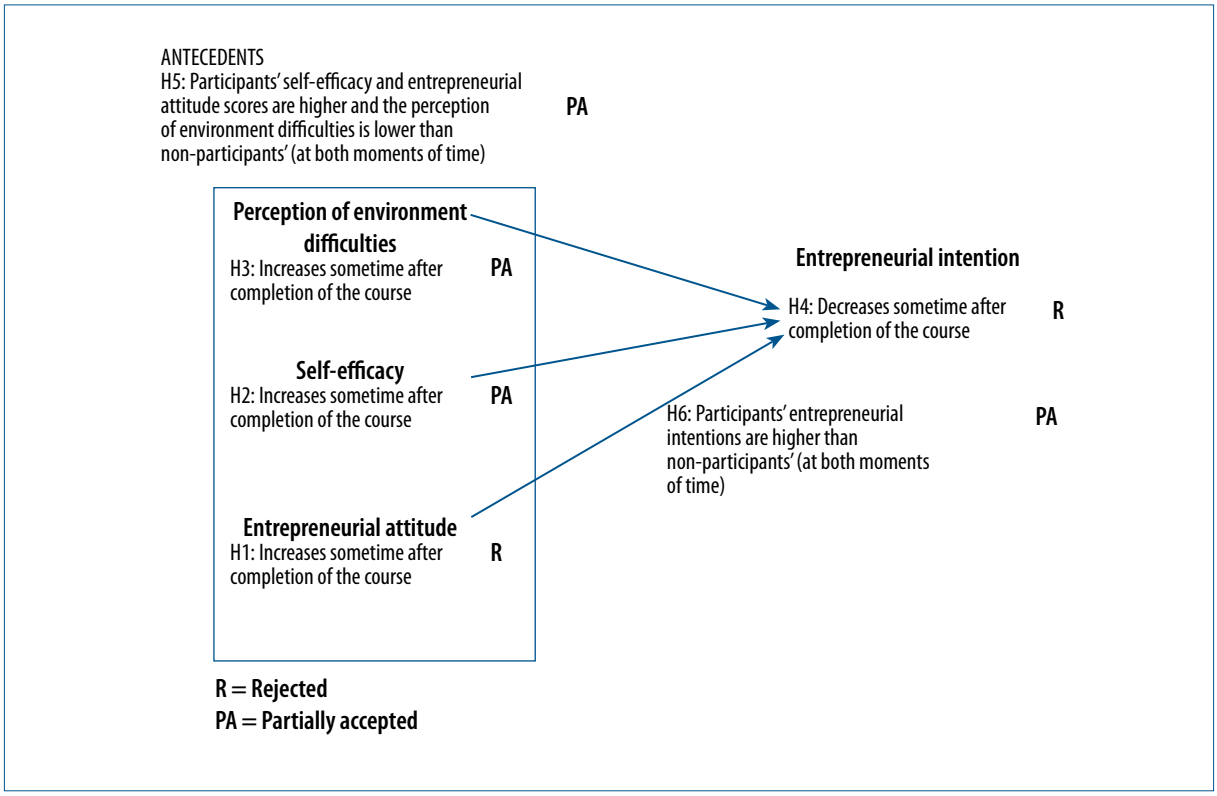
Figure 1. Incidence of antecedents on entrepreneurial intention



3. Methodology

Several recommendations were followed when designing this training evaluation (Storey, 1999; Westhead et al., 2001). First, a representative sample of participants should be used. In this edition of the "Entrepreneurs" course, the number of participants in the course was 170 and, of these, 70 voluntarily answered the first questionnaire when finishing the course and 54 answered the follow-up questionnaire six months later (41.2% of the total answered the first one and 31.76% answered the second one). The sample (shown in Table 1) is representative of the studied population. As can be observed, the sample is balanced in terms of gender, and the majority is under 23 years old, studying Business Administration and not juggling studies with paid employment. A response bias test revealed no significant differences between respondents at different campuses with respect to students' age, gender or occupation.

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Table 1. Profile of participants in the course who filled in both questionnaires

Gender	***Female***	***Male***	
	48.1%	51.8%	
Age	***Between 18 and 23 years old***	***Between 24 and 29 years old***	***Between 30 and 48 years old***
	54.7%	37.8%	7.5%
Studies	***Business Administration***	***Humanities***	***Sciences***
	59.6%	21.2%	19.2%
Occupation	***Student***	***Employee***	
	75%	25%	

Second, a matched control group has to be incorporated. All students undertaking the elective subject on "Entrepreneurship" filled in the questionnaire in the class (70), but only 23 of them volunteered to fill in the second one (six months later), which accounts for a 33% response. Eight of them were male and fifteen female, aged between 19 and 25 years (the average is 21.5 years old). *T*-tests were conducted to see whether there were any significant differences in scores between participants and non-participants in the "Entrepreneurs" programme.

Third, pre and post (programme participation) testing should be carried out. In our study, two points of time were studied, since we carried out post-programme testing at both the end of the course and six months after it. In order to identify any statistically significant change in the variables in the same group in two different moments of time, we used the Wilcoxon test (Cooper & Lucas, 2006). We acknowledge that the change might have been caused, at least in part, by external events or individuals' tendencies. However, it is proposed that it would be difficult to attribute the existence of a change to any external factor, other than the course, since the majority continues studying six months later, having yet to confront the creation of their own firms.

Finally, objective as well as subjective outcomes should be measured. This last condition was not adhered to, since the programme does not imply the creation of a firm by the participants and, therefore, we could not measure objective outcomes. Entrepreneurial training is seldom followed by actual start-up activities and, therefore, intentions have been widely used as a proxy for evaluating the impact of training. The questionnaire, tested in a previous study published by the authors, contained questions relating to those cognitive variables that influence entrepreneurial intention.

Desirability and feasibility of creating their firms: Measured using a seven-point Likert scale. A descriptive analysis has been made of these variables, although they are not included in the model.

Entrepreneurial self-efficacy (Table 2): We used subscales obtained from earlier studies that establish entrepreneurial self-efficacy scales, with a ten point-Likert scale, in line with previous research (Kolvereid & Isaksen, 2006). We chose the subscale of *risks assumption* by Chen et al. (1998), the subscales of *new products and market opportunities development* and *coping with unexpected situations* by De Noble, Jung, and Ehrlich (1999) and the subscale of *economic management* by Anna, Chandler, Jansen, and Mero (1999).

Entrepreneurial attitude (Table 3)*:* Degree to which the founder is committed to the new business in comparison with other alternatives that may be attractive for him/her and how much he/she is willing to sacrifice in order to become self-employed, that is, his/her intention to invest time and resources. Scale by Liao and Welch (2004) on a five-point Likert scale.

Perception of the environment (Table 4)*:* The scale by Grilo and Thurik (2005) with regard to individuals' perceptions of the difficulties in the environment was measured using a five-point Likert scale.

Entrepreneurial intention (Table 5)*:* Four-item scale by Cooper and Lucas (2006) using a seven-point Likert scale.

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4. Results

The results in Table 2 show that the self-efficacy levels in the diverse abilities were high after the course. Participants had internalised the acquisition of these abilities and this raised the probability of knowledge being transferred to new behaviours. Besides, a positive change can be observed from the end of the course to the follow-up moment in several abilities, supporting Hypothesis 1, at least partially.

Table 2. Entrepreneurial self-efficacy

	% good to excellent		Wilcoxon test Z (sig.)
	At the end of the course	After six months	
1. I can work productively under continuous stress, pressure and conflict	54.9	57.4	NS
2. I can tolerate unexpected changes in business conditions	56.9	63.0	-2.054[b] (0.040)
3. I can develop and maintain favourable relationships with potential investors	86.3	79.6	NS
4. I can see new market opportunities for new products and services	64.7	75.5	-2.508[b] (0.012)
5. I can manage cash-flow (profits + amortisations + provisions)	66.7	66.7	NS
6. I can control business costs	68.6	81.5	NS
7. I can persist in the face of adversity	63.3	71.2	-2.215[b] (0.027)
8. I can discover new ways to improve existing products	74.5	79.6	NS
9. I can develop relationships with key people to access capital sources	78.4	77.8	NS
10. I can identify new areas for potential growth	70.0	70.4	NS
11. I can design products that solve current problems	62.7	66.7	-1.740[b] (0.082)
12. I can take decisions under uncertainty and risk	64.0	68.5	-3.016[b] (0.003)
13. I can bring product concepts to market in a timely manner	58.8	63.0	NS
14. I can learn everything I need to create a firm	98.0	92.6	NS
15. I can create products that fulfil customers' unmet needs	80.4	79.2	NS
16. I can take risks in a calculated way	72.5	72.2	NS
17. I can assume the responsibility of ideas and decisions	90.2	84.9	NS
18. I can determine what the business will look like	84.0	94.4	NS
19. I can do the required tasks to make my firm a good start-up	88.0	80.8	NS
20. I can identify potential sources of funding to invest in the firm	70.0	75.5	NS
21. I can manage expenses	78.0	86.8	NS

NS= not significant
b= based on negative files, those that contain the cases in which the value of the variable in the second observation exceeds the value in the first one

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With respect to entrepreneurial attitude, the levels were very high at the end of the course and had been maintained after the six months period (Table 3). Here, there is no support for Hypothesis 2 concerning an increase in entrepreneurial attitude after the course, since the high level had been maintained.

Table 3. Entrepreneurial attitude

	% of those who agree or totally agree		Wilcoxon test Z (sig.)
	At the end of the course	After six months	
1. I would prefer to have my own business than to earn a higher salary as an employee	47.1	52.8	NS
2. I would prefer to have my own firm than any other promising career	33.3	28.3	NS
3. I am predisposed to make personal sacrifices to keep my firm going	68.6	59.3	NS
4. I would do another job only for the time that I needed to in order to create my own firm	58.8	56.6	NS
5. I am predisposed to work for the same salary in my own firm as that of an employee in another firm	78.4	64.8	NS

Furthermore, Table 4 shows that the perception of difficulties confronted in the environment had worsened after the six-month period. The literature emphasises that one of the main dissuasive elements for firm creation is an inadequate knowledge of the process and the perception of risks (Oakley, Mukhtar, & Kipling, 2002). Therefore, Hypothesis 3 is supported, suggesting the need to eliminate these perceived barriers through the programme's delivery as a crucial point in order to foster entrepreneurial motivation.

Table 4. Perception of the environment

	% of those who disagree or totally disagree		Wilcoxon test Z (sig.)
	At the end of the course	After six months	
1. It is difficult to create a firm due to a lack of financial support	17.6	18.5	-1.737[b] (0.082)
2. It is difficult to create a firm due to the complexity of administrative procedures	17.6	40.7	-2.678[b] (0.007)
3. It is difficult to obtain enough information about the process of creating a firm	54.9	75.9	-1.798[b] (0.072)
4. One should not create a firm if there is a risk that it will fail	52.0	58.5	NS
5. The present economic climate is not favourable to those wishing to create their own firm	34.0	25.9	NS

With respect to entrepreneurial intention (Table 5), only one item had increased after the course and this was related to thinking frequently about ideas and ways to create a firm. The spiralling growth in confidence in their skills may have formed an "entrepreneurial alertness" within these individuals that led them to be more receptive to the identification of opportunities in their environment and more creative to transform them into entrepreneurial

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ideas. Hypothesis 4 cannot be supported, since there was no decrease in entrepreneurial intention sometime after completion of the course.

Table 5. Entrepreneurial intention

	% of those who agree, agree very much or totally agree		*Wilcoxon test Z (sig.)*
	At the end of the course	*After six months*	
If I see the opportunity to create a firm, I will make the most of it	88.5	83.3	NS
The idea of firms with high risk/high reward attracts me	50.0	52.8	NS
I frequently think about ideas and ways to create a firm	63.5	74.1	-2.511[b] (0.011)
Someday I will try to create my own firm	76.9	77.8	NS
Entrepreneurial intention (average on a seven-point Likert scale)	5.05	5.25	NS

After assessing the evolution of those who had participated in the programme, we proceeded to compare them with the control-group. The study found that participants in the "Entrepreneurs" programme had higher levels of *self-efficacy* and *entrepreneurial attitude* at both moments in time than non-participants. The participants in the programme also had a less optimistic *perception of the economic climate*, although this difference disappeared in the follow-up questionnaire. *Entrepreneurial intention* was significantly higher for the participants in comparison to the control group after the six-month period. Therefore, Hypotheses 5 and 6 are supported, at least partially. One reason for these results might be the importance of practical training provided on the "Entrepreneurs" course versus the more traditional lectures on the degree subject.

5. Conclusions

Our research question was: What is the impact of the "Entrepreneurs" course on participants' entrepreneurial beliefs, attitudes and intentions? To answer this question we designed the study using the TPB model as a course evaluation tool; testing two moments in time and comparing the course participants with a control group. The results suggest that the course encouraged participants to develop, even after the course, entrepreneurial self-efficacy and a perception of entrepreneurship as a desirable career option, with a medium-high level of entrepreneurial attitude and intention both in the short and medium term.

However, although almost all participants perceived the entrepreneurial option as highly desirable (92.2%), only half of them perceived it as highly feasible (53.8% and only 41.5% after six months), and their perceptions of the difficulties that have to be confronted in the environment worsened over time. These findings suggest that focusing on "Developing a Business Plan", although practical in nature, did not provide participants with the direct experience in entrepreneurship that they would need to go from intention to action.

We consider that our study contributes to scholarly knowledge on two levels. First, with regard to designing an effective teaching programme, in which there is an interrelation between the objectives, the contents and

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the methodologies used to deliver them. With regard to the programme objective, it is advisable to consider a broad definition of entrepreneurship focusing on developing entrepreneurial mindsets which individuals can mobilise throughout their careers, either through intrapreneurship or their own firms. The programme under review, although recognising the importance of building an entrepreneurial mindset as a learning objective, still places considerable importance on the creation of new ventures, focusing on how to develop a business plan. Methodologies are selected contingent on the programme's objectives. In comparison with the control group, participants in the "Entrepreneurs" course had greater self-efficacy and entrepreneurial attitudes and intentions and more perceptions of environmental difficulties. These findings underline the importance of using a practically oriented and participative learning approach. However, as stated previously, we consider that more emphasis on the value of "experience" and the "experiential learning" approach has to be included in future editions of the course. Our proposals are the following: providing participants with follow-up assistance for creating their own firms; establishing practical placements in firms that are starting up or have recently been created to obtain vicarious experience and/or inviting entrepreneurs to come to the classroom. Previous literature has evidenced that an extra-curricular course has better results when it includes practical placements in firms, especially with respect to the maintenance of a positive change in entrepreneurial intention (Cooper & Lucas, 2006). Besides this, students can learn from those who have first-hand experience of firm creation: how failure can be overcome, how to confront difficulties and how to persist in the face of important challenges (Fayolle & Gailly, 2008; Cooper & Lucas, 2006).

Second, with respect to entrepreneurial training evaluation, the findings indicate that the TPB is an appropriate theory to test the effectiveness of an entrepreneurship course that aims to promote entrepreneurial mindsets. We consider that a better knowledge of how entrepreneurial training impacts on cognitive variables is needed in order to adjust educational curricula to serve potential entrepreneurs and also to make an efficient use of those public resources allocated to foster an entrepreneurial mindset. If we achieve the reinforcement of students' perceptions not only of self-efficacy in entrepreneurial tasks but also of the environment, we will be able to observe an increase in entrepreneurial intention that might be translated into more entrepreneurial behaviour, which has to be appropriately sustained over time.

Our study also has some limitations for which we propose suggestions for further research. Since previous literature has shown that entrepreneurial-related attitudes and abilities exert a significant influence on entrepreneurial activities (Arenius & Minitti, 2005; Koellinger, Minniti, & Schade, 2007), the study analysed the antecedents of entrepreneurial intention on a sample of university students. However, we acknowledge that trying to motivate students to become entrepreneurs is a long-term and challenging endeavour. In this programme, however, there was no follow-up of their career paths afterwards. For this reason, as a future line of research, we propose designing a study that assesses the persistence of entrepreneurial intention and its antecedents after a longer period of time, controlling for events in participants' lives.

Besides this, future studies need to address the possibility of self-selection bias, since students who voluntarily engage in entrepreneurship training are more likely to be thinking about starting a business. However, we do not have the possibility of dealing with a compulsory programme to avoid that bias. Another limitation of this study was that participants did not fill in a questionnaire before entering the course; this information would have been useful to test the impact of the programme according to the initial level of intention. Nevertheless, due to the exploratory nature of this study, it can be assumed that the course at least had an important impact on the participants' perceptions, which had been maintained in many variables after a period of time. This study was limited to a single

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cohort of students at a single institution. Future studies should address the sampling issue by taking into account the moderating effect of previous entrepreneurial experience, socio-economic status or context on the impact of education programmes on entrepreneurial intentions.

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Twitter as a resource to evaluate the university teaching process

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Abstract

The widespread use of social networks among college students has an excellent potential for academic purposes. The university has in its own students an important source of information that can be used to evaluate the quality of its services, and social networks provide a great assessment tool. The purpose of the study is to analyse an experiment based on the use of Twitter in the daily evaluation of the teaching process and its impact on the students. One hundred and forty-five students voluntarily and, if they so wanted, anonymously, participated in the experiment. They evaluated each of the classes through tweets. The students' perceptions of the usefulness of Twitter for evaluating the teaching process was analysed through a questionnaire with open and closed questions. The main findings of the research showed considerable satisfaction with the process followed in the subject. There was also a modest positive evaluation in assessing the incorporation and use of Twitter for academic purposes. It is concluded that Twitter can be a useful tool for students to evaluate the teaching process and that Twitter is highly suitable for incorporation into the university sphere.

Keywords

social networks, evaluation, students, university, teaching, Twitter

Twitter como recurso para evaluar el proceso de enseñanza universitaria

Resumen

La gran difusión de las redes sociales entre los estudiantes universitarios es un excelente potencial para su utilización con una finalidad académica. La universidad tiene en su alumnado una importante fuente de información para la calidad de sus servicios y en las redes sociales una potente herramienta de evaluación. El propósito del estudio se centra en analizar una experiencia basada en la utilización de Twitter en la evaluación diaria del proceso de enseñanza y su repercusión en el alumnado. La experiencia contó con la participación de un total de 145 estudiantes que voluntariamente, y de forma anónima si así lo deseaban, evaluaron cada una de las clases recibidas a través de la emisión de tuits. La percepción del alumnado sobre la utilidad de Twitter para la evaluación del proceso se realizó a través de un cuestionario de preguntas abiertas. Los principales hallazgos de la investigación indicaron una alta satisfacción con el proceso seguido en la asignatura. Más discretamente se valora positivamente la incorporación y el uso de Twitter para el fin académico. Se concluye que Twitter puede ser una herramienta adecuada para el estudiante en la evaluación del proceso de enseñanza y con amplias facultades para su incorporación en el ámbito universitario.

Palabras clave

redes sociales, evaluación, estudiantes, universidad, docencia, Twitter

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1. Introduction

University education has always adapted to society's demands and, at the same time, has become one of the driving forces of change. However, the digital age has created a genuine break with the past due to demands for new roles, structures and trends. The introduction of new forms of communication and technologies for teaching and learning offers many innovative possibilities to increase the quality of teaching and learning processes and better adapt them to the characteristics of students (García Portillo, Romo, & Benito, 2008).

In order to increase the efficiency of the university system, relevant assessments of each of its component fields (teaching, management and research) are performed. In many cases, these evaluations are done through a variety of indicator systems, thus causing a lack of consensus on what to evaluate (results, process, teaching, etc.) and how to evaluate it (qualitative, quantitative, specific, general or other types of indicators) (Palomares, Garcia, & Castro, 2007).

The massification of university classrooms and the devaluation of teaching as compared to research have led to teachers looking for more responsive evaluation instruments closer to a final continuous assessment process. This approach is controversial and incomplete as it only relies on student performance, leaving aside the teaching process (Carle, 2009; Griffin, 2004; Remedies & Lieberman, 2008; Stieger & Burger, 2010). Following Dickey and Pearson (2005), this final evaluation can be clearly contaminated by different aspects: facts and latest content, or by first impressions of teachers and / or the subject. In Europe in general and Spain in particular, within the new guidelines for university teaching arising from the process of convergence of higher education, the movement from a final evaluation towards procedural models is gaining momentum (López Pastor, 2012).

We agree with Kassens-Noor (2012) in thinking that Twitter can be a tool that fits this type of continuous and formative teaching evaluation. Its advantages are that it is based on microblogging (sending and publishing short messages) and that it is quick to read (no more than 140 characters), dynamic (information available in real time), accessible (for almost any device that connects to the network), functional (allows images, videos and links to other content to be embedded), organized (using hashtags representing subjects and ordered by date of publication), interactive (allowing users to see the posts of others, follow them, reply, share their messages through retweets or save them by marking them as favourites), non-invasive (not an IM chatline) and anonymous if desired (using nicknames or depersonalized nicknames) (Arana, Cabezudo, Morais, & Peñalba, 2012; Guzman, Del Moral, & González, 2012; Bernal, Cascales, Clemente, & Izquierdo, 2012; Kassens-Noor, 2012; Wakefield, Warren, & Alsobrook, 2011; Welch & Bonnan-White, 2012; Toro, 2010).

Studies on the use of social media in higher education are still scant and show some controversy. Calabuig and Donaire (2012), in their analysis of Twitter as a tool for participation and knowledge, concluded that the use of Twitter in the classroom was very positive, since for most students it was a useful methodological strategy and interesting for developing basic skills in higher education. However, Espuny, González, Lleixà, and Gisbert (2011), in their study on the attitudes and expectations of the educational use of social networks in college students by asking them about their views, found that although they were very familiar with and favourable to the incorporation of social networking, they saw little pedagogical use for this tool in higher education.

Moreover Kassens-Noor (2012), on research conducted to evaluate Twitter as a teaching practice to improve active and informal learning in higher education, warns us that in the specific case of Twitter, it could present some limitations over other methods; the reduced number of characters, for example, which may be an advantage depending on the intended use, can mean an impediment that restricts students' broad and deep reflections. In

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the same vein, Toro (2010), from his analysis of the uses of Twitter in higher education, also adds, as a limitation to this tool, the distraction factor that it may have for some students since it can also be used as a social network. It can become addictive and the intended scholarly or educational value is lost. In addition, if students are not convinced of the pedagogical usefulness and benefits that its proper use in the classroom can bring, there will likely be a degree of resistance to its implementation and thus the benefits of its utilization will be clearly diminished (Lowe & Laffey, 2011; Rinaldo, Tapp, & Laverie, 2011).

Another benefit of the use of Twitter is that it overcomes the spatial and temporal boundaries of the classroom, extrapolating the debates of the contents of the subject outside the class, which is useful for internalization, identification and socialization of learning, even for the development of skills such as writing and synthesis, as well as interaction and collaborative work between students and teachers (Calabuig & Donaire, 2012; García Sans, 2009; Moguel, Alonzo, & Gasca, 2012; Toro, 2010). Wakefield, Warren, and Alsobrook (2011), in their work on how the network of real-time Twitter can arouse reflective thinking and communication, conclude that the tool fostered the understanding of materials, communication and promoted student learning.

In the study by Junco, Heiberger, and Loken (2011), done on 125 students to determine whether the use of Twitter as an educational tool helps engage students and mobilize teachers in a more active and participatory way, they found that participation and involvement was greater in the group using Twitter than in the group not using it, and that students who used the platform achieved better qualifications.

Welch and Bonnan-White (2012), in an investigation of 205 college students, found no significant differences in levels of involvement and commitment among students who used Twitter in the classroom and those who did not, and they asserted that those students who enjoyed using Twitter performed better in terms of their perception of commitment and participation.

We want to draw attention to the lack of specific studies on the use of Twitter to evaluate the teaching process. Only Kassens-Noor (2012) comes relatively close to it in his research conducted around the class diary, which recognizes that despite the limitations of the software, Twitter can be a useful tool to evaluate the development of the teaching process.

The possibility of improving teaching and learning during the class itself through the use of social networks led us to propose this research in which the value of Twitter as an evaluative tool in the process is analysed. Specifically, we set as our objectives: to assess the learning process (content, methodology and teacher intervention) of an undergraduate course, and to describe and interpret the students' perceptions of the use of Twitter as a tool for participation in the university education process.

2. Method

Methodologically we have relied on a qualitative design based on the analysis of data produced (Cuñat, 2007; Strauss & Corbin, 2002) and the grounded theory of Glaser and Strauss (1967), supplemented with a descriptive analysis of frequencies.

The research involved a total of 146 students belonging to three groups of the subject of Teaching Physical Education in Elementary Education, given in the second year of the master's degree in Elementary Education at the University of Granada, Spain. Student participation was voluntary and they were previously and fully informed of the research objectives and the importance of immediacy in sending the tweet at the end of the class or for it to

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be available on Internet. Anonymity was provided through a common account for those students wishing to keep their identity private.

Two data collection instruments were used: Twitter, to obtain feedback from students on the activities developed in the classroom, and a questionnaire with three questions, two closed, which assessed their perception of participation in Twitter from 1-4 in relation to the subject and the overall value placed on its use in the classes; the third was open, each student was free to reflect his or her views on the implementation and use of Twitter in the subject.

Data collection through Twitter was done either from a joint account or the students' own accounts. At the beginning of each week, the teachers issued a tweet in which they reminded the students of the hashtags to be used to collect the opinions of each of the classes. There were a total of 30 (5 lectures, 11 practical classes, 11 occasions for dialogues, 2 days of theoretical presentation by the students, 3 tutorials and one day of shared assessment). There was no specification or limitation on issuing tweets, participation in each class was therefore different; students were only given information about the utility their feedback would have to improve the course, without it having any effect on their evaluation and qualification. This made disinterested participation possible, and free and honest opinions were sought.

Qualitative data was compiled and organized for analysis and processing using NVivo 10 software. The analysis process followed, based on grounded theory, with an inductive initial phase from an open or in vivo coding, in which the students identified the ideas and concepts and that had high interpretative significance. Later, in a more deductive phase, the central categories that would be the focus of the analysis were defined. Different indexing trees to deal with each of the targets in a simple and rigorous way were set. Finally we made comparisons using coding matrices and attribute crosses that enabled us to make graphs to illustrate the report. The analysis of the questionnaire was made by describing frequencies, enriched by the qualitative analysis of the views presented in the open question, following the same process described above for the qualitative analysis.

3. Results

We should note that the students contributed a total number of 495 tweets, an important quantity representing approximately 18% of total tweet potential that could have been received if each student had sent one for each class received, with attendance of around 75%.

Based on the number of tweets (Chart 1) we can see how participation occurs mainly around the activities dedicated to conferences and to practical classes, especially those directed by teachers. By contrast, group tutorials and students' theoretical presentations had the lowest values, together with the final sessions dedicated to the shared evaluation. Finally, we must highlight the progressive loss of participation in classes dedicated to dialogue activities.

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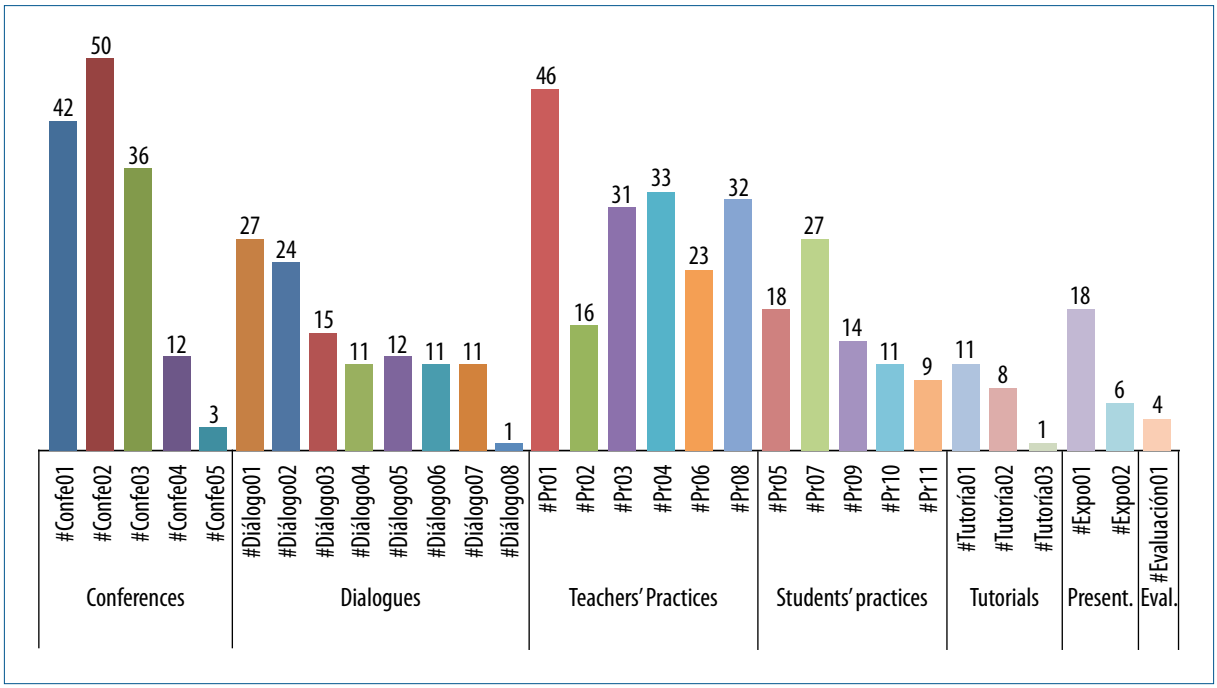
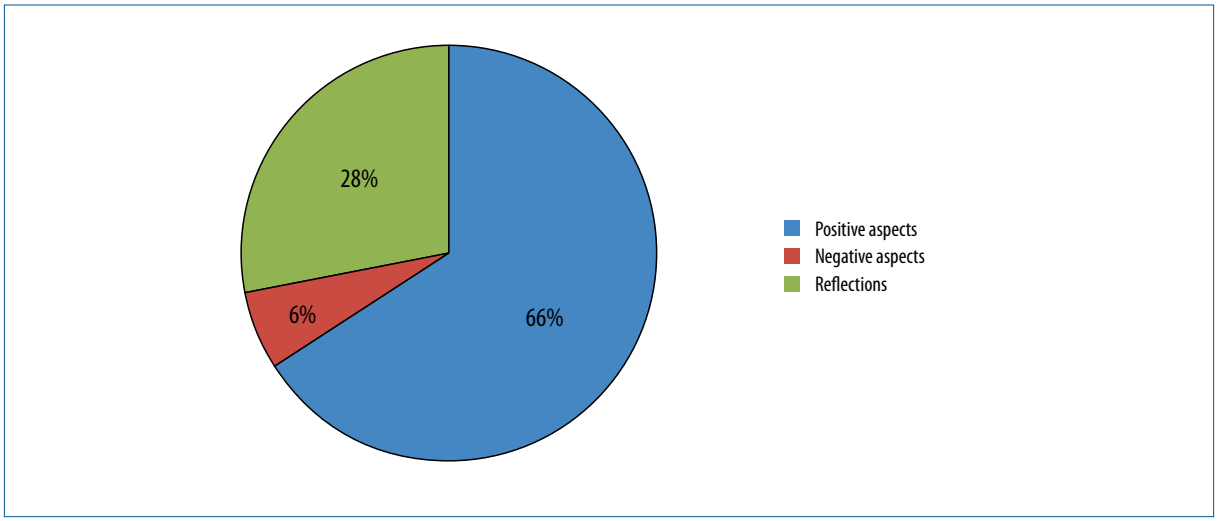
Chart 1. Number of tweets in each class organized by hashtags



3.1. Evaluation of the teaching process

The first objective was to determine the overall assessment of the entire teaching process and make our own reflections about the usefulness of Twitter. To do this, the students' tweets organized by classes through hashtags were classified into three categories according to whether they made reference to positive or negative aspects or did not make a direct reference to an assessment of the class, but rather reflected on the content given (Chart 2).

Chart 2. General evaluation of the classes according to the percentage of references



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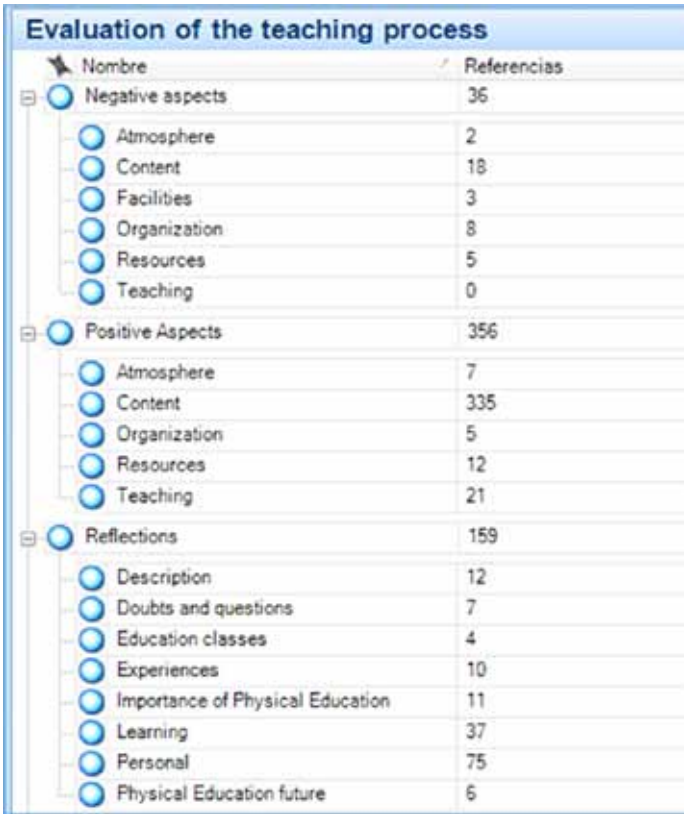
Sixty-six percent of the comments made allusions to positive aspects of the subject, and only 6% of the tweets criticized some nuance that should be improved or said that it was unwise. The remaining percentage corresponded to areas not directly related to evaluation; these gave personal reflections on an issue, question or experience stimulated by the content of the class.

For a more detailed analysis of the content of the tweets, we divided the categories into subcategories (Figure 1). The majority of the comments made a positive assessment of the content, mainly expressing general satisfaction with remarks such as 'amazing ...', 'Very interesting ...', '... injected motivation', etc.

Figure 1. Coding of tweets issued



We found that many of the tweets made no reference to any particular aspect of evaluation, but reflected underlying ideas of the class itself, most of which were along the lines of 'we must accept and love ourselves as we are.'

Finally, the references in the comments on the negative aspects, far fewer in number, were mostly related to the content given. Some of them put a positive aspect with a negative one, such as: 'As the first contact with the subject, it was in my opinion good, although too much information was included.' A few users clearly reflected dissatisfaction with some aspect: 'It is clear that I did not like the class much, it went out of our hands!' Negative comments about the organization were mainly related to time, punctuality or some other specific organizational aspect, 'the class was good but not how it was led, the same people always spoke and when others wanted to talk they did not let them'.

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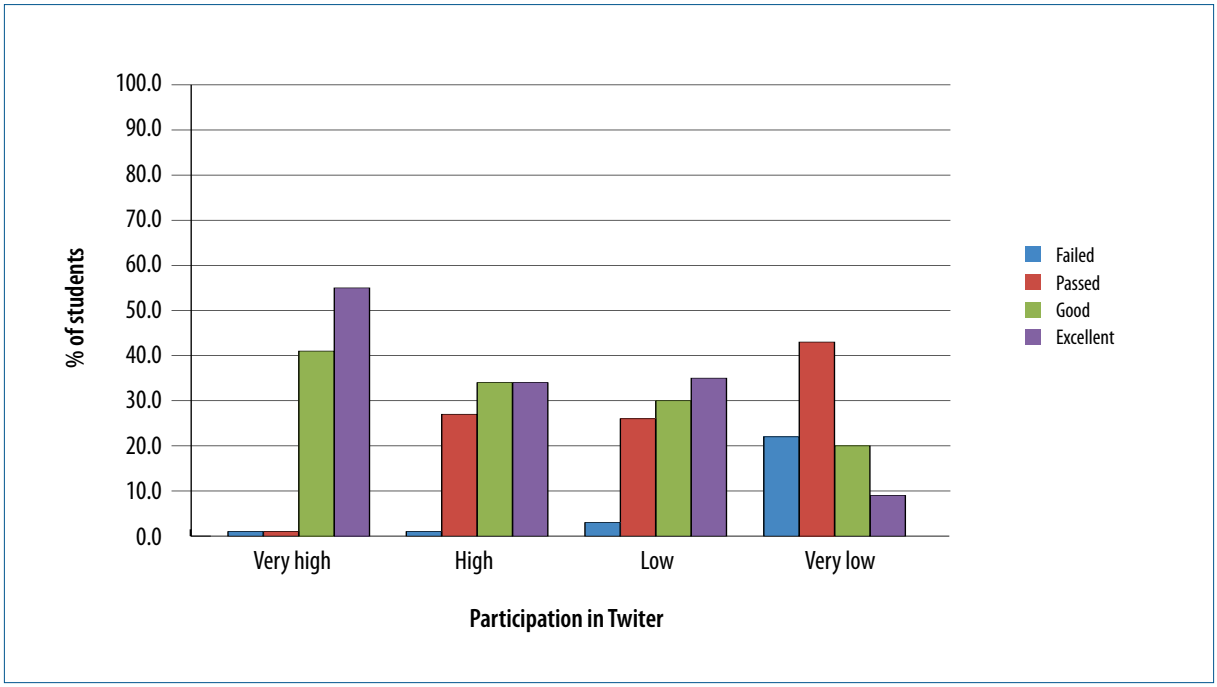
3.2. Evaluation of Twitter as a tool for participation in the university education process

As is clear from their responses, it has to be borne in mind that 9% of the students considered their participation as deficient because they had never used Twitter at any time or on any specific occasion, and 30% said they had seldom used it. Therefore, it seems that the remaining 61% made use of the tool proficiently (Chart 3).

Chart 3. Twitter assessment based on participation



The trend in participation changes depending on the participation when making the evaluation of Twitter for the intended purpose. Thirty-three percent of the students welcomed the use of the tool, describing it as good and excellent compared to 28% who valued its use negatively, while the remaining 39% simply approved of its use.

Crossing the data of evaluation and participation in Twitter, we found that the students who least valued the use of Twitter in education were those who took little or no part in it. It is worth noting that a high percentage of students who still perceived their participation as scant (passed) nevertheless gave a high score (good or excellent) to its use in the course. Those students who perceived their participation as high or very high did not list failure as a mark, and good and excellent are the predominant scores.

The views expressed by students in the open question about using Twitter mainly made positive references (Figure 2). Most of them remarked on the freedom of expression that it allowed them, and being able to share ideas with peers, 'with Twitter I found a way to express freely what we felt about the classes.'

The second most referred-to aspect in the positive comments was teacher feedback, i.e., the usefulness of the tool to inform teachers of their strengths and the weaknesses they should improve in each class: 'Twitter has been a great help to the teachers, because our opinion is of great importance in that subject.'

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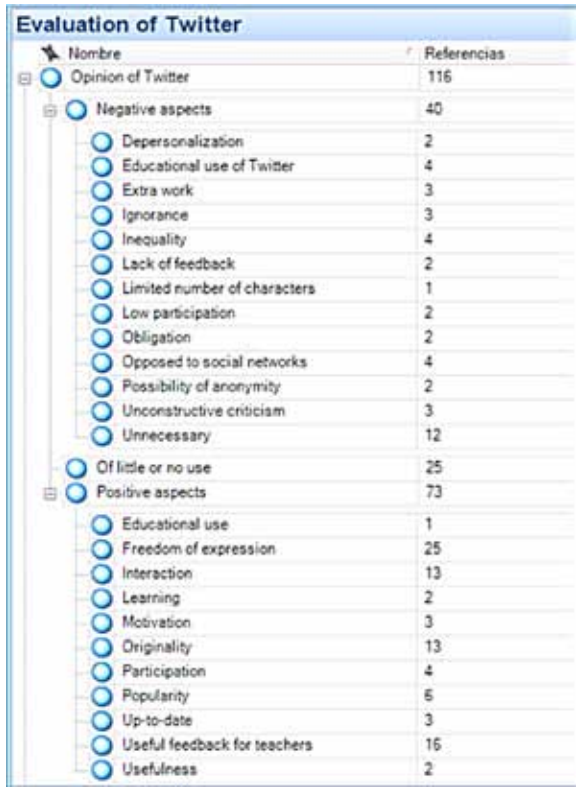
Figure 2. Coding of comments on Twitter



Innovation is also highly valued. Many opinions spoke of the originality of the idea and appreciated the novelty and intention to do something different, 'It's new to me and I think for all my fellows [...] it seems like a great idea to motivate us.' In addition, the students perceived very positively the ability to interact both with peers and with the teachers that allowed them to '... maintain direct contact between students and teachers.'

Although to a lesser extent, a considerable number of references in the evaluations mentioned the weaknesses and disadvantages of using Twitter in teaching. Forty ratings contained some comments about its shortcomings. Of these, the majority judged Twitter as unnecessary for the subject. Some cases considered that the benefit of its use was intended for teachers whereas students obtained no value from it: 'the use of Twitter seems right for teachers to have an outside view of what is happening in their classes, but I do not see it as really useful for students.'

Other sources of dissatisfaction are inequalities that can be created according to whether or not one owns an account on the platform, or has greater or lesser skill in handling it, which excludes those students from participating in the process ('... not everyone has it, and all students are no longer in the same conditions for participation'). Some students are opposed to social networks and to socialization through the network ('I do not want more networks to socialize me ...'); others do not consider it a good teaching resource for incorporation into academia 'as it is a social network, it is for more personal use'.

If we consider the effect of participation on the type of opinions, we see that the difference between positive and negative aspects gradually increased as the students' participation increased (Chart 4).

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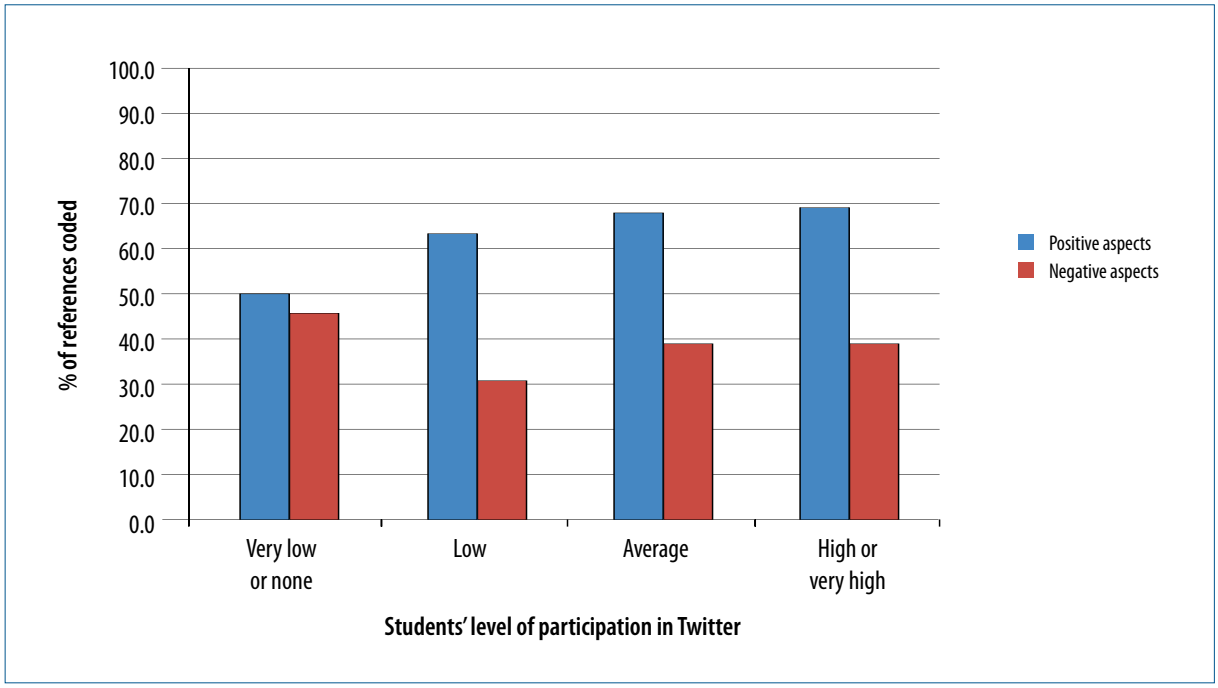
Chart 4. Opinion on Twitter according to degree of participation



Thus, while those who barely used Twitter during the course discussed almost equally both the negative and positive aspects of the tool, students with greater participation showed considerable difference in favour of the positive.

4. Discussion

Regarding the assessment of teaching, from the evaluations of each of the classes, we can say that overall satisfaction has been high throughout the course. The students acknowledged having experienced an active methodology based on their sharing in the preparation and development of classroom activities. Moreover, we believe that the 'poisonous pedagogy' (Miller, 1998) of an evil named assessment may have adversely affected the level of global participation. Some students (it is a question we should research) have been inhibited from participating, despite having an anonymous account, for fear of having their opinions 'controlled' by the teachers, a symptom of the lack of democratic participation in the university classroom, or the prevalence of the outcome of the process, where students are only interested in what brings direct benefits to the final grade.

The freedom that Twitter offers to express opinions, sometimes far from the main objective, has opened another interpretive door in research, and enriched the processes lived in the classroom from a global viewpoint.

Most of the comments, both positive and negative, made reference to the content and theme of the class, highlighting its main virtues or criticizing those aspects disagreed with, either regarding its content or the way in which it was explained or worked. The high percentage of positive feedback leads us to interpret that overall satisfaction is high and therefore the path taken is in principle suitable.

We found that the students' evaluation of Twitter as a tool for participation in the university education process was positive, but nevertheless there were numerous references against it. Among these difficulties, to a greater or

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lesser extent we have encountered all those put forward by Wakefield, Warren, and Alsobrook (2011) – rejection of social networks or discomfort with their use – and those proposed by Welch and Bonnan-White (2012), which, together with the above, highlighted the lack of familiarity or overload of accounts. In our experience, the criticisms were directed mostly towards consideration of the tool as unnecessary for the development of the subject. The failure to observe the direct impact of their participation and the zero impact on their course grade may have influenced this perception. Coinciding with the findings of Welch and Bonnan-White (2012), the experience was more positive in those students who reported having had a higher level of participation. Their estimates were always above good and their views in a large percentage alluded to the benefits of the platform. Students with little or no participation had a lower valuation of the use of Twitter (mostly approved) and a similar percentage of opinions regarding the advantages and disadvantages.

5. Conclusions

However, based on the results, we can conclude that Twitter as a tool for evaluating classes is broadly positive. The possibility of expressing views freely and taking part in the process of improving teaching the subject stand out. This strategy has proved to be very powerful and effective thanks to its spontaneity and immediacy. Yet, we think it should be complementary to a final deeper and more rigorous assessment. Its formative and continuing value allows us to approach the perspective of students, their views and interests, enabling us to act, change and improve the course at any time during the process. In addition, the proper use of Twitter to motivate the student can succeed in creating a sense of belonging and effective integration into the subject, and the student is considered as an active part of the process and identified with the results.

Of all the views and inputs obtained, we conclude that the addition of Twitter to the University academic level has been a positive and beneficial experience, being a popular and novel means that is usually well received by students. In those cases where the use of Twitter is rejected, we must ask whether it is specific to the tool or whether the problem is related to the teaching and learning proposed.

We detect that the tool has varied and valuable potentials different from those observed for its incorporation into our area and on which it would be interesting to continue researching, for example: to study the interest awakened in students by the fact of using an application that allows tweets with a certain hashtag to be shown in real time and to be projected in class while the teacher gives the class, or its use in sharing resources related to the topics covered in class; or the incorporation and visualization of tweets on the platform or website (Twitter for Websites) of the course to encourage student participation.

Finally, we must admit that part of the final success depends on students perceiving clearly the ultimate goal of using the tool and overcoming the simple instrumental view of Twitter. To achieve this, our experience tells us that the classroom should be democratized; the student should be granted equal status and freedom with the teacher and, from there, to promote an evaluation for improvement and learning that overcomes the sanctioning and hierarchical model that still prevails in the university classroom.

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Methodological proposal for the application of international benchmarking in order to assess the quality of virtual higher education

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Abstract

This research focuses on providing a benchmarking methodology that allows any university offering virtual education (e-learning or b-learning) to compare itself to the best international universities in order to improve the quality of the virtual education offered. In order to verify the adequacy of the proposed methodology, it has been applied to the Polish Virtual University (PUW). On the other hand, the Open University of Catalonia (UOC) was chosen as the leading partner university. The benchmarking performed has allowed the author to obtain solid results in order to draw up and implement a complete action plan for improvement, which will make it possible to increase, in the short and medium terms, the quality of the virtual education offered by PUW. It is therefore concluded that the proposed benchmarking methodology is adequate in order to assess and improve the quality of virtual higher education.

Keywords

benchmarking, virtual higher education, education assessment, quality of education

Propuesta metodológica para la aplicación del benchmarking *internacional en la evaluación de la calidad de la educación superior virtual*

Resumen

El objetivo de este trabajo consiste en proporcionar una metodología de benchmarking *que permita a las universidades que ofrezcan educación virtual compararse con las mejores universidades a nivel internacional al objeto de mejorar la calidad de su educación virtual. Para comprobar la idoneidad de la metodología propuesta, esta se aplica a la Universidad Virtual de Polonia (PUW). Como universidad socia (líder) se elige la Universitat Oberta de Catalunya (UOC). El* benchmarking *realizado ha permitido obtener unos resultados sólidos para la elaboración y posterior implantación de un completo plan de acción de mejora que permitirá mejorar a corto y medio plazo la calidad de la educación virtual de la Universidad Virtual de Polonia. Por ello, se concluye que la metodología de* benchmarking *propuesta es adecuada para evaluar y mejorar la calidad de la educación superior virtual.*

Palabras clave

benchmarking, *educación superior virtual, evaluación, calidad*

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1. Introduction

The development of virtual learning environments, the emergence of competiveness in those environments and the students' expectations and conditions require universities to focus on a high quality virtual education and to apply methods in order to improve its quality.

One of the methods is benchmarking, that is, a systematic process carried out by a specific organization in order to learn from the best ones on the local (national benchmarking) or global (international benchmarking) market through a comparative assessment of products, services, processes, methods, procedures and strategies (Fazlagić, 2006). Based on that comparison, the university obtains knowledge regarding the quality of the education offered by other universities and identifies the reasons due to which they obtain better results in order to learn from them and improve the quality of a specific action (Cobo, 2009).

Nowadays, benchmarking is being increasingly applied to the quality management of virtual higher education, as confirmed by different projects regarding the application of it to that area. Table 1 shows the projects considered of interest to this research.

Table 1. Examples of benchmarking projects performed in the virtual education sector

Name	*Coordinating institution. Performance period*	*Benchmarking purposes*	*Benchmarking areas*
BENVIC	Open University of Catalonia (UOC) 1999-2001	To develop and apply assessment criteria in order to promote quality standards for virtual higher education.	• Institutional mission and basis • Learning resources • Support for teachers • Learning assessment • Accessibility • Efficacy • Technological resources • Institutional implementation
ACODE	Australasian Council on Open, Distance and e-Learning 2004-present	To support a continuous improvement of the quality of virtual higher education.	• Institutional policy and governance • Planning of quality improvement • Professional/personal development • Support for teaching staff • Support for students
MASSIVE	University of Granada (UGR) 2005-2007	To promote, through peer review, a mutual support services model for European universities offering virtual education.	• University strategies • Integration of information and communication technologies (ICTs) into the teaching-learning process • Evolution of the university library • Support for teaching staff • Support for students • Design of virtual courses
eMM	University of Manchester 2005-2008 (First phase)	To provide information to all directors interested in understanding the capacity of virtual higher education.	• Learning • Support • Assessment • Organization

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Name	Coordinating institution. Performance period	Benchmarking purposes	Benchmarking areas
E-xcellence	European Association of Distance Teaching Universities (EADTU) 2008-2012	To help universities improve the quality, the attractiveness and the accessibility of their virtual education by creating standards of excellence.	• Strategic management • Curricular design • Course design • Course delivery • Support to teaching staff • Support to students

Source: Prepared by the author based on Cano et al. (2012), Cobo (2009), Devedžić et al. (2011), European Association of Distance Teaching Universities (2011), Op de Beeck et al. (2012), Keppell et al. (2011) and Marshall (2009)

These and other projects of unquestionable utility have made it possible to carry out comparative analysis of various universities based in different countries using a set of specific criteria. However, no methodologies have yet been designed, based on the results from those projects, that could be used as practical support by universities in order to introduce the method in a correct and satisfactory manner. Given the lack of a proper methodology, the purpose of this research is to draw up a benchmarking methodology, with all the necessary phases, in order to apply it to universities offering virtual education based in different countries so as to improve its quality.

2. Assessment of the quality of virtual higher education

The quality of virtual education is a complex matter, especially, given its multifactorial nature. Some authors link its quality to learning processes, products and services based on the use of information and communication technologies (ICTs) (Marúm-Espinosa, 2011). Others (Ardila-Rodríguez, 2011) refer to the quality of virtual education as user satisfaction, system excellence, positive academic results and good social impact. According to Silvio (2006), such quality should be understood as the union between academic excellence, equity and social relevance. In his opinion, bringing quality to virtual education means studying it from its singular and specific aspects, taking into consideration all variables, criteria and specific indicators arising from the characteristics of virtual education. According to that author, the quality of virtual education cannot be compared or reduced to the criteria applied to traditional education, as it requires specific assessment models and methodologies adapted to the different contexts of virtual education.

Rubio (2003) highlights two types of models that can be used to assess the quality of virtual education:

1) Partial focus based mainly on one of the following:

- Assessment of the educational activity
- Assessment of the educational material
- Assessment of the technological platforms
- Financial assessment

2) Global focus. It is the assessment based on a series of elements included in an e-learning solution in order to set out the criteria to be used to manage and assess its quality. Two trends can be distinguished within this focus:

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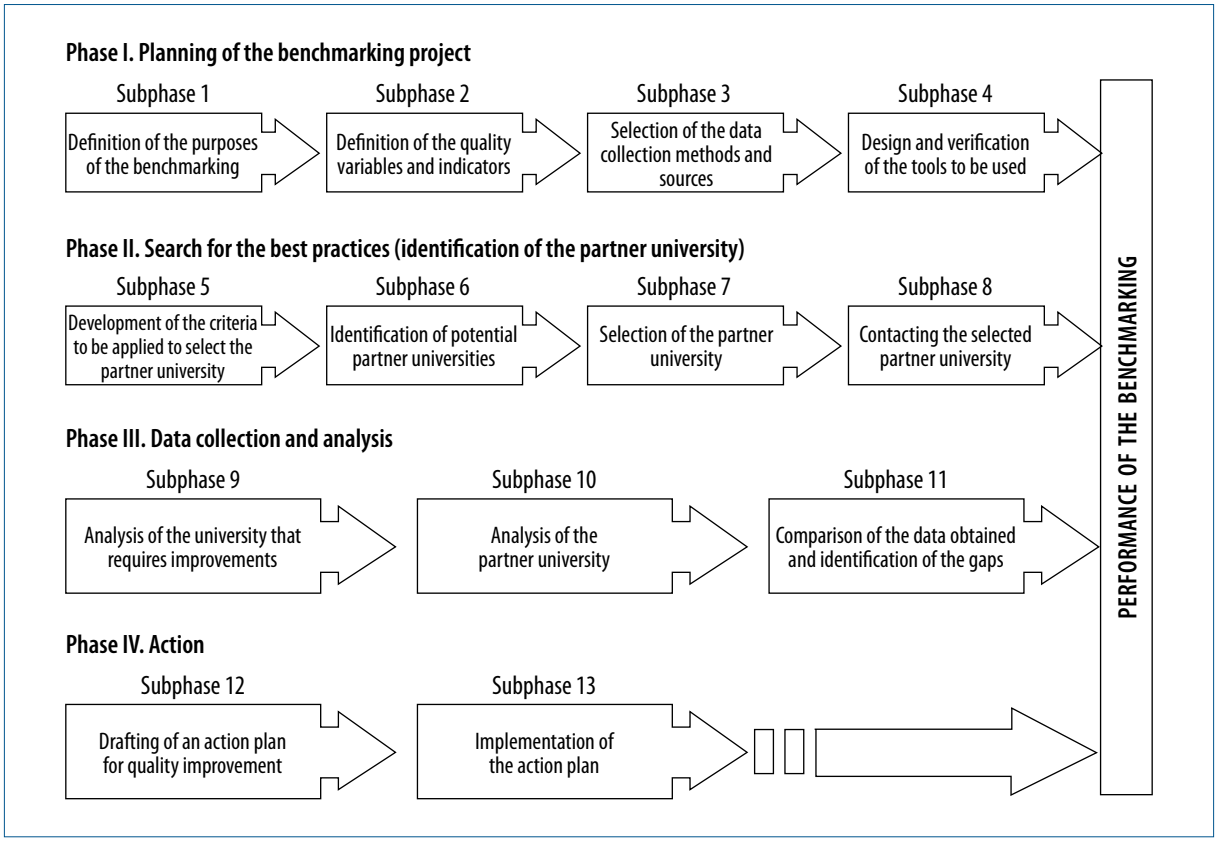
a) Assessment systems focused on Total Quality Management (TQM) models and/or standards
b) Systems based on benchmarking

As can be observed, a university can assess the quality of its virtual education using different methods in order to reach the highest quality and the best results possible based on its competitiveness' conditions. One of the methods is benchmarking, the purpose of which is to discover the very best practices.

3. The proposed methodology for performing international benchmarking of the quality of virtual higher education

Nowadays, there are several methodologies describing how benchmarking should be carried out. However, most of them have been designed for application to the industrial sector and, thus, it is difficult to apply them in order to assess the quality of virtual education, as they do not take into consideration its specific context. For this reason, the author proposes her own methodology to carry out such benchmarking, setting out all the necessary phases and subphases (see Figure 1).

Figure 1. The proposed benchmarking methodology for the assessment of the quality of virtual higher education



According to Figure 1, the benchmarking process is divided into four phases and thirteen subphases, as described below.

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Phase I. Planning of the benchmarking project

Subphase 1: Definition of the purposes of the benchmarking

The start point of each benchmarking process is to define its purposes and main tasks to be fulfilled.

Subphase 2: Definition of the quality variables and indicators

In this subphase, all the variables and indicators to be used to measure quality will be defined.

Subphase 3: Selection of the data collection methods and sources

In this subphase, the type of data necessary to carry out the research will be defined. Given the relevance of data collection, various data sources will be defined.

Subphase 4: Design and verification of the tools to be used

The last step of phase I consists in designing data collection tools to be used during the benchmarking process.

Phase II. Search for the best practices (identification of the partner university)

Subphase 5: Development of the criteria to be applied to select the partner university

The first subphase of phase II, consists in developing the criteria to be applied to select the universities to be considered for the final selection of the partner university (the university with the best practices).

Subphase 6: Identification of potential partner universities

This subphase requires exhaustive research using secondary data in order to identify the best university according to certain variables. Based on the results from that research, the universities with the best possible practices will be identified in order to select potential partner universities.

Subphase 7: Selection of the partner university

In this subphase, the university that best fulfills all the criteria set out in subphase 5 will be identified.

Subphase 8: Contacting the selected partner university

At this point, the first formal contact with the selected partner university will be made. For this purpose, it is necessary to contact the persons in charge of the that university, informing them of the purposes of the research, as well as of the reasons why the selected university is considered one of the best of its kind, asking them whether they are interested in participating in the research.

Phase III. Data collection and analysis

Subphase 9: Analysis of the university that requires improvements

Based on the indicators drawn up in subphase 3, all the internal data necessary to assess the performance of the university will be collected, using the collection sources and tools created in that subphase.

Subphase 10: Analysis of the partner university

Based on the indicators drawn up in subphase 3, all the internal data necessary to assess the performance of the partner university will be collected, using the collection sources and tools created in that subphase.

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Subphase 11: Comparison of the data obtained and identification of the gaps

In this subphase, the results from the application of the criteria to the analyzed university will be compared to those obtained from their application to the partner university. The differences between the results will be defined in order to identify the gaps between the two universities.

Phase IV. Action

Subphase 12: Drafting of an action plan for quality improvement

In this phase, an improvement plan containing specific actions to be taken will be designed in order for the analyzed university to achieve the very best practices.

Subphase 13: Implementation of the action plan

This subphase consists in implementing the previously drawn up plan, and in following up and monitoring its implementation.

4. Empirical application of the proposed methodology. Research results

In order to verify the efficiency of the proposed methodology, the author applied it from April to August 2013 to the Polish Virtual University (PUW).[1] The benchmarking was performed according to the methodology described in Figure 1.

Phase I. Planning of the benchmarking project

Subphase 1: Defining of the purposes of the benchmarking

The main purpose of the benchmarking was to assess the quality of the education offered by PUW in order to compare it to a leading university and define the gaps between them so as to identify the steps that should be taken in order to improve the quality of the education offered by PUW.

Subphase 2: Definition of the quality variables and indicators

Based on the analysis described in Table 1, it can be concluded that the most common benchmarking variables applicable to virtual education can be divided into five main groups:

- Strategic plan
- Institutional context
- Educational agents
- Teaching-learning processes
- Virtual platforms

The aforementioned variables were applied to this research. Table 2 below defines each of the aforementioned variables, as well as the criteria and indicators to be used for each of them.

1. According to the specialist literature, benchmarking may take anywhere between a few days and several months. The period mainly depends on the data that one wants to collect and the methods used to compile them (Stapenhurst, 2009; Levy & Valcik, 2012). In our case, the four-month time range was appropriate for compiling, analysing and reporting on the data collected.

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Subphase 3: Selection of the data collection methods and sources

The author applied documentary analysis methods and social research techniques in order to collect all the necessary data. For this purpose, semi structured face-to-face interviews and non-participant observation of the virtual classroom were carried out. Both primary and secondary sources were used for documentary analysis. Regarding primary sources, the author used, among others, the documentation provided by the researched university for the variables described above, that is, strategic plans, curricula, course documents, student statistics, teaching guides and materials. Regarding secondary sources, the author used, among others, information materials provided by the Education Ministries of Poland and Spain, reports drafted by the Polish E-learning Association, the Polish Accrediting Commission, the Spanish National Agency for Quality Assessment and Accreditation (ANECA) and the Catalan University Quality Assurance Agency (AQU)

A total of eight semi-structured interviews were carried out in order to understand, as much as possible, the issues related to the scope of this research. The interviews were carried out with directors of virtual programs (2), human resources managers (2), managers of virtual classrooms (2) and teachers-tutors (2).

The non-participative observation of virtual classrooms allowed the quality of the virtual environment to be assessed. Furthermore, the author applied her knowledge of virtual education acquired through years of professional experience as a teacher-tutor at PUW and through her studies at various virtual universities, among others, the Open University of Catalonia (UOC), the National Distance Education University (UNED) of Spain and the Virtual Educa Teacher Training Institute of Argentina.

Table 2. Definition of the variables

Variables	*Conceptual definition*	*Criteria*	*Indicators*
Strategic plan	A document showing the current and future position of the university from a strategic point of view.	Vision	It clearly defines the desired future.
			It is motivating for all university members.
		Mission	It explains why the university exists.
			It is achievable.
		Values	It can guide the managers in their activities.
			It encourages the team spirit of the university.
		Strategic purposes	They are ambitious.
			They a They are coherent.
			They are achievable.
Institutional context	The university's set of resources and characteristics.	Infrastructure	The university has all the necessary facilities.
			The university has one or more virtual libraries.
			There are standards for the technological infrastructure configuration.
		Human resources	Teaching staff (teacher/student ratio).
			The teaching, administrative and technical personnel tasks are clearly defined (in writing).

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Variables	*Conceptual definition*	*Critera*	*Indicators*
Educational agents	The persons involved in the teaching-learning process	Students	The students are informed of the admittance and graduation profile.
			The students are offered additional services.
			There are rules regarding the students' rights and duties.
		Teachers-tutors	There are teacher/tutor selection procedures.
			There are teacher/tutor assessment procedures.
Teaching-learning process	The cognitive activity carried out by students guided by teachers-tutors in order to gain knowledge and skills.	Studies program	The program recipients are well defined.
			The program is up to date.
		Teaching materials and resources	They are varied.
			There are resources for students with special needs.
			There are procedures for the validation of teaching materials.
		Methodology	The teaching strategies applied by teachers-tutors are varied.
			The learning process is sufficiently encouraged.
			Feedback is given to each student.
		Tutoring	There are instructions regarding communication paths with tutors.
			The tutors' tasks and functions are well defined.
			The tutoring is monitored.
		Learning activities	The activities are varied.
			A schedule has been defined for each activity.
			The way each activity should be delivered is well defined.
		Learning assessment	An assessment methodology has been well defined.
			The students are involved in the assessment process.
Virtual platform	The tool used to support the virtual education process	Course management by users	There are activity management tools.
			There are tools to encourage team work.
			There are tools to create a personal learning environment (PLE).
		Communication management	Asynchronous communication.
			Synchronous communication.
		Assessment and follow-up	There are assessment exercises.
			There are self-assessment exercises.
		Standardization	The platform meets the SCORM standard requirements.
			The platform meets the A/AA accessibility requirements.

Source: Drawn up by the author based on Duart and Martínez (2001), Espinosa and González (2006), García Aretio (1998), Giorgetti et al. (2013), HEQC (1997), Ornellas and Muñoz (2012), Sánchez (2009) and Sarramona (2001)

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Subphase 4: Design and verification of the tools to be used

In order to collect all the necessary data to carry out the benchmarking, the author drew up five assessment protocols to be used for the comparative assessment.

These were:

- A comparative assessment protocol of the strategic plans
- A comparative assessment protocol of the institutional context
- A comparative assessment protocol of the teaching-learning process
- A comparative assessment protocol of the educational agents
- A comparative assessment protocol of the virtual platform

The results from the application of the aforementioned protocols have been arranged according to the Likert scale, ranging from 1 (non-fulfillment of the indicator) to 4 (high fulfillment of the indicator). Furthermore, comments were made regarding each of the applied indicators (qualitative assessment), as the author considered that subjective values should be included in the assessment. For this reason, the objective data obtained from the application of the protocols was completed with the author's comments on the results obtained (see Table 3). The drafted protocols were assessed by four experts in virtual higher education.

Phase II. Search for the best practices (identification of the partner university)

The author chose a Spanish university as partner university, given that Spanish universities offer highly developed virtual education, as shown by numerous international rankings, such as the Online MBA Listing 2013 by the *Financial Times* (Financial Times, 2013) or *Ranking Mundial de Universidades en la Web* (Consejo Superior de Investigaciones Científicas, 2013).

A description of the selection process for the partner university is given below:

– During subphase 5, the author created six selection criteria: online mode, access to ICTs, course variety, other services offered, quality and prestige.

– During subphase 6, a total of 41 Spanish universities offering virtual education were analyzed. As a result, four preselected universities were thoroughly assessed, applying the above-mentioned criteria.

– During subphase 7, UOC was selected as the partner university, as it satisfactorily fulfilled all the applied criteria.

– Subphase 8 consisted of sending a letter to the partner university, requesting its authorization to carry out the benchmarking and explaining the functioning of the entire process.

Phase III. Data collection and analysis

Subphases 9 and 10: Internal analysis of PUW and UOC

The purpose of these subphases is to collect data about the partner university and the quality of its virtual education. For this reason, prior to collecting that data, the quality of the virtual education offered by PUW was assessed in order to increase the possibility of detecting all areas to be improved. The assessment was carried out using comparative assessment protocols (see Table 3 for an example of those protocols) and the data collection sources described in subphase 3.

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Table 3. Example of a completed comparative assessment protocol

Learning activities								
Indicators	***Level of fulfillment of the indicators (comments)***							
1. The activities are varied	PUW				UOC			
	1	2	3	4	1	2	3	4
	Comment: Depends on the subject, but the nature of most of the activities is the same, that is, forum participation.				Comment: Learning activities are divided in two groups: 1) Application activities (individual and non-immersive activities). 2) Research activities (collaborative and immersive activities).			
2. There is an activities schedule	1	2	3	4	1	2	3	4
	Comment: There is no activities schedule.				Comment: The guide includes a "Learning planning" chapter that contains a navigation map for each course describing all the activities to be performed and their schedule.			
3. The way the activities should be delivered has been described	1	2	3	4	1	2	3	4
	Comment: The students have to post the completed activities in the virtual classroom's delivery box.				Comment: The students have to post the completed activities in the virtual classroom's delivery box.			

Subphase 11: Comparison of the data obtained and identification of the gaps

Once the quality of the virtual education offered by PUW had been assessed, its situation as compared to the partner university was defined in order to identify possible gaps (see Table 4) between the two universities in five main areas, as well as to determine their causes.

A brief summary of those gaps is given below.

The first variable used by the author was the strategic plan of each university. One of the biggest weaknesses of PUW in this area is that its vision and the values that it should abide by for its future development have not been developed. Furthermore, the strategic mission and objectives of PUW are significantly less well defined than those of UOC.

Another relevant variable that creates a positive and a negative gap in comparison to the partner university is the institutional context. The positive gap is that the teaching load of PUW (student/teacher ratio) is lower than that of the partner university. The negative gap is that PUW lacks not only a virtual library but also strategies for the availability of technological services and human resources management.

Regarding educational agents, there is a clear negative gap between the two universities, as PUW does not provide its students with any additional services, that is, it does not assist them with their access to the job market and it does not encourage them to participate in educational events or scientific research/programs. What is more, not even PUW's teachers participate in such events. Moreover, PUW has not defined any teacher/tutor selection procedure.

Regarding the teaching-learning process variable, there is a very significant negative gap between the two universities. In this case, PUW has not set out any procedures for the updating or drafting of studies programs. Furthermore, it lacks educational material, learning strategies and technologies, and the activities it offers are not varied. Finally, it should be noted that the qualification criteria and assessment systems applied by PUW teachers are not detailed enough.

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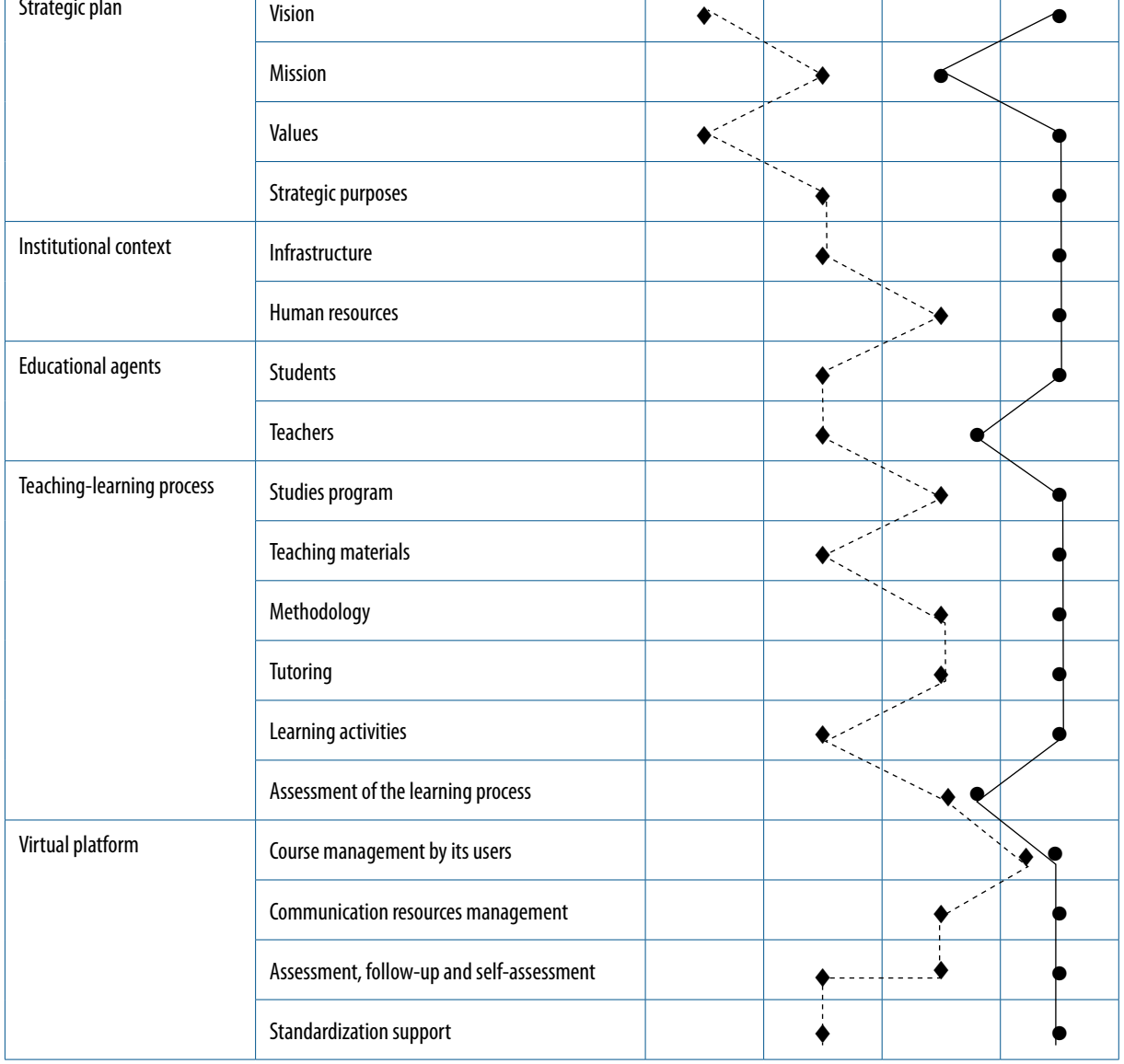
Table 4. Quality gaps detected in the virtual education offered by PUW and UOC

		Average score*			
Variables	*Criteria*	*1*	*2*	*3*	*4*
Strategic plan	Vision				
	Mission				
	Values				
	Strategic purposes				
Institutional context	Infrastructure				
	Human resources				
Educational agents	Students				
	Teachers				
Teaching-learning process	Studies program				
	Teaching materials				
	Methodology				
	Tutoring				
	Learning activities				
	Assessment of the learning process				
Virtual platform	Course management by its users				
	Communication resources management				
	Assessment, follow-up and self-assessment				
	Standardization support				



Explicaciones: PUW ♦- - - - - - - - - - ♦ ; UOC ●——————●

* The average score is the sum of scores obtained for each indicator divided by the total number of indicators making up each criterion

Regarding the last variable, that is, the virtual platform, the negative gap of PUW in comparison to the partner university is due to the fact that the virtual platform used by PUW offers very few tools for team projects and it does not offer any tool for students to create their own personal learning environment (PLE). Moreover, the platform offered by PUW has not had accessibility standards applied to it, so it does not offer students with special needs the possibility of studying.

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Phase IV. Action

Subphase 12: Drafting of an action plan for quality improvement

In order to remove or reduce the gaps identified in phase III, an improvement action plan was designed, consisting of specific actions to be taken so that PUW could not only remove the said gaps, but also achieve the very best practices.

Table 5 shows an example of the plan drafted for PUW.

Table 5. Example of an action plan to improve learning activities

Strategic purpose: To improve learning activities		
Specific purposes	***Actions***	***Indicators***
1. To offer activities of different kinds	1.1. Launching different collaborative activities.	Number of activities
		Results from the survey carried out among the students
2. To offer support to the students in the performance of the activities	2.1. Offering guidelines for performing the activities.	Results from the survey carried out among the students
	2.2. Answering students' questions within two days.	
3. To draw up a timetable for the activities	3.1. Planning learning activities at the same time as drafting the curriculum.	Studies curriculum
	3.2. Drafting an activities timetable for each subject before the start of each course and posting it in the virtual classroom.	Activities timetable

Subphase 13: Implementation of the action plan

In this subphase, the drawn-up action plan had to be implemented and monitored. This subphase is extremely important, as any failure could lead to the strategic objectives not being reached and, thus, the quality of the virtual education offered by PUW not being improved. In order to avoid that risk, a set of the most relevant indicators was drawn up in order to ensure that each step of this subphase would be carried out.

Conclusions

The results obtained from the application of the proposed benchmarking methodology enable the following conclusions to be drawn:

Regarding the methodology

The drawn-up methodology sets out all the relevant phases in order to carry out international benchmarking of the quality of virtual higher education. It is not a static methodology, as it allows a dynamic application based on modifications and the evolution of quality assessment models through the adaptation, elimination and implementation of new indicators and variables.

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Regarding the application of the methodology

By applying the methodology, the author has been able to verify its complete usefulness and great potential when it comes to improving the quality of virtual education by discovering the very best practices and collecting all the necessary data in order to assess, in a comparative manner, the quality of the virtual education offered by different universities and, as a result, to draw up an improvement action plan for such education.

Regarding the utility of the methodology

The methodology was created to perform international benchmarking of the quality of the virtual education offered by Polish universities. The application of a comparative analysis (with a leading international university) made it possible to establish a thorough diagnosis of the actual quality of the virtual education offered by the selected Polish university, as well as to discover the very best practices in order to increase the quality of it and to initiate a learning process based on the best virtual education universities at an international level. The creation of a clear and objective methodology allowed the author to use the results obtained to draft an action plan for the continuous improvement of the quality of the virtual education offered by the chosen Polish university. It is believed that the use of the methodology described above could extend beyond the purposes initially set and become a tool that brings added value and knowledge to all institutions offering virtual education (both in Poland and abroad).

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Teaching methodology used in the master's degree programme for secondary education teacher training: student assessment

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Abstract

This study analyses future secondary school teachers' perceptions of the teaching methodology used in a teacher training master's degree programme. A descriptive study was designed and the data were collected by adapting the "Questionnaire to evaluate university professors' teaching and assessment methodology" (n=252). Students achieve better results under the learning-centred model, which is related to the constructivist and student-centred system, rather than a traditional teaching-centred model, which is related to the teacher whose task is to expose information to students.

Keywords

teaching methodology, evaluation, master's degree, student

Metodología docente en el máster de formación del profesorado de educación secundaria: valoración del alumnado

Resumen

El objetivo de este estudio es analizar las percepciones de los futuros docentes de educación secundaria sobre la metodología docente utilizada en el máster de formación de profesorado de educación secundaria. Para ello, se ha diseñado un estudio descriptivo y se han recogido los datos mediante la adaptación del «Cuestionario para la evaluación de la metodología docente y evaluativa de los profesores universitarios» (n = 252). El alumnado muestra percepciones más favorables para la escala «modelo centrado en el aprendizaje», relacionada con el modelo constructivista, centrado en el alumno, de facilitación del aprendizaje, frente al «modelo centrado en la enseñanza» de corte tradicional, centrado en el profesor, cuya tarea consiste en trasmitir la información de manera expositiva al alumnado.

Palabras clave

metodología docente, evaluación, máster, alumnado

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Introduction

The European convergence process in higher education has led to the emergence of new conceptions, approaches and a teaching practice (Margalef & Pareja, 2008) that involves changes to teaching and assessment methodologies (Pallisera, Fullana, Planas, & Del Valle, 2010).

In this new context, teaching should be viewed from a different angle than the one used to date (Tomusk, 2006); the teacher's role should be to enable, facilitate and guide students to learn theory and professional practices of a particular subject (Herrera, 2007) that promote their overall development (Kallioinen, 2010). The focus has been shifted towards student activity and their learning (Padilla & Gil, 2008; Pozo & Pérez, 2009) through the development of strategies that promote the active participation of students and techniques for independent and self-regulated learning in more flexible working environments (Kramarski & Michalsky, 2009; Rezende, Fonseca, Nunes, Da Silva, & Antas, 2014).

The new European process increases student satisfaction with teaching faculty and knowledge application (Otero, Ferro, & Vila, 2012). The most highly valued aspects are personal relationships with teachers, the possibility of studying or working in other European countries, a low student-teacher ratio and the development of continuous assessment processes (López, Valles, & Monjas, 2009; Boud & Falchikov, 2007).

However, Carrasco (2012) highlights student criticism of compulsory class attendance and excessive workload, both individual or in groups (Korkmaz & Yesil, 2011; Nam & Zellner, 2011). Thus, student attitudes toward the development of blended learning strategies are positive (Jung, 2001), but the level of training of the teachers and other technical issues have been criticised (Owston, York, & Murtha, 2013; Santamaría, Ramos, & Sánchez, 2012). In addition, Hernández and Carrasco (2012) explain that students of master's degree programmes for secondary education teacher training are not satisfied with the set time for didactic training, the link between theory and practice in training programmes and the coordination among teachers. Thus, secondary education training must bridge the gap between the knowledge and the skills acquired in educational psychology training, review the student-teaching period of working alongside other teaching staff and include practical lines of work in the curriculum (Popa & Bucur, 2014).

University students have internalised that methodological changes developed after the Bologna process are applied in practice in isolated cases and represent surface level changes, meaning there is a dissonance between the curriculum and what really takes place in the classroom (Hernández-Pina, 2002). Some authors (Korthagen, 2010; Recchia & Puig, 2011) have established certain elements that jeopardise quality teacher training: disengagement and decontextualisation of the curriculum with fragmented knowledge, rote learning, theory being divorced from practice, experience and knowledge separation and the inability to carry out action research projects.

Medina, Domínguez, and Ribeiro (2011) argue that university professors develop an academic-focused teaching style that does not respond to today's knowledge society challenges, the job demands, and the changes in lifestyles and ways of life. Also, Edwards, Donderis, and Ballester (2005) reveal the limited involvement of professors and students in the process, making it necessary to implement awareness-raising actions and training policies that can change the academic culture and successfully advance towards European convergence in the Spanish university system. Gorozidis and Papaioannou (2014) even argue that political decision-makers should encourage the development of strategies that foster professor motivation to drive and implement successful educational innovations.

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It is necessary to use active learning techniques, collaborative work, the acquisition of problem-solving skills and critical thinking development (Sáez & Ruiz, 2012). This approach would reduce traditional on-site classroom sessions, which tend to focus on the acquisition of conceptual knowledge (Cano, 2008). Therefore, the design and creation of shared learning spaces that bridge gaps and stress relationships to foster the creation of methodologies that give rise to collaborative learning is proposed (Johnson & Johnson, 2009).

Methodological design

Research objectives

The European convergence process and the implementation of the European Higher Education Area (EHEA) in the Spanish university system have brought significant changes to the teaching and learning process and, therefore, to the professor role. Therefore, this work analyses future secondary school teachers' perceptions of the teaching and assessment methodology used in a teacher training master's degree programme at the Catholic University of Murcia, Spain. To achieve this general aim, the following specific objectives were defined:

- To understand student perceptions of the traditional knowledge and teaching model in higher education.
- To examine student evaluations of active and constructivist knowledge and the learning model used by faculty and its implications in the classroom.
- To examine the teaching skills of postgraduate professors.

Data collection instrument

For data collection, the CEMEDEPU ("Questionnaire to evaluate university professors' teaching and assessment methodology") prepared by Gargallo, Suárez, Gargella, and Fernández (2011) was adapted. This instrument, aimed at university students, is structured into three scales with 48 items, with answer options ranging from 1 to 5 (where 1=strongly disagree and 5=strongly agree).

The instrument was developed to measure the extent to which a learning-centred model or a teaching-centred model are experienced as well as the perceived teaching skills of competent university faculty (Gargallo et al., 2011). To adapt the questionnaire to the study population, all of the items were modified and the questions were directed at the students, although the content of the questionnaire was not changed.

Thus, validity of the content was confirmed by a group of experts and through a pilot test. In the first case, several university professors who specialise in the area of teaching and school organisation from several Spanish universities were asked to make an overall assessment of the questionnaire and to indicate on a scale of 0-10 the adequacy of the initial instrument. With respect to the individual items, the experts were asked to indicate the degree to which each item was relevant to the subject under study (in content) and the degree of accuracy and adequacy (in form). In general, the evaluations by the experts showed that most of the items were valid and adequate in terms of how they were written in order to be understood by the study population.

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Once the experts had given their opinions, we proceeded to implement a pilot test on 100 students of the master's degree programme in secondary education teacher training at the University of Jaen, Spain. Thus, the KMO (Kaiser-Meyer-Olkin) sampling adequacy statistic reached a value of 0.914 and the Bartlett's sphericity test value was 6038.066 (p=0.000). In addition, an exploratory and confirmatory factor analysis showed three factors that explained 49.03% of the variance: the first factor, comprised of 13 items based on the teaching-centred model; the second factor, comprised of 15 items based on the learning-centred model and the third scale, pertaining to teaching skills, was comprised of 20 items.

As to the reliability of the instrument, Cronbach's alpha coefficient was used and produced satisfactory results (0.956). Furthermore, the split-half method obtained a value of 0.896 for the first part and a value of 0.949 for the second, indicating that the scale is very reliable. The Spearman-Brown coefficient shows a value of 0.870, which suggests high reliability of the instrument.

Sample

The study population was comprised of 264 students of the master's degree programme to train teachers in compulsory secondary education, sixth form, vocational training and language instruction at the Catholic University of Murcia during the 2013/2014 academic year. For the selection of the sample, nonprobability sampling was used of the accidental or purposive type. Thus, subjects who chose to respond to the questionnaire were selected for the sample (n=252). To calculate the sample size, the formula for groups with fewer than 100,000 subjects was used with a confidence interval of 95% and a maximum error of the estimate of 4%.

Of the sample, 59.6% were women, and 40.4% were men. The age range of the majority of the participants was between 21 and 25 years (42.9%), followed by 26 and 30 years (33.7%), with a slightly smaller percentage being over the age of 30 (23.4%). With respect to their areas of specialisation, 32.7% were specialising in Humanities, Social Sciences and Business, 27.5% in Science and Technology, 20.3% in Physical Education and Sports, 17.5% in Philology and Languages and finally, 2.0% in Fine Arts. The reason for enrolling in the master's degree programme was, for 75.7% of the participants, to become a teacher (secondary education, sixth form, vocational training, or language instruction); for 14.8%, to access a doctoral education programme; and, for 9.5%, to complete their studies in educational psychology.

Data analysis

To process the data, the Statistical Package for Social Sciences software (SPSS, version 21 for Windows) was used. A descriptive analysis was also carried out on each item.

Results

Students of the teacher training master's degree programme claim that professors make use of more than just exams ($M = 2.64$) based on objective criteria ($M = 3.41$) and they claim that this is not the only or the best assessment methodology ($M = 2.98$).

They also understand that the assessment should not be limited to simple evaluation of knowledge acquired by students ($M = 2.90$). A competent university professor is someone who: adequately explains the items comprising the syllabus ($M = 3.67$) and has a good command of those items ($M = 3.61$); is responsible for organising the knowledge

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(*M* = 3.81) and conveying it to the students (*M* = 3.34) during face-to-face sessions (*M* = 3.71); and does not use lectures (*M* = 3.35) for the purpose of taking study notes as the fundamental methodology for instruction (*M* = 3.28).

Similarly, the participants assert that university professors understand learning as a process for gaining the knowledge made available to students on a subject area (*M* = 3.79) and they understand that higher education should not be reduced to learning and understanding the scientific content of the subject areas (*M* = 2.82).

Table 1. Descriptive analysis for the "teaching-centred model" scale

Item	Mean	Standard deviation
Exams are the only assessment methodology	2.64	1.335
University professors believe it is enough for students to learn the fundamental scientific content of the subject area	2.82	1.157
University professors understand that assessment should be limited to the evaluation of the knowledge acquired	2.90	1.168
Exams are the best assessment methodology	2.98	1.150
My role during face-to-face sessions is to be alert and to take study notes	3.28	1.134
The role of the university professor is essentially to transmit knowledge to their students	3.34	1.019
During face-to-face sessions, the lecture is the fundamental methodology used	3.35	1.070
University professors use exams with objective criteria as an assessment methodology	3.41	0.912
The most important characteristic of a competent university professor is to have a good command of the subject area	3.61	0.960
A competent university professor is someone who explains the subject area well	3.67	0.965
University professors should use the time during face-to-face sessions to explain the contents of the subject area well	3.71	1.021
University professors understand that learning involves increasing the knowledge available to students	3.79	0.951
The fundamental responsibility of the university professor is to organise the knowledge that students should gain	3.81	0.947

Second, students observe a certain level of carelessness on behalf of university professors in carrying out scientific seminars (*M* = 3.32). However, they value the use of learning contracts as an assessment methodology (*M* = 3.58), since they show real-life applications of the theory (*M* = 3.67) using case studies and/or simulations (*M* = 3.78); they use questions and systematic reflection in the classroom (*M* = 3.79) and a varied and complementary methodology (*M* = 3.79) based on the use of information and communication technologies (ICT) (*M* = 3.90). Thus, students appreciate it when university professors establish a working environment where they have an active role (*M* = 3.83), since they provide the student with the opportunity to make personal contributions to building their own knowledge (*M* = 3.94). Therefore, students perceive that university professors understand knowledge as a necessary element for interpreting reality and not just to pass a subject (*M* = 3.86).

Regarding the assessment, students claim that university professors evaluate the teaching and learning process using several methods and continuous assessment procedures to establish improvement proposals (*M* = 3.91). They also use academic mentoring with an appropriate working plan (*M* = 3.77).

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Table 2. Descriptive analysis for the "learning-centred model" scale

Item	Mean	Standard deviation
University professors organise seminars with students	3.32	1.043
University professors use learning contracts, negotiating with the student, setting tasks and work that should be performed, determining the type of exams, etc. as an assessment methodology	3.58	0.930
University professors show real-life applications of the theory	3.67	0.904
University professors evaluate not only to assess student results, but to get information about the learning process and to introduce any necessary improvements	3.71	0.875
University professors use formative assessment procedures to review and to return the work with instructions for improvement	3.71	0.931
University professors use case studies and/or simulations to enhance the integration of theory and practice	3.74	0.878
University professors use mentoring with a working plan established beforehand and they do not simply wait for students to attend	3.77	1.005
University professors use questions and reflections systematically to help students think	3.79	0.871
University professors use a varied and complementary methodology according to the students' characteristics	3.79	0.862
University professors provide a working environment that fosters active student learning	3.83	0.905
University professors understand that the knowledge acquired by students is to interpret reality and not just to pass a subject	3.86	0.853
The use of ICT encourages participation, interactivity and student cooperation through online sessions, discussion forums, etc.	3.90	0.918
University professors supplement the exam as an assessment method with other training orientation methods (papers, essays, etc.)	3.91	0.906
University professors provide students with the opportunity to make personal contributions (forums, sessions, etc.)	3.94	0.943
A competent university professor does not present knowledge as something closed off to modification; it is open to reconstruction and development by the student	4.05	0.850

For teaching skills, master's degree students are indifferent to being given an initial assessment by the university professors to detect prior knowledge (M = 3.20). However, students do value the synthesis of discussions at the beginning of the face-to-face sessions (M = 3.54) and at the end (M = 3.52), which establishes a climate of good interpersonal relations (M = 3.86).

In addition, students claims that the university professors consider the assessment results for planning the teaching and learning process (M = 3.56), since they follow up on the student learning throughout the academic year (M = 3.58). This process allows university professors to guide students and improve their academic performance (M = 3.78) according to the objectives set in the syllabus (M = 3.81). In addition, university professors inform the students about the methods (M = 3.88) and criteria for assessing the learning (M = 3.86) as well as the criteria developed in marking tests (M = 3.86).

Students think that university professors care about them personally (M = 3.69), and try to convey their interest in the subject (M = 3.83). They plan the course syllabus on a yearly basis and take time to carry out this

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task (*M* = 3.72); they design clear objectives and communicate them for each of the topics covered (*M* = 3.76). In addition, university professors facilitate the course syllabus and inform the students about changes to it (*M* = 3.93), they select contents using appropriate criteria (*M* = 3.80), use a variety of resources that facilitate the presentation of the material (*M* = 3.77) and they disclose the bibliographic references for the subject (*M* = 3.72).

Table 3. Descriptive analysis for the "teaching skills" scale

Item	*Mean*	*Standard deviation*
University professors perform an initial assessment to identify prior student knowledge	3.20	1.242
At the end of the face-to-face sessions, university professors summarise the discussion in the session	3.52	0.974
At the start of the face-to-face sessions, university professors review what has been discussed in the previous session	3.54	1.085
University professors consider assessment results to modify their planning, methodology and teaching activities in the short or medium term	3.56	0.974
University professors evaluate at different times to review student learning	3.58	1.006
University professors are interested in students as individuals	3.69	1.024
Students are given bibliographic references for the subject	3.72	0.909
Annually, university professors plan the syllabus and they take time to carry out this task	3.72	0.858
University professors clearly communicate objectives to the students on each of the topics covered	3.76	0.926
University professors use a variety of resources (audiovisual, transparencies, video, whiteboard, documents, etc.) to facilitate the presentation of content	3.77	0.918
University professors guide students to improve their results	3.78	0.984
University professors select contents using appropriate criteria (objectives, relevance, usefulness, student interest, etc.)	3.80	0.848
University professors assess learning processes according to the objectives set in the planning	3.81	0.850
University professors try to convey their interest in the subject to students	3.83	0.877
Students know the criteria for marking exams used by university professors	3.86	0.983
University professors ensure that there is a good interpersonal climate during the face-to-face sessions	3.86	0.896
University professors inform students about the learning assessment criteria	3.86	0.902
University professors inform students about the learning assessment methods	3.88	0.913
University professors establish clear objectives for the subject	3.92	0.851
University professors provide a syllabus and inform students about changes to it	3.93	0.830

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Discussion and conclusions

This study has revealed future secondary education teachers' perceptions of the educational methodology used in the teacher training master's degree programme. Thus, it reflects on "how to teach" in order to put forward suggestions for improvement to promote quality in higher education.

In general, students achieve better results under the learning-centred model, which is related to the constructivist and student-centred system, rather than a traditional teaching-centred model. It shows positive perceptions of students towards an active and participatory methodology in the teaching and learning process (Kramarski & Michalsky, 2009; Rezende et al., 2014), although traditional approaches are still used in higher education teaching (Sáez & Ruiz, 2012; Medina et al., 2011).

Future teachers define a competent university professor as someone who adequately explains the content of the subject area and also has a good command over it; and as someone responsible for organising the knowledge that students should gain. In addition, students of the master's degree programme for secondary education teacher training value the use of learning contracts, case studies and/or simulations, systematic reflection in the classroom and varied and complementary methods of instruction, based on the use of ICT. These results are in line with the research by Gargallo et al. (2011), who revealed how students show a preference for university professors who understand knowledge as a construction of shared meaning, use a variety of complementary teaching methodologies, encourage self-evaluation and make use of mentoring, information technology, communication and collaborative work.

Students appreciate it when professors facilitate the subject syllabus at the beginning of the course, since this establishes clear and well-defined objectives as well as the methods and criteria for assessment. However, they complain about initial assessments at the beginning of the course for the purpose of learning about students' prior knowledge of the subject area. These results support the research of Brown, Benito, Portela, and Rodríguez (2007) and Otero et al. (2012), who reveal student satisfaction with educational management and organisation. However, it contradicts González and García (2012), who support an improvement in the management of degree programmes by fostering coordination among professors to develop an active methodology that directly involves students in the teaching and learning process.

The data collected in this work should cause university professors to reflect on the procedures that ought to be used to teach and evaluate students, especially in the context of the new higher education system as a result of the European convergence process and the implementation of European higher education. In this sense, we must develop student-centred learning, since this is an internationally useful concept and model that can be transferred to a range of settings in higher education (Bovil, Jordan, & Watters, 2015). The design and creation of spaces that encourage the development of collaborative learning situations should also be fostered (Johnson & Johnson, 2009) as should learning service experiences that can facilitate teacher reflection on the ethical aspects of the profession and the role those aspects play in professional work (Bell, Horn, & Roxas, 2007; Root, 2005).

However, the small sample that has been used for this work does not guarantee the generalisation of the results to other samples. Similarly, the exclusive use of the questionnaire as a data collection instrument can lead to problems in terms of social desirability bias and the sincerity of the responses.

Further research could analyse undergraduate student perceptions and the results could be compared to those corresponding to postgraduate students, to understand their specific needs and concerns in terms of the teaching methodology.

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21st-Century Instructional Designers: Bridging the Perceptual Gaps between Identity, Practice, Impact and Professional Development

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Abstract

The purpose of this paper is to discuss instructional designers' current status through a brief discussion of the history of instructional design, comparison of instructional design models, and a presentation of a perspective on how instructional designers cope with their current identity and profession while seeking professional development. In this paper, we identified various reasons for addressing why professional development effort is less than ideal for instructional designers. These include a lack of priority given to professional development at an organization level, budget and funding, individual workload, and departmental visions and priorities. In order to address and overcome these factors, we recommend an instructional designer community of practice within institutions. As the landscape of education is constantly transforming, the designers' field cannot stay static. To respond to all the changes, instructional designers not only need to strive for continuous learning but also to adopt a more collaborative practice, where they can share and exchange ideas and best practices.

Keywords

instructional design, professional development, instructional improvement, instructional innovation

Diseñadores instruccionales del siglo xxi: cruzando las brechas perceptuales entre la identidad, práctica, impacto y desarrollo professional

Resumen

El propósito de este artículo es debatir sobre el estatus de los diseñadores instruccionales a través de un breve comentario sobre la historia del diseño instruccional, la comparación de los modelos de diseño instruccional y una presentación sobre la perspectiva de cómo los diseñadores instruccionales afrontan su identidad actual y su profesión, mientras buscan su desarrollo profesional. En este artículo hemos identificado varias razones para determinar por qué el esfuerzo de desarrollo profesional no es ideal para los diseñadores instruccionales. Estas razones incluyen una falta de prioridad que se da al desarrollo profesional a un nivel organizacional, el presupuesto y la financiación, la carga de trabajo individual y visiones y prioridades departamentales. Para hacer frente y superar estos factores, recomendamos una comunidad de práctica de diseñadores instruccionales dentro de las instituciones. Como el panorama de educación está cambiando constantemente, el área de diseñadores no se puede quedar estática. Para poder responder a todos los cambios, los diseñadores instruccionales no solo necesitan esforzarse en su aprendizaje continuo, también necesitan adoptar una práctica de mayor colaboración, mediante la que pueden compartir e intercambiar ideas y mejorar prácticas.

Palabras clave

diseño instruccional, desarrollo profesional, mejora de la enseñanza, innovación de la enseñanza

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Introduction

The 21st century poses a challenge to educators —including instructional designers— as learners' attitudes toward learning and technology evolve at a very fast pace. There are many examples in the literature that discuss who instructional designers are, what they do as professionals, what kind of instructional design model they use, and what kind of challenges they regularly face (Cox & Osguthorpe, 2003; Gibbons, 2003; Gibby, Quiros, Demps, & Liu, 2002; Rowland, 1992; Schwier, Hill, Wager, & Spector, 2006). The purpose of this paper is to examine instructional designers' current status through a brief discussion of the history of instructional design, comparison of instructional design models, and a presentation of a perspective on how instructional designers cope with their current identity and profession while seeking professional development. This paper aims to provide a perspective from designers for designers.

While there have been many discussions on how instructional designers need to be trained for the field, there is limited literature on what they need to be trained on and how they need to continue their professional development. Cheong, Wettasinghe, and Murphy (2006) broadly discuss the shift of education systems and assert that designers should not remain stagnant in their thinking and need to continue learning on a regular basis. Professional development for instructional designers is also clearly stated and emphasized as a competency for designers by the International Board of Standards for Training, Performance, and Instruction, which states "Apply research and theory to the discipline of instructional design and update and improve knowledge, skills, and attitudes pertaining to instructional design process and related field" (International Board of Standards for Training, Performance, and Instruction, 2012). The following sections will focus on instructional designers, the models and challenges, and the possible solutions.

Who is an Instructional Designer?

Richey, Fields, and Foxon (2001) specify four roles for the instructional designer: analyst, evaluator, e-learning specialist, and project manager. The position has been compared to different professions, such as film directors (Gibby et al., 2002) and architects and structural engineers (Gibbons, 2003), in a sense, to use the best available tools and technologies in different layers and phases of instructional design in order to attract and engage more clients. In recent years, instructional designers have been referred to as an "agent of social change" (Schwier et al., 2006) and "civic-minded professionals" (Yusop & Correia, 2012). The profession takes on different titles in different parts of the world or even within the same institution.

Definition and History of Instructional Design

The term "instructional design" has been interpreted in various ways based on grounded theories or for practical reasons. The various terms and definitions are overarched by the common theme of teaching and learning, but these un-unified concepts sometimes confuse instructional designers and hinder the fostering of an understanding and interpretation of the crucial issues and foundations related to instructional design. Furthermore, the constantly shifting landscape of education demands design that can grow and change with its context. Therefore, key elements

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of instructional design can be overlooked or even ignored by groups owing to a lack of knowledge or context (Levy, 2003).

Different terms have been used to represent the field of instructional design. Shrock (1995) used "instructional development" as a broader context for her description of the history of the field. To Shrock, instructional development is a self-correcting systems approach that seeks to apply scientifically derived principles to the planning, design, creation, implementation, and evaluation of effective and efficient instruction. This umbrella definition encompasses a wide range of concepts open to interpretation in different ways in different instructional design models. Instructional design includes all the processes involved in optimizing learning and performance (Reiser, 2001a). The following descriptions incorporate the overall history of instructional development and learning theories.

Although instructional design has roots in the study of educational psychology, the relevance of instructional design was established during and after World War II with the huge success of the incorporation of training films in the United States Army Air Force (Reiser, 2001b). Skinner (1954) introduced behaviorist principles of learning in his publication, *The Science of Learning and the Art of Teaching*. The key element of his theory lies in the reinforcement of desired learner responses. His instructional design emphasized formulating behavioral objectives, breaking instructional content into small units, and rewarding correct responses early and often. Another famous instructional theorist was Bloom. In 1956, he led a committee that introduced a taxonomy of educational objectives (Bloom, 1956). According to Clark (1999), the taxonomy provided instructors with a means to decide how to impart instructional content to learners most effectively. However, during these times, a standardized design process had yet to be devised.

Gagné (1965) elaborated the analysis of learning objectives and the relationship between different classes of learning objectives and appropriate instructional designs. Due to the advent of the instructional application of microcomputers, the utilization of instructional development by agencies outside of the educational sector, such as military training, business, industry, and even consumer products (educational video games) grew in the 1980s. Merrill, Li, and Jones (1991) claimed that it was necessary to develop new models of instructional design to accommodate the interactive capabilities of the new computer.

In the 1990s, with the influence of the technology movement, constructivist approaches encouraged learners to construct their understanding and meaning of reality and experiences. Dick (1996) and Lebow (1993) tried to see how constructivist principles could enhance instructional design practice. Also, the use of the Internet for distance learning led instructional designers to consider how online courses could be carefully designed within the new environment.

The advent of new media in the 21st century has brought about technological innovations coupled with new ways of approaching learning and instruction. Owing to the divergent and complex nature of the instructional design process and practice, the field of instructional design seems to be growing more general or, conversely, more specific. The different roles that instructional designers play under the name of the instructional design field depend on institutional, organizational strategic plans and instructional designers' personal levels of expertise. Looking at what is happening in the field of instructional design today raises many questions. Merrill (1996) distinguished the new paradigm of instructional theories from the old paradigm by emphasizing the user–designer concept. In the same vein, Sahin (2009) introduced postmodern instructional design principles (plurality, flexibility, and humanity) to respond to 21st-century learners' needs and preferences.

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The 21st century requires more diverse and holistic learning skills than ever before due to the global paradigm shift in the technological, social, economic, and cultural context. What must now be considered is a new instructional design paradigm to help learners cope with these 21st-century demands. Instructional designers need to be flexible and creative to respond to the demands of this continually changing professional context.

In the next section, we will discuss different instructional design models and will briefly compare them with the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. These comparisons will help to argue why we believe instructional design models need to be more flexible in this evolving field and why the designers' field cannot stay static.

Instructional Design Models

Instructional design models provide guidelines or frameworks that help to organize structures of procedures in designing and developing instructional activities. From a designer's perspective, various models can be used in the instructional design process only to the extent that is manageable for the particular subject and context. In other words, one model may be more effective for designing a dentistry course, and another model for designing a math course. The aim of this paper is not to determine which model is better but rather to explore some of these models and find links among them through an instructional designer's lens as they impact designers' work and approach.

There are numerous instructional design models (e.g., Dick and Carey, Kemp, ASSURE, and Rapid Prototyping), which are all somehow variations of the traditional ADDIE model (Culatta, 2011). Why the ADDIE model? This is not a foreign concept or question for those in the field of instructional design. While there is still some confusion on the focus of the field, ADDIE seems to be the most recognized model or colloquial term for instructional development among Instructional Design and Technology (IDT) professionals (Bichelmeyer, 2005). Molenda (2003) argues that ADDIE might not even be a model but rather a label covering instructional development processes in a systematic approach. Each of the phase outcomes of ADDIE leads into the subsequent stage. In the analysis phase, target learners, learners' existing knowledge, the learning environment, and instructional problems and objectives are identified. In the design phase, which is systematic and specific, learning objectives, assignments, lessons, and media are developed and selected. In the development phase, the content is developed and proper technologies are used. In the implementation phase, instructor(s) and learners are trained in learning environments and other technologies used in the course. The evaluation phase is reiterative throughout the process in formative forms, and at the end of the development process the evaluation is summative in the form of learners' feedback.

The Dick and Carey design model details a comprehensive and detailed process of Instructional System Design (ISD) that starts by identifying instructional goals and ends with a summative evaluation (Lee & Lee, 1996). In this model, the instructional development process happens within nine phases. The sequential steps in this design (Dick, Carey, & Carey, 2001) are as follows: (1) assess needs to identify goal(s), (2) conduct instructional analysis and analyze learners and context, (3) write performance activities, (4) develop assessment instruments, (5) develop instructional strategy, (6) develop and select instructional materials, (7) design and conduct formative evaluations, (8) revise instruction, and (9) design and conduct summative evaluation. The analysis phase in ADDIE is similar to the first two phases of this model. The write performance objectives phase in Dick and Carey's model is similar to

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the development stage in ADDIE, while the evaluation step in both models covers the same thing. This model is also a systematic model.

The Kemp design is similar to Dick and Carey's in that it consists of nine steps, starting with identifying instructional problems and ending with an evaluation process. The model strongly emphasizes learners' characteristics as well as resources to support instruction and learning activities (Morrison, Ross, & Kemp, 2010). The nine elements of the model listed in Morisson, Ross, and Kemp (2004) are (1) identify instructional problems, (2) identify learners characteristic, (3) analyze tasks, (4) design instructional objectives, (5) design content sequencing, (6) design instructional strategies, (7) design the message, (8) develop instruction, and (9) develop evaluation instruments.

The Rapid Prototyping model is inspired by software development (Grant, 2010). The model is used to develop instructional materials in a design–evaluation cycle that continues throughout the life of the project. The model cycle is not as detailed as ADDIE; however, its continual design–evaluation cycle has sometimes been cited as a way to improve the generic ADDIE model (Learning-Theories.com, 2012). The Rapid Prototyping model consists of three steps: (1) prototype, (2) review, and (3) refine. This model reduces costs and time by using a working model early in a project to reduce revisions later. The designer using this model gathers information through needs analysis and setting goals, then constructs and uses a prototype, and finally refines and maintains the design (Camm, 2012).

ASSURE is another ISD model, ASSURE is an acronym taken from the tasks associated with the model and consists of (A) analyze learners, (S) state standards and objectives, (S) select strategies, technology, media, and material, (U) utilize technology, media, and materials, (R) require learner participation, and (E) evaluate and revise (Academy of Teaching Excellence, 2002; Culatta, 2011). Similar to ADDIE, this model starts with analyzing learners and ends with evaluation and revisions.

Within the Center for Teaching, Learning and Technology context at the University of British Columbia, there are five main design and development processes: Planning, Development, Production, Implementation, and Evaluation (PDPIE) (Cho & Cronk, 2007). This design model is quite close to the hybrid design model proposed by Passerini and Granger (2000), which also has five phases – analysis, design, development, evaluation, and delivery. While the PDPIE design is not the same as that of the ADDIE model, it is similar in some respects. The first phase of the PDPIE model calls for conducting a needs analysis, which covers learners' characteristics and instructional goals. In the second phase, the main content and the assessment and instructional strategies are determined and developed. In the production phase, the content is finalized and developed online. The implementation phase covers facilitators' training, delivery, learners' support, and resources. Finally, the last phase, similar to that of ADDIE, covers evaluation in both the formative and summative formats.

The comparison between ADDIE and other models is shown in Table 1.

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Table 1. Comparison of the ADDIE model with other instructional design models

THE INSTRUCTIONAL DESIGN MODELS' STEPS	ADDIE MODEL PHASES					
		Analysis	*Design*	*Develop*	*Implement*	*Evaluation*
	Dick and Carey	Needs assessment to identify goals, instructional analysis, analyze learners and context	Develop instructional strategy, develop and select instructional materials, design formative evaluation, revise instruction	Write performance activities, develop assessment instruments, develop instructional strategy, revise instruction	Develop and select instructional materials	Conduct formative evaluation, design/ conduct summative evaluation
	Kemp	Analysis of instructional problems, learner characteristics and task	Develop and design instructional strategies, design content sequencing, and design the message, design of evaluation instruments	Development of instructions	Instructional delivery and implementation, support services	Formative, confirmative and summative evaluation
	Rapid Prototyping	Information gathering	Setting objectives, construct prototype, refine	Construct prototype	Use prototype	Review
	ASSURE	Analyze learners	State standards and objectives, select strategies, technology, media and materials	Utilize technology, media and materials	Require learner participation	Evaluate and revise
	PDPIE	Planning	Development	Production	Implementation	Evaluation

Although considered the standard, a key question is whether the ADDIE model can remain so in the 21st century. The implementation phase of the classic ADDIE may now not be necessary in the development process due to the need for immediate delivery of content. A wide variety of available tools now allows educators to distribute and deliver content immediately. The focus of instructional design will continue to evolve to meet the various needs that contemporary educators and learners demand. Instructional designers, therefore, will follow different models based on their particular needs, situations, and tasks. This section also demonstrates that there is not a fixed model to follow but various models to respond to different teaching and learning demands in an evolving field. With a foundation of what instructional design is, and various models for implementation, we will now explore instructional designers' challenges.

Instructional Designers' Challenges

We are instructional designers who work in the same department/unit, and we have realized that we exercise different skill sets and have different experiences in our day-to-day instructional design practice due to a great variety and ambiguity in what we practice. Because of our realization, we naturally became curious about how other instructional designers see themselves as instructional designers and what challenges they face.

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Method

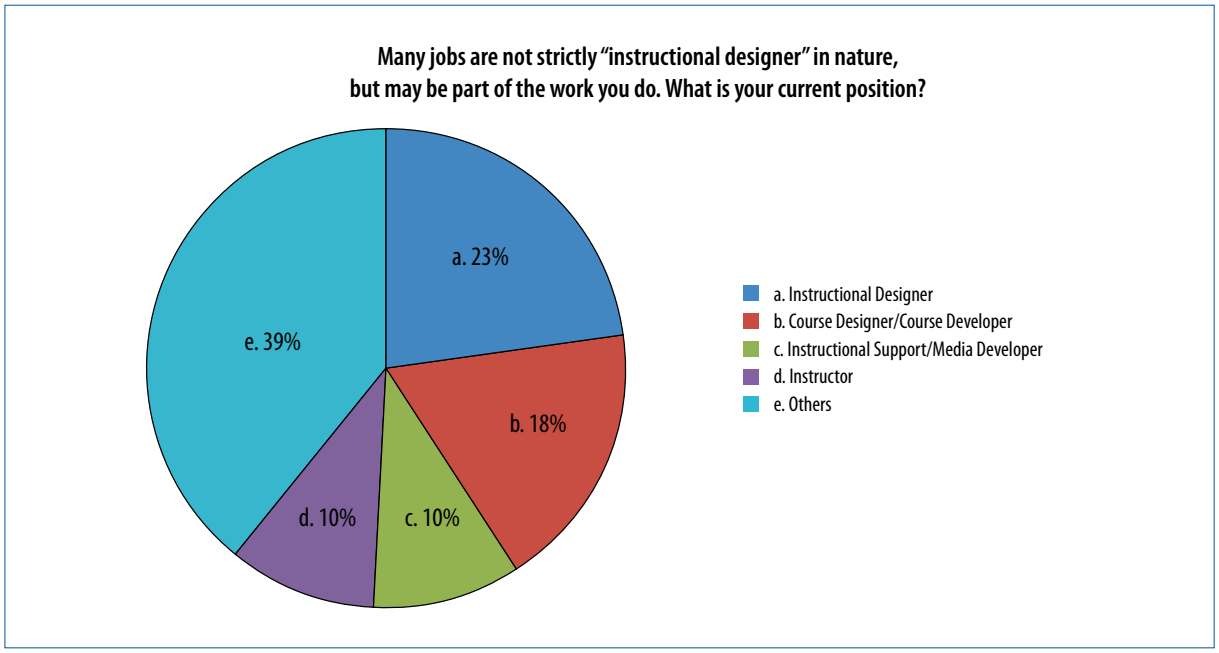
In May 2011, we conducted a brief survey at an event called "Just Instructional Design" in Vancouver, British Columbia, Canada. The event took place with 60 participants. It was open to all professionals from public schools or private companies who were either instructional designers or were involved in the instructional design process. The survey provides an overview of the professionals who consider themselves involved in instructional design, the general public's perceptions of the role of an instructional designer, and the challenges that instructional designers face. Thirty-five participants completed the instructional designer's survey.

A. Identity and the Nature of our Actual Practice

To identify professionals involved in instructional design, albeit under different titles, one question asked was "Many jobs are not strictly 'instructional designer' in nature, but may be part of the work you do. What is your current position?" Figure 1 gives the distribution of answers to this question.

Results

Figure 1. Respondents' current positions



Only 23% of the instructional designers surveyed self-identified as being primarily instructional designers, as shown in Figure 1. Most considered themselves course designers/developers, instructional support/media developers, instructors, and other roles first and foremost. While many of the respondents' titles/positions were different from that of instructional designer, most of the positions carried similar responsibilities to those of instructional designers. These titles include learning designer, project manager, educational consultant, instructional development consultant, education program designer, educational analyst, manager (facilitation and

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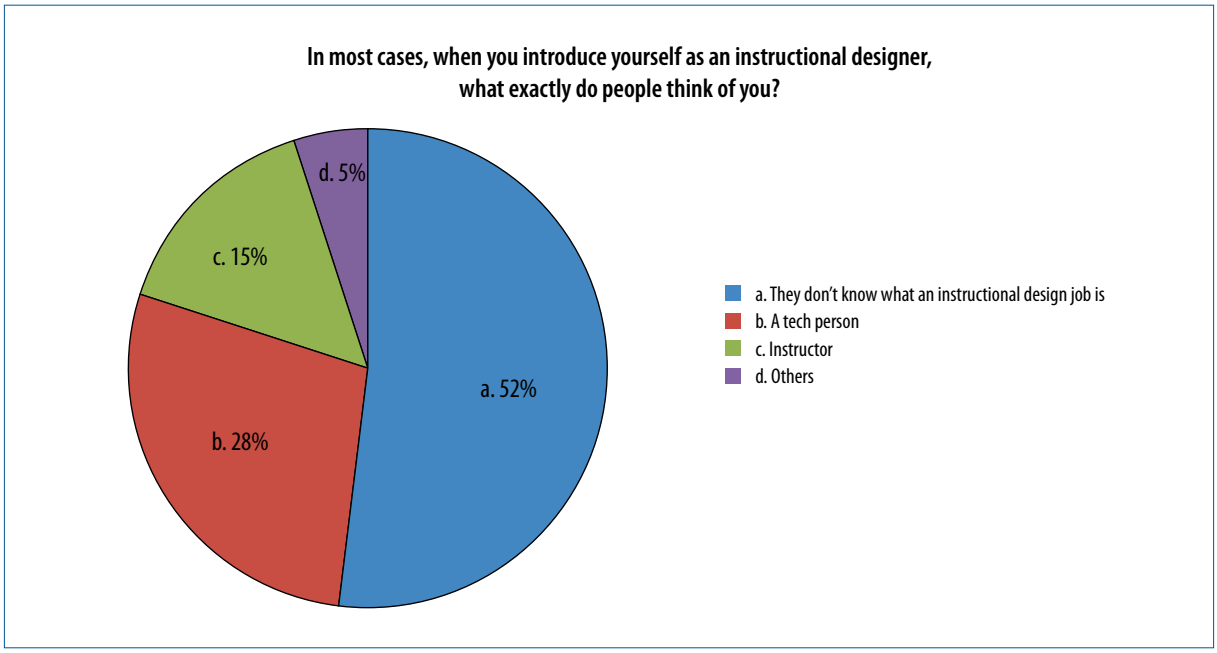
process design), educational technology manager, meta designer, faculty learning management systems training coordinator, administrator, curriculum developer, facilitator, program manager, learning consultant, and educational technology specialist. This clearly demonstrates that many educators under different titles consider themselves significantly involved in the instructional design process and have a common understanding and knowledge of it. The nebulous perceptions of instructional design are found not only among instructional designers themselves but also among the general public. To understand the ambiguity of the position among people, another question asked was "In most cases, when you introduce yourself as an instructional designer, what exactly do people think of you?" See Figure 2 for the answers to this question.

Figure 2. What people think of instructional designers



According to the survey, 52% of the instructional designers surveyed responded that most people they introduce themselves to are not aware of what instructional design entails. Once they introduce themselves as an instructional designer, most claimed that people think of them as a "tech" person or an instructor, as shown in Figure 2.

According to Reiser (2001a), instructional design was not recognized as its own field until the 1960s, and its relative novelty leaves many instructional designers shrouded in obscurity. As a result, the role of an instructional designer is vague. The poorly informed perceptions of instructional designers could pose challenges to their identities; in some cases, the unclear roles may negatively impact the status of instructional designers in the workplace. A significant amount of literature in the field of instructional design has raised and discussed the questions and concerns about "who we are" and "what we do as professionals" (Cox & Osguthorpe, 2003; Gibbons, 2003; Gibby et al., 2002; Rowland, 1992; Schwier et al., 2006). The results of our survey confirm that these questions are still unanswered and that the role of an instructional designer is still not well defined.

While instructional designers are still struggling with their identity and job titles, examining the nature of our actual practice has become another interesting question to explore in our field. Recent researchers have taken

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different approaches to respond to this question; some focus on "how instructional designers practice" (Cox & Osguthorpe, 2003; Gibbons, 2003; Rowland, 1992) and others focus on "why they practice" (Schwier et al., 2006).

Identifying different titles such as instructional designers, technology coordinators, educational technology specialist, curriculum consultant, training managers, educational researchers, university professors, advisors, and consultants, Schwier et al. (2006) demonstrate that instructional designers' primary concern should not be their identity. They emphasize that instructional designers have multiple identities, multiple roles, and are involved in a multitude of activities. They warn instructional designers to "avoid the 'tickytacky' nature of rigidly imposed standard solutions and approaches, as Malvina Reynolds reminds us" (Schwier et al., 2006, p. 15).

In their research, which clearly focuses on why instructional designers practice rather than how they practice, Schwier et al. (2006) interviewed 25 instructional designers, mostly from Canada, and found that instructional designers may be acting as agents of social change more than they realize. They explain the confusion about why people come to instructional designers only as an afterthought as being because the understanding of instructional designers "grand purpose" (p. 4) is not shared and instructional designers see themselves as just key participants rather than leaders.

Inouye, Merrill, and Swan (2005) invite the discipline and its profession to consider "help" (p. 14) as a new alternative for the central concern of IDT. They further explain that having help at the center of our profession affects what we are and what we do and know as professionals.

In a recent publication, Yusop and Correia (2012) gave instructional design and its nature a new perspective by introducing instructional designers as civic-minded professionals. They contended that instructional designers contribute to positive social change through their design work and by engaging in social relationships and communications with clients who require their services.

In the preceding paragraphs, we have explored and answered the identity and nature of our practice questions by offering a synthesis of the variety of relevant literature in existence.

B. Training for the Job vs the Real-World Situation

There seems to be a consensus among professionals in this field that there is a discrepancy between the way instructional design is taught and is practiced in real-world situations. A significant amount of recent instructional design literature indicates differences in competency requirements as well as positions in various sectors and workplaces with respect to the organizational culture (Cox & Osguthorpe, 2003; Larson & Lockee, 2009). Larson and Lockee (2009) give an example that skills such as gap analysis and cost–benefit analysis are not seen commonly in job advertisements for higher education positions.

To respond to these differences, many IDT professionals and faculty have emphasized the inclusion of real-world, relevant, and authentic experience in different workplace environments in their programs and training. Flexibility, workplace cultural preparation, internships, and assistantships were considered as other techniques and strategies to be offered in these programs to get instructional designers ready for real-world situations (Larson & Lockee, 2009, p. 16).

While instructional designers have been concerned with catching up with technology, they seem to have forgotten about the main purpose of their profession. Yusop and Correia (2012) stress how recent publications support the idea that most current training prepares designers to be technically competent, which undermines their transformative power to initiate social change. They explain that recent approaches are also model-centric

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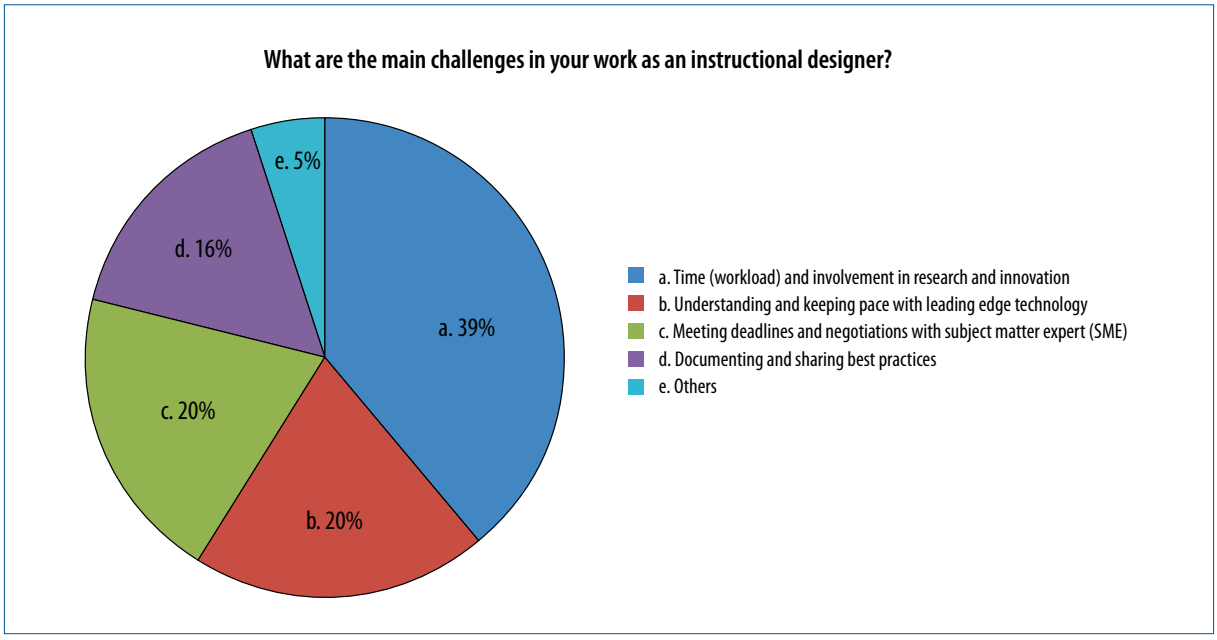
(Gibbons, 2003) and so fail to address the broader scope of instructional design knowledge. They stress that designers should be trained to be active contributors in improving public life or the civic aspect of their profession. Therefore, they propose applying civic professionalism in IDT training to prepare instructional designers to be socially aware and technically competent in performing their job. They introduce a new conceptual framework to the field called the civic-minded instructional design framework by adapting Kaufman's organizational elements model to explain three levels of organizational planning. Within this framework, they explain that a professional civic-minded instructional designer functions at three different context levels: micro, macro, and mega. They also identify four major characteristics of a civic-minded instructional designer, building on Hatcher's categorization of characteristics of a civic-minded professional (Yusop & Correia, 2012, p. 186). These major components are belief, knowledge, skills, and dispositions. They conclude that a lack of focus on educating designers to be active contributors to improving public life is evident, and they call upon educators and academics to include and emphasize the civic aspect of the IDT profession in their training.

The literature discussed above has stressed the social and civic-related skills of this profession, which needs to improve every day as society evolves and clients' demands change. Many educators in the field have emphasized how instructional designers should develop themselves professionally so that they can confidently respond to design challenges. Cheong et al. (2006), for example, encourage life-long learning habits for instructional designers. While the importance of ongoing professional development for designers is evident, there are different views and discussions on the topic. In reality, professional development does not occur regularly. Cheong et al. (2006) identify two reasons that explain why the effort of professional development is less than ideal for instructional designers. One is the lack of priority given to professional development at an organization level, and the other is budget and funding.

To explore professional development and designers' challenges, we asked the question in our survey, "What are the main challenges in your work as an instructional designer?" More than 20% of the respondents considered workload/time as one of the main challenges holding them back from being more involved in innovation and research.

Figure 3. Main challenges of instructional designers



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In addition to the two reasons identified by Cheong et al. (2006), we argue that individual workloads as well as departmental visions and priorities are also affecting the professional development of designers. The results of our survey support the idea that workload is one of the challenges that might distance designers from proper professional development. Our own experiences as instructional designers practicing in the field for more than 10 years also indicate that, in some cases, despite having a professional development plan, our training and professional development can go off track/plan because of departments' priorities.

Discussion and Conclusions

Instructional design is a dynamic and fluid field. Its relative infancy as a recognized and distinct area of study and application even makes it amorphous at times. This paper explored the challenges that stem from this status. The ongoing shifts and evolution of the field force instructional designers to constantly adapt and evolve with it. This is a challenge in itself, but more importantly, it breeds further issues of identity-related uncertainties, inconsistent industry standards, and maintenance of mastery in one's field. These topics should be addressed in both a short-term and a long-term manner to optimize the instructional designer's role. In the short term, the main requirement is mainly to act immediately on the rapid growth and development of the field, while in the long term, progress must be continually maintained in an ever-changing role.

One of the biggest themes discussed here was "a lack of consistency". A lack of consistency in the expectations and identity of instructional designers makes it extremely difficult to attain consistency in industry standards. This, of course, breeds uncertainty as to how training can be standardized and practical; as a result of this lack of consistency, many instructional designers may feel confused as to how they can best perform their role in the workplace. Moreover, the position requires constant training and professional development; however, due to lack of time, heavy workload and other factors, designers may not be able to get adequate training.

Due to the evolving nature of this field, standardizing training and encouraging professional development are not simple tasks. How can designers be sufficiently trained to adapt to a non-static landscape while maintaining the depth of knowledge and expertise to make valuable contributions in practice? Professional development needs continuous collaboration to be as dynamic as the domain of instructional design is, with emphasis on constant analysis and refinement. Professional development needs to prepare designers not for a single role but a multitude of roles. Preparing instructional designers for their work should be aligned with the nature of their work, which is innovative and never stagnant. Creating a community of practice might be a simple solution to designers' challenges in an institution. We, along with other instructional designers at the University of British Columbia, have developed a community of practice to support each other in the field of instructional design and practice. The community members meet every six weeks to discuss and resolve a design challenge as a team, share best practices, discusses recent instructional design literature and innovations, explore new technologies and tools, and we invite guest speakers. This community and system of collaboration allows for the enhancement of our professional development and is a good opportunity to discuss our challenges and resolve them as a team. However, further research on whether a community of practice actually advances instructional designers' professional development is needed.

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Learning Analytics: Intelligent Decision Support Systems for Learning Environments

Relationship between hours spent on the Internet and Web 2.0 in Higher Education

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Abstract

This article analyses the relationship between the number of hours spent by university students on the Internet and their attitude, training, use, impact and perception of difficulties in Web 2.0 integration, as well as their knowledge and use of Web 2.0 tools in Higher Education. To this end, we used a Likert scale applied to a sample of 403 students from the University of Huelva (UHU), Spain. To test the hypothesis, we conducted a one-way ANOVA with post hoc comparisons. The results obtained partially confirmed the general hypothesis. The greatest differences were found in the factors of impact and use of Web 2.0 tools, whereas the least differences were found in the factors of attitude, training, difficulties and knowledge of Web 2.0 tools.

Keywords

ICTs, Internet, Web 2.0, training, attitude, use, impact, university education

Relación entre horas dedicadas a internet y web 2.0 en educación universitaria

Resumen

El presente artículo analiza la relación existente entre el número de horas diarias que el alumnado universitario dedica a internet y la actitud, formación, uso, impacto, percepción de dificultades de la integración de la web 2.0, así como el conocimiento y uso de herramientas de la web 2.0 en educación universitaria. Para ello hemos usado una escala tipo Likert aplicada a una muestra de 403 alumnos de la Universidad de Huelva. Para contrastar la hipótesis realizamos una ANOVA de un factor con comparaciones post hoc. *Los resultados obtenidos permiten confirmar parcialmente la hipótesis general. Las diferencias mayores se observan en los factores de impacto y uso de herramientas de la web 2.0, mientras que las diferencias menores se observan en los factores de actitud, formación, dificultades y conocimiento de herramientas de la web 2.0.*

Palabras clave

TIC, internet, web 2.0, formación, actitud, uso, impacto, educación universitaria

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Introduction

In recent years, there has been a dramatic increase in the utilisation of information and communication technologies (ICTs). The use of the Internet in particular has become normalised as part of everyday human activity. An increasing number of people now use the Internet to engage in activities which until recently took place in real life (Casas, Ruiz-Olivares, & Ortega-Ruiz, 2012). There is currently no conception of learning that does not include ICTs and the Internet. Another step in this development of connectivity is Web 2.0, which enables us to develop new virtual education based on tools for common creation, distributed authoring and virtual interaction in networks (Aguirre & Manasía, 2009, p. 321).

Many research works have focused on studying this phenomenon, highlighting a series of factors which appear to be relevant to Web 2.0 integration in education: training is one of the main obstacles hindering the use of ICTs in education, as the training of teachers and students is considered essential (Hinojo & Fernández, 2002; Ruiz, Rubia, Martínez, & Fernández, 2010). Training in ICTs and their use by university teaching staff has been the subject of research and reflection in recent years (Alba, 2005; Alba & Carballo, 2005; Area, 2004; Cabero, 2014; Sánchez & Mayor, 2006; Tejedor, García, & Prada, 2009).

The second factor is the attitudes towards ICTs. Most studies analyse the differences between attitudes towards new technological resources and their use (Boza, Tirado, & Guzmán, 2010; Cavas-Bulent, Cavas-Pinar, Karaoglan, & Kisla, 2009; Martínez, Amenabar, & Lareki, 2011).

The third factor is the use of ICTs. Research highlights their usefulness as a space for storage and dissemination of documents, evidencing the application of a pedagogical model that does not significantly add anything to the technological systems, as virtual educational uses are still approached with traditional parameters (Suárez, 2009). But they can also become a new educational scenario, characterised by a virtual representation of the teaching/learning process and a restructuring of the usual way of working in education (Díez, 2012). Pérez Ríos (2003) or Sangrà and González (2004) considered the use of ICTs in Higher Education as an appropriate means to improve the educational quality of their programmes.

The fourth factor is the impact of Web 2.0 on teaching-learning processes, described in the works of Redecker, Ala-Mutka, Bacigahpo, Ferrari, and Punie (2009) and Dabbagh and Reo (2011). They emphasise the use of Web 2.0 as a dominant force for action in Higher Education that promotes significant changes, providing new tools and novel, more cost-effective formats for knowledge, as well as personalised learning experiences. However, the way an institution incorporates Web 2.0 into existing processes will determine the positive impact of this innovation.

The fifth and last factor is the difficulties or challenges faced in Web 2.0 integration, mainly highlighting lack of confidence, lack of competence and negative attitudes towards change (Albirini, 2006; Ertmer, 2005). The British Educational Communications and Technology Agency (BECTA, 2004) points out the resistance to change and the negative attitude held regarding the possible use of these technologies to improve teaching and learning. Different studies also underscore the lack of time (BECTA, 2004; Osborne & Hennessy, 2003), lack of training (Cuadrado, 2008; Toprakci, 2006; Valdes, Angulo, Urías, García, & Mortis, 2011; Ballesteros, Cabero, Llorente, & Morales, 2010) and the difficulties of access (BECTA, 2004).

Finally, a review of research on Web 2.0 tools used in teaching-learning activities highlighted the role of wikis, blogs, forums, podcasts, Moodle and Webquest as aids in collaborative learning, as well as in change and innovation (Garay, Luján, & Etxebarría, 2013; Díez, 2012).

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However, the scarcity of studies linking the hours spent on the Internet and Web 2.0 in university students justifies the interest of this research, whose initial hypothesis is that students that spend more time on the Internet are positively differentiated from those who spend fewer hours in terms of their attitude, training, impact, perception of difficulties, knowledge and use of Web 2.0 in education.

Method

Participants

The population under study is taking degree courses in Educational Psychology, Psychology, Social Education, Early Childhood Education, Primary Education, Music Education, Special Education, Foreign Language Teaching, Industrial Relations and Nursing at the University of Huelva (UHU), Spain. The random cluster sample used ensures adequate representation and consists of 403 students, with a confidence level of 95.5% and estimated sampling error of 4.8%, of which 172 are men and 231 are women, with a mean age of 23.02 years and an average of 3.96 hours spent on the Internet daily.

Instrument and variables

For data collection, a Likert scale with values from 1 to 7 was used, consisting of the following factors: attitude, training, use, impact and difficulties of Web 2.0 in Higher Education, knowledge and use of Web 2.0 tools, which had been previously validated (Boza & Conde, 2015).

Data analysis

To test the hypothesis, we carried out an ANOVA 1x3. To this end, we proceeded to categorise the variable *daily hours of Internet use* into three user groups based on the mean (3.96) plus/minus a standard deviation (2.6), resulting in a low-use group (1-2 hours), a medium-use group (3-6 hours) and a high-use group (7 or more hours). Next, post hoc comparisons were drawn using the Bonferroni or Tamhane tests based on assumed equal variances or not, respectively, analysed by Levene's test.

Results

Below we present a breakdown of the results by factor, first noting the sub-hypothesis to be tested:

- H1: Students who spend more hours on the Internet are positively differentiated from those who spend fewer hours in their attitude towards Web 2.0 integration in education.

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Table 1. Attitude towards Web 2.0 and hours of Internet use (* = p <0.05; ** = p <0.01; *** = p <0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
ATTITUDE TO WEB 2.0	A5. Tool for quality education	5.17	1.47	5.17	1.18	4.69	1.79	3.63*	0.00	-0.47	-0.47
	A6. A passing fad	2.95	1.88	3.13	1.62	2.82	1.43	1.10	0.18	-0.12	-0.30
	A7. Younger teachers are more predisposed	5.65	5.90	5.30	1.32	5.44	1.32	0.40	-0.34	-0.21	0.13
	A8. Attractive and novel for students	5.52	1.13	5.32	1.19	5.21	1.48	1.67	-0.20	-0.31	-0.11
	A9. Easier work	5.06	1.22	5.15	1.32	4.85	1.69	1.39	0.08	-0.21	-0.30
	A10. Teachers reluctant due to lack of knowledge	5.14	1.52	4.93	1.41	4.87	1.55	0.99	-0.20	-0.27	-0.06
	A11. Helps personalise education	4.94	1.47	4.55	1.33	4.49	1.48	3.41*	-0.38	-0.45	-0.06
	A12. Teachers' positive attitude towards use	4.50	1.35	4.37	1.38	4.47	1.50	0.40	-0.13	-0.03	0.10

Overall, the hypothesis was rejected. No significant differences were found in attitude towards Web 2.0 in any of the following indicators: tool for quality education; a passing fad; younger teachers are more predisposed; attractive and novel for students; easier work; teachers reluctant due to lack of knowledge; or teachers' positive attitude towards use. Significant differences were found in only two of the eight indicators evaluated. Students who use the Internet more were also more likely to view Web 2.0 as a tool for quality education. In contrast, those spending less time on the Internet were more likely to think that Web 2.0 helps personalise education.

- H2: Students who spend more hours on the Internet are positively differentiated from those who spend fewer hours browsing in their attitude towards training for Web 2.0 integration in education.

Table 2. Training in Web 2.0 and hours of Internet use (* = p <0.05; ** = p <0.01; *** = p <0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
TRAINING	T13. Known by teachers	4.34	1.51	4.21	1.58	3.79	1.66	2.90	-0.12	-0.54	-0.41
	T14. Teachers are suitably trained	3.77	1.54	3.69	1.46	3.71	1.34	0.10	-0.07	-0.06	0.01
	T15. Training more technical than didactic	4.38	1.49	4.35	1.58	4.14	1.62	0.62	-0.03	-0.24	-0.20
	T16. Students have received sufficient training	3.76	1.54	3.66	1.49	3.49	1.68	0.72	-0.10	-0.27	-0.16
	T17. Teacher training comes from their experiences	4.58	1.67	4.43	1.49	4.64	1.83	0.60	-0.15	0.05	0.20
	T18. A teacher training plan is necessary	5.22	1.55	5.33	1.40	5.51	1.48	0.92	0.10	0.29	0.18
	T19. Lack of motivation in teaching	4.72	1.68	4.98	1.41	5.37	2.55	3.18*	0.26	0.65*	0.39
	T20. Training courses are the way to learn	4.74	1.53	4.78	1.36	4.35	1.71	2.57	0.04	-0.39	-0.43
	T21. Students have clear knowledge	3.35	1.49	3.77	1.62	3.14	1.58	4.92**	0.42	-0.21	-0.63*

Overall, the hypothesis was rejected. No significant differences were found in training in Web 2.0 in any of the following indicators: known by teachers; teachers are suitably trained; training more technical than didactic; students have received sufficient training; teacher training comes from their experiences; a teacher training plan is necessary; or training courses are the way to learn. The only differentiation was in students who spend more time

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on the Internet believing that there is a lack of motivation in teaching and that, in the medium-use group, students have clear knowledge.

- H3: Students who spend more time on the Internet differ in their assessment of the use of Web 2.0 in education compared to students who spend fewer hours online.

Table 3. Use of Web 2.0 and hours of Internet use (* = p <0.05; ** = p <0.01; *** = p <0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
USE	U22. Web 2.0 is limited to creation of digital materials	4.05	1.90	4.38	6.61	4.17	1.81	0.33	0.32	0.11	-0.21
	U23. Complement to teaching	4.68	1.75	4.74	1.19	5.01	1.45	1.41	0.05	0.33	0.27
	U24. Teachers use Web 2.0 to post information	5.14	1.56	5.31	1.38	5.08	1.64	0.91	0.17	-0.06	-0.23
	U25. Students handle Web 2.0 easily	4.58	1.52	4.74	1.49	4.77	1.61	0.48	0.15	0.18	0.02
	U26. Teachers use Web 2.0 in their teaching	4.55	1.50	4.50	1.46	4.46	1.58	0.16	-0.04	-0.12	-0.07
	U27. Use of Web 2.0 has more advantages than drawbacks	5.27	1.42	5.04	1.26	4.83	1.70	2.35	-0.23	-0.44	-0.20

The hypothesis was rejected. No significant differences were found between them in any of the uses of Web 2.0 analysed: Web 2.0 is limited to creation of digital materials; complement to teaching; teachers use Web 2.0 to post information; students handle Web 2.0 easily; teachers use Web 2.0 in their teaching; or use of Web 2.0 has more advantages than drawbacks.

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- H4: Students who spend more time online estimate that Web 2.0 integration has greater impact than students who spend fewer hours on the Internet.

Table 4. Impact of Web 2.0 and hours of Internet use (* = p <0.05; ** = p <0.01; *** = p <0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
IMPACT	I28. Brings about change in teaching practice	5.00	1.40	4.97	1.28	5.01	1.59	0.03	-0.02	0.01	0.04
	I29. Major impact on social relations	5.11	1.42	5.18	1.44	4.95	1.78	0.69	0.07	-0.15	-0.23
	I30. Favours collaborative learning experiences	5.42	1.14	5.07	1.28	4.68	1.55	7.60**	-0.35*	-0.74**	-0.39
	I31. Improves student-teacher communication	4.99	1.51	4.94	1.35	4.26	1.61	7.40**	-0.04	-0.73*	-0.68*
	I32. Students assume a more active role in learning	5.14	1.40	4.81	1.40	4.49	1.59	4.86**	-0.33	-0.65*	-0.31
	I33. Causes impoverishment of written expression	4.65	1.94	4.94	1.64	4.92	1.81	1.08	0.29	0.27	-0.01
	I34. Improves academic performance	4.24	1.39	4.32	1.36	4.04	1.40	1.19	0.082	-0.20	-0.28
	I35. Provides only superficial learning	3.39	1.66	3.95	1.58	4.10	1.62	5.92**	0.56*	0.71*	0.15
	I36. Improves interaction among teachers	4.46	1.57	4.36	1.34	4.03	1.72	2.11	-0.09	-0.43	-0.33
	I37. Improves subject methodology	4.68	1.39	4.85	1.24	4.28	1.49	5.20**	-0.17	-0.57*	-0.39
	I38. Generates more virtual tutorials	4.86	1.69	4.89	1.40	4.29	1.83	4.29*	0.28	-0.56	-0.59*
	I39. Dehumanises the student-teacher relationship	3.58	1.75	3.98	1.63	4.28	1.78	4.20*	0.40	0.70*	0.30
	I40. Encourages student individuality	3.84	1.67	4.17	1.60	4.44	1.53	3.29*	0.32	0.59*	0.26
	I41. Foments autonomous student-centred learning	4.96	1.44	4.67	1.38	4.90	1.77	1.65	-0.29	-0.05	0.23
	I42. Generates greater commitment in students	4.96	1.52	4.65	1.30	4.35	1.74	4.09*	-0.31	-0.61*	-0.30

The data do not allow us to confirm or reject the hypothesis overall, but significant differences were found between some students and others. The analysis points to the perception of positive impacts by students that use the Internet less, and negative impacts by those using the Internet more. Students who use the Internet more are differentiated by believing that the impact of Web 2.0 provides only superficial learning; dehumanises the teacher-student relationship and encourages student individuality. In contrast, students who use the Internet less are distinguished by considering that the impact of Web 2.0 favours collaborative learning experiences; improves student-teacher communication; improves subject methodology; generates more virtual tutorials; students assume a more active role; and generates greater commitment in students.

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- H5: Students who spend more time online perceive more difficulties in Web 2.0 integration than students who spend fewer hours on the Internet.

Table 5. Hours of Internet use and difficulties with Web 2.0 (* = p<0.05; ** = p<0.01; *** = p<0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
DIFFICULTIES	D43. Teachers find it hard to adapt	4.58	1.64	4.48	1.58	4.91	1.45	2.15	-0.10	0.32	0.43
	D44. An extra workload for teachers	4.43	1.77	4.32	1.67	4.82	1.56	2.52	-0.11	0.38	0.50
	D45. Technical issues a drawback	5.42	1.54	5.00	1.57	5.63	1.35	5.90**	-0.41	0.21	0.62*

The hypothesis was partially confirmed. Students who spend many hours on the Internet are differentiated by tending to consider technical issues a drawback. They are also more likely to perceive as difficulties that teachers find it hard to adapt and that Web 2.0 involves an extra workload for teachers, although these differences are not significant.

- H6: Students who spend more time online have more knowledge of Web 2.0 tools than students who spend fewer hours on the Internet.

Table 6. Hours of Internet use and knowledge of Web 2.0 (* = p<0.05; ** = p<0.01; *** = p<0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
KNOWLEDGE OF TOOLS	Platforms (KNO)	3.98	1.88	4.29	1.86	4.22	1.97	0.96	0.30	0.23	-0.06
	Blogs (KNO)	4.02	1.75	4.29	1.72	4.51	1.82	1.86	0.27	0.48	0.21
	Wikis (KNO)	3.49	1.91	3.95	1.92	4.58	1.90	7.48**	0.46	10.09**	0.63*
	Social networks (KNO)	5.76	1.59	6.00	1.30	6.03	1.46	1.22	0.23	0.26	0.02
	Forums (KNO)	5.04	1.61	5.37	1.35	5.55	1.72	2.94	0.32	0.50	0.17
	Chats (KNO)	5.08	1.94	5.49	1.55	5.70	1.71	3.47*	0.40	0.62*	0.21
	Virtual tutorials (KNO)	4.68	1.92	4.65	1.73	4.88	1.88	0.48	-0.02	0.20	0.23
	Videoconferences (KNO)	4.35	1.97	4.33	1.87	4.94	1.90	3.08*	-0.02	0.58	0.60
	Video sharing (KNO)	4.96	1.93	5.20	1.65	5.64	1.65	3.44*	0.23	0.67*	0.43
	Photo sharing (KNO)	5.45	1.67	5.63	1.44	5.61	1.63	0.52	0.18	0.16	-0.01
	Podcasts (KNO)	3.84	2.01	3.92	2.00	4.18	2.08	0.68	0.08	0.34	0.25
	Social markers (KNO)	4.36	2.12	4.94	1.70	5.41	1.87	7.40**	0.58*	10.04**	0.46

The hypothesis was partially confirmed (4 out of 12 tools) along with the overall trend of the results. Students who make more use of the Internet are also more aware of Web 2.0 tools, especially wikis, chats, videoconferences, video sharing and social markers. They also know more about the rest of the tools (platforms, blogs, social networks, forums, virtual tutorials, photo sharing and podcasts), but the differences were not significant.

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- H7: Students who spend more time online use Web 2.0 tools more than students who spend fewer hours on the Internet.

Table 7. Internet hours and use of Web 2.0 tools (* = p<0.05; ** = p<0.01; *** = p<0.001)

FACTOR	ITEM	INTERNET HOURS						ANOVA	MEAN DIFFERENCES		
		1-2 h (low) N = 113		3-6 h (medium) N = 212		7 or more h (high) N = 78		F	Medium/ low	High/ low	High/ medium
		M	SD	M	SD	M	SD				
USE OF TOOLS	Platforms (USE)	3.87	1.90	4.01	1.95	3.86	1.97	0.30	0.14	-0.00	-0.15
	Blogs (USE)	3.26	1.87	3.50	1.74	3.94	1.98	3.15*	0.24	0.67*	0.43
	Wikis (USE)	3.17	2.09	3.48	2.06	4.09	2.02	4.60*	0.31	0.92**	0.61
	Social networking (USE)	5.60	1.78	5.99	1.42	5.91	1.62	2.29	0.38	0.30	-0.08
	Forums (USE)	4.44	1.84	4.88	1.55	5.04	1.92	3.38*	0.43	0.59	0.16
	Chats (USE)	4.41	2.16	5.00	1.80	4.92	2.08	3.37*	0.58*	0.51	-0.07
	Virtual tutorials (USE)	3.57	1.94	3.95	1.75	3.87	2.08	1.52	0.38	0.30	-0.07
	Videoconferencing (USE)	3.06	1.94	3.25	1.89	3.78	2.28	3.17*	0.18	0.72	0.53
	Video sharing (USE)	4.16	2.11	4.86	1.54	5.12	1.86	8.14***	0.70**	0.95**	0.23
	Photo sharing (USE)	4.92	1.88	5.45	1.48	5.09	2.01	3.88*	0.53*	0.17	-0.36
	Podcasting (USE)	3.04	1.85	3.37	1.98	3.55	2.19	1.72	0.33	0.51	0.18
	Social markers (USE)	3.84	2.00	4.46	1.79	5.05	1.97	9.57***	0.61*	10.21**	0.59

The hypothesis was broadly confirmed (8 out of 12 tools). This trend was also confirmed in the rest of the tools. Students who spend more time online also tend to use more tools such as blogs, wikis, forums, chats, videoconferencing, video sharing and social markers. In addition, students who are medium-level Internet users are also more likely to use photo sharing tools. There were no significant differences in the use of distance training platforms, social networking, virtual tutorials or use of podcasts, but the trend was the same for these three latter tools.

Discussion and conclusions

Regarding the general hypothesis that students who spend more time on the Internet are positively differentiated from those who spend fewer hours in terms of their attitude, training, impact, perceived difficulties, knowledge and use of Web 2.0 in education, we may conclude that:

1. Major differences are observed in the factors: impact and use of web 2.0 tools, whereas minor differences are observed in the factors: attitude, training, difficulties and knowledge of Web 2.0 tools.
2. We found no differences, or very few, in attitude towards, training in, evaluation of use of and perception of difficulties regarding Web 2.0 integration in university education.
3. Students who spend more time on the Internet differ from those who spend fewer hours particularly in their consideration of Web 2.0 in education as lacking in teacher motivation, that the learning it provides is superficial, that it dehumanises teacher-student relations and that it encourages student individuality rather than socialisation. They are also more familiar with tools such as wikis, chats, videoconferencing, video sharing and social markers. Finally, they are also more assiduous users of tools like blogs, wikis, forums, chats, videoconferences, video sharing, photo sharing and social markers.

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4. In particular, students who spend fewer hours online differ from those that dedicate more time in their appraisal of Web 2.0 as an instrument for quality education. They also think that it helps personalise education, that students are familiar with it, and that it favours collaborative learning experiences, improves student-teacher communication, encourages the active role and commitment of students, improves course methodologies and generates more virtual tutorials. In general, they are aware of and use Web 2.0 to a lesser extent.
5. We may therefore say that overall the general hypothesis was partially confirmed.

In this sense, the results of our research are similar to those of other studies, such as Aguirre and Manasía (2009), Echeburúa and Corral (2010) and Ben and Dahmani (2008), which highlight the potential effects of Internet use in the medium and long term and the multitude of possibilities it provides. It is striking that students who spend more time using the Internet highlight the negative aspects of Web 2.0. Works such as those by Redecker et al. (2009) and Dabbagh and Reo (2011), analysing the impact of Web 2.0 in Higher Education institutions, show that the way the institution incorporates Web 2.0 into existing processes will determine the positive impact of this innovation.

In terms of the level of use and knowledge of tools, the outcomes are consistent with those of other studies, for example by Martínez et al. (2011), who reported a high level of awareness and use of the most popular Web 2.0 tools, including e-mail, the Internet and browsing, as well as basic use of IT applications.

On the other hand, students who spend less time online were more likely to emphasise the positive aspects of Web 2.0 use, although they are less familiar with the tools and tend to use them less. This coincides with the research carried out by Alba and Carballo (2005), in which the students perceived the advantages of Web 2.0 in day-to-day academic practice, although their knowledge and use of Web 2.0 tools was lower.

From the data analysed above, our interpretation is that university training in Web 2.0 may not be the result of institutional measures, but instead of personal interest and self-learning (Antón & Zubillaga del Río, 2008).

To this end, it would be interesting to design training adapted to characteristics, needs and expectations, identifying preferences in the usefulness of Web 2.0.

The complexity of the subject calls for further research, taking into account other types of variables, such as age, gender and educational qualifications, which would allow the design of training plans to be tailored to the utility and features of the different degree courses.

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Learning Analytics: Intelligent Decision Support Systems for Learning Environments

Educational Data Mining and Learning Analytics: differences, similarities, and time evolution

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Abstract

Technological progress in recent decades has enabled people to learn in different ways. Universities now have more educational models to choose from, i.e., b-learning and e-learning. Despite the increasing opportunities for students and instructors, online learning also brings challenges due to the absence of direct human contact. Online environments allow the generation of large amounts of data related to learning/teaching processes, which offers the possibility of extracting valuable information that may be employed to improve students' performance. In this paper, we aim to review the similarities and differences between Educational Data Mining and Learning Analytics, two relatively new and increasingly popular fields of research concerned with the collection, analysis, and interpretation of educational data. Their origins, goals, differences, similarities, time evolution, and challenges are addressed, as are their relationship with Big Data and MOOCs.

Keywords

Online Learning, Educational Data Mining, Learning Analytics, Big Data

Minería de datos educativos y análisis de datos sobre aprendizaje: diferencias, parecidos y evolución en el tiempo

Resumen

*El progreso tecnológico de las últimas décadas ha hecho posible una diversidad de formas de aprendizaje. Hoy en día las universidades ofrecen múltiples modelos de enseñanza entre los que poder elegir, por ejemplo aprendizaje mixto (*b-learning*) o aprendizaje electrónico. Aunque cada vez son más numerosas las oportunidades para alumnos y profesores, el aprendizaje en línea también plantea dificultades debidas a la falta de contacto humano directo. Los entornos en línea permiten generar grandes cantidades de datos relacionados con los procesos de enseñanza-aprendizaje, de los que se puede extraer una valiosa información que se puede usar para mejorar el desempeño del alumnado. En este trabajo queremos estudiar los parecidos y diferencias entre la minería de datos educativos y el análisis de datos sobre aprendizaje, dos campos de investigación relativamente nuevos y crecientemente populares relacionados con la recogida, el análisis y la interpretación de datos educativos. Trataremos su origen, objetivos, diferencias y parecidos, evolución en el tiempo y retos a los que se enfrentan, así como su relación con los macrodatos y los cursos en línea abiertos y masivos (MOOC).*

Palabras clave

aprendizaje en línea, minería de datos educativos, análisis de datos sobre aprendizaje, macrodatos

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1. Introduction

In the traditional educational model, instructors have the principal role in the learning process. Students are assumed to have basic knowledge and skills, while instructors are expected to share their knowledge and experience. Learning is tested by means of proctored exams and homework. Before the Internet era, there were several types of distance-education models based on TV programmes, manuals or recorded audios/videos. Typically, instructors were available to solve doubts by phone or mail. Although they allowed learning from home and presented a flexible timetable, the lack of interactivity hindered the learning process.

The Internet has dramatically changed the system, since most institutions have become interested in providing online courses. Besides the fact that they do not require large investments, these courses are not restricted to a specific geographical location or timetable, which increases the number of potential students. As a result, universities dedicated only to online education have emerged and traditional universities have expanded their offer with b-learning (hybrid classroom and online learning) and e-learning (pure online learning) courses.

As Daradoumis, Juan, Lera-López, & Faulin (2010a) state, e-learning has many more positive aspects: (a) it favours interactive communication among students, and between students and instructors; (b) it promotes continuous evaluation based on tests, and individual and collaborative activities; (c) it contributes to the development of technical skills; and (d) it helps to reduce the gap between theory and practice (e.g., Marquès, Lazaro, Juan, Vilajosana, Domingo, & Jorba, 2013). The role of the instructor is to design, organize and support learning experiences. While in the traditional model all students listen to the same lectures and complete the same homework in the same sequence and at the same pace (Bienkowski, Feng, & Means, 2012), this model promotes a more personalized learning process, in which the student has an active role. However, e-learning courses also present higher dropout rates due to the fact that distance education may create a sense of isolation in students, which can feel disconnected from the other students, the instructors and the university (Juan, Daradoumis, Faulin, & Xhafa, 2009b).

E-learning courses may be provided through Learning Management Systems (LMS) such as Moodle, Sakai and ILIAS, or Learning Platforms such as Knewton and DreamBox. A characteristic of these courses is the vast amount of data that can be collected. In addition to student's background and performance data, each action carried out (reading files, participating in forums, sending messages, or visiting recommended links, for example) leaves a digital fingerprint.

There are two fields of research devoted to analyzing this data: Educational Data Mining (EDM) and Learning Analytics (LA). Their overwhelming popularity is almost certainly due to several factors: (a) there is interest in employing a data-driven approach to make better decisions, as it is usual in business intelligence or analytics (Daradoumis, Rodríguez-Ardura, Faulin, & Martínez-López, 2010b); (b) there are powerful statistical, machine-learning and data-mining methods and techniques to search for patterns in data and construct predictive models or decision rules that can be easily adapted to educational data; (c) generating data is relatively easy, and current computer capacity allows its storage and processing; (d) because of the financial crisis and fierce competition, universities are under pressure to reduce costs and increase income by exploiting the growing educational demands from developing countries, reducing dropout rates and improving course quality.

The main goal of both EDM and LA is to extract information from educational data to support education-related decision making. Information may be oriented towards several stakeholders (Daradoumis et al., 2010a).

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Instructors may get more objective feedback to evaluate both the structure of their courses and the effectiveness of the learning process. Monitoring the students' learning process may help to rapidly spot those having difficulties in following the course, and units that generate more confusion. It can be a complex and time-consuming task without the appropriate tools (Juan, Daradoumis, Faulin, & Xhafa, 2009a). Students may receive recommendations about resources according to their performance, goals and motivations, may graphically analyze the outputs of their learning process, compare them with those of the rest of the class, and observe the performance and contributions related to collaborative activities. Managers may use information to design a better allocation of human and material resources to improve the overall quality of their academic offer. Finally, researchers may test and adapt their theories based on educational data.

Some initial similarities and differences between EDM and LA will be discussed in this paper. From a general perspective, it can be argued that EDM focuses more on techniques and methodologies, while LA deals more with applications. However, as we will see, these differences seem to be less and less noticeable as both fields evolve over time. In addition, the most significant barriers to EDM and LA applications in educational environments and a few hot research topics will be mentioned. Accordingly, the contributions of this work are: (a) to analyze the origins and particularities of these fields of research; (b) to provide an overview of the associated literature; (c) to examine how both knowledge areas have evolved in recent years and to discuss their possible convergence; and (d) to present some of the challenges and new trends, including those related with Big Data and MOOCs.

The rest of this paper is organized as follows: Section 2 and 3 offer an introduction to EDM and LA, respectively; Section 4 reviews some common methods, and Section 5 points out the main similarities and differences between these concepts; Section 6 identifies the principal issues that still need to be addressed and explores the latest lines of research; finally, general conclusions are drawn in Section 7.

2. Educational Data Mining

EDM develops and adapts statistical, machine-learning and data-mining methods to study educational data generated basically by students and instructors. Their application may help to analyze student learning processes considering their interaction with the environment (Baker, Costa, Amorim, Magalhães, & Marinho, 2012). Initially, some workshops were held at conferences on Artificial Intelligence in Education and Intelligent Tutoring Systems. The first International Conference on EDM (Baker, Barnes, & Beck, 2008) was held in 2008 in Montreal. It has been held every year since then. The most popular societies are the International Educational Data Mining Society (http://www.educationaldatamining.org/) created in 2011, and the *IEEE Task Force of Educational Data Mining* (http://datamining.it.uts.edu.au/edd/) formed in 2012.

The related literature is extensive and varied. A commonly cited report is presented in Bienkowski et al. (2012), who introduce EDM and LA and also their bases, implementation challenges and application areas. Special consideration is given to Adaptive Learning Systems, which adapt learning experiences based on model predictions. As far as we are concerned, there are three books that detail applications and methods: Romero & Ventura (2006), Romero, Ventura, Pechenizkiy, & Baker (2010), and Peña-Ayala (2014). Romero & Ventura (2010) present a survey with more than 300 references.

Applications of EDM methods comprise several steps (Figure 1). Initially, a design is planned, i.e., the main aim of the study and the required data are identified. Afterwards, the data is extracted from the appropriate educational

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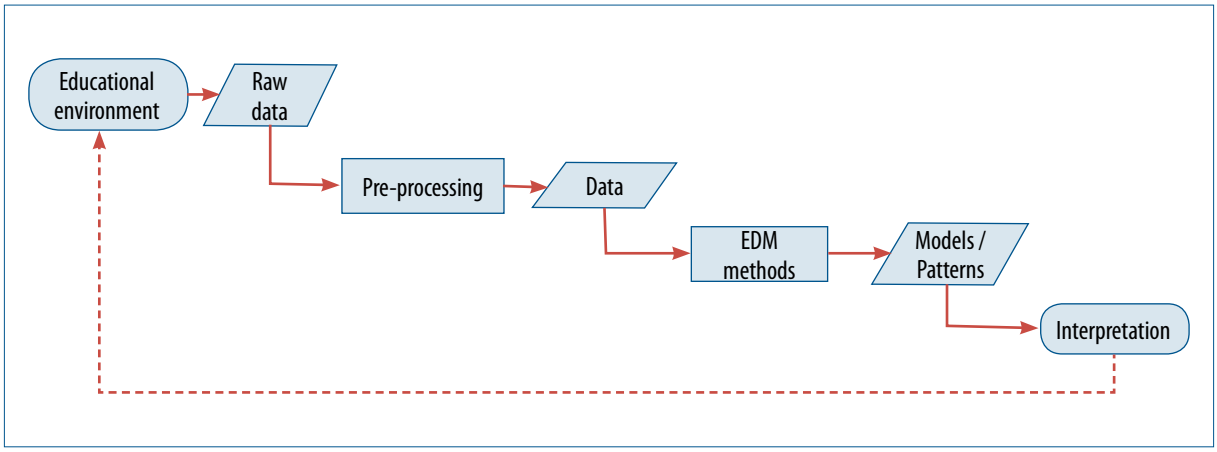
environment. Frequently, data will need to be pre-processed, since it may come from several sources or have different formats and levels of hierarchy. Models or patterns are obtained from applying EDM methods, which have to be interpreted. If the conclusions suggest applying changes to the teaching/learning process or are not conclusive (because the problem has not been adequately addressed, the raw data are small or not suitable, or the selected methods are not powerful enough), the analysis is performed again after modifying the teaching/learning process or the study design.

Figure 1. Overview of how EDM methods are applied



There are increasing numbers of EDM applications. According to Baker et al. (2012), they can be grouped into the following four categories:

1. Student modelling: student data (including knowledge, motivations, etc.) and EDM techniques may be used to design a customized learning process by modelling differences between students.
2. Modelling of the knowledge structure of the domain: methods combining psychometric modelling frameworks with space-searching algorithms are created for discovering data-based domain models.
3. Pedagogical support: efficient educational support may be identified.
4. Scientific research: applications may help to develop and test educational scientific theories and to formulate new hypotheses.

Specific applications are described in Romero & Ventura (2013): predicting student performance, scientific inquiry, providing feedback for supporting instructors, personalizing/recommending to students, creating alerts for stakeholders (in real time in the event of undesirable student behaviours), student modelling (developing and tuning cognitive models of students, which represent their skills and declarative knowledge), domain modelling, student grouping/profiling, constructing courseware, planning and scheduling (related to courses, student scheduling, resource allocation, etc.), and parameter estimation.

A huge variety of tools have been designed and implemented to deploy EDM methods. However, most of these tools include a limited subset of the existing methods, are not publicly available or have been tested only in case studies. García, Romero, Ventura, & de Castro (2011) provide a list of them and point out that they are usually too complex for instructors without a background in data mining. Besides being easy to interpret and use, tools should

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be fast, especially in monitoring learning processes, where risk of dropouts and group internal conflicts may be better addressed if instructors are alerted before they occur (Juan et al., 2009a).

While most LMSs incorporate their own tools to automatically generate customizable statistics reports of course development, these are often quite basic. For instance, Moodle (https://moodle.org/) allows several types of report to be generated: (a) logs for selected activities, students, items and periods of time; (b) live logs, which include recent activity; (c) activity reports, presenting the numbers of views of each activity in a course; (d) course participation, analyzing the actions of selected students for a given period and activity; and (e) data on activity completion. Blackboard (http://es.blackboard.com/sites/international/globalmaster/) also offers several types of report, e.g., (a) user activity overview, which displays overall system and course activity for all students; (b) user statistics, consisting of the average number of students and other users per month and per day; (c) user activity in forums; and (d) user activity in groups. Another interesting tool that can be easily employed is Google Analytics (Figure 2). It can provide information about the number of visits, pages visited, the average duration of each visit, demographics, etc. Regarding monitoring student activity and performance, Lera-López, Faulin, Juan, & Cavaller (2009) review the tools provided by Sakai, WebCT/Blackboard and Moodle.

Figure 2. Example of a Google Analytics report

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3. Learning Analytics

According to the call of the First International Conference on Learning Analytics and Knowledge (LAK) (https://tekri.athabascau.ca/analytics/), LA can be defined as the measurement, collection, analysis and reporting of data about learners and their contexts, for the purposes of understanding and optimising learning and the environments in which it occurs. The first International Conference on LAK (Long, Siemens, Conole, & Gašević, 2011) was held in 2011, also in Canada. It has been held annually since then. The most active professional society was founded in the same year: the Society for Learning Analytics Research (SoLAR) (http://www.solaresearch.org).

The book by Larusson & White (2014) is one of the main LA contributions to the literature. It includes the latest theories, findings, strategies, tools and case studies, and focuses on the following uses: (a) how to enhance student and faculty performance; (b) how to improve student understanding of course material; (c) how to assess and attend to the needs of struggling learners; (d) how to improve accuracy in grading; (e) how to allow instructors to assess and develop their own strengths; and (f) how to encourage more efficient use of resources at the institutional level.

The basic steps to test a learning/teaching process-related hypothesis are the same as those explained for EDM: an iterative process in which data is extracted from an educational environment and pre-processed before applying computational/quantitative methods in order to support stakeholders (instructors, course managers, etc.) when making decisions.

4. Common methods in EDM and LA

Most methods applicable to educational data are employed in both EDM and LA. The most popular are related to prediction, clustering and relationship mining. However, there are many more that cover a wide range of applications. The methods, their descriptions and a few examples are shown in Table 1.

Baker & Yacef (2009) study the proportion of works employing each group of methods during the period from 1995 to 2005 (using data extracted from Romero & Ventura, 2007) and from 2008 to 2009 (using data from Baker et al., 2008, and Barnes, Desmarais, Romero, & Ventura, 2009). Papers from the first period mainly involved relationship mining methods (43%) or prediction methods (28%). Human judgment or exploratory data analysis (17%) and clustering (15%) were also popular. In contrast, relationship mining in the next period slipped to 5th place (9%), while prediction methods reached 1st place (42%, papers from 2008 only). The proportion using human judgment and clustering methods did not change considerably (12% and 15%, respectively). Discovery with models gained representation (19%), since no paper from the first period used this method. Also worthy of note is the importance of item response theory, Bayesian nets and Markov decision processes (28%).

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Table 1. Common EDM-LA methods. Source: adapted from Romero & Ventura (2013)

Method	*Goal/description*	*Key applications*	*Example*
Prediction	To infer a target variable from some combination of other variables. Classification, regression and density estimation are types of prediction methods.	Predicting student performance and detecting student behaviours.	Yadav, & Pal (2012)
Clustering	To identify groups of similar observations.	Grouping similar materials or students based on their learning and interaction patterns.	Antonenko, Toy, & Niederhauser (2012)
Relationship mining	To study relationships among variables and to encode rules. Association rule mining, sequential pattern mining, correlation mining and causal data mining are the main types.	Identifying relationships in learner behaviour patterns and diagnosing student difficulties.	Kinnebrew, & Biswas (2012)
Distillation of data for human judgment	To represent data in intelligible ways using summarization, visualization and interactive interfaces.	Helping instructors to visualize and analyze the ongoing activities of the students and the use of information.	Baker, Corbett, & Wagner (2006)
Discovery with models	To employ a previously validated model of a phenomenon as a component in another analysis.	Identification of relationships among student behaviours and characteristics or contextual variables. Integration of psychometric modelling frameworks into machine-learning models.	Jeong, & Biswas (2008)
Outlier detection	To point out significantly different individuals.	Detection of students with difficulties or irregular learning processes.	Ueno (2004)
Social network analysis	To analyze the social relationships between entities in networked information.	Interpretation of the structure and relations in collaborative activities and interactions with communication tools.	Palazuelos, García-Saiz, & Zorrilla (2013)
Process mining	To obtain knowledge of the process from event logs.	Reflecting student behaviour in terms of its examination traces, consisting of a sequence of course, grade and timestamp.	Trćka, Pechenizkiy, & Aalst (2011)
Text mining	To extract high-quality information from text.	Analysing the contents of forums, chats, web pages and documents.	Tane, Schmitz, & Stumme (2004)
Knowledge tracing	To estimate student mastery of skills, employing both a cognitive model that maps a problem-solving item to the skills required, and logs of students' correct and incorrect answers as evidence of their knowledge on a particular skill.	Monitoring student knowledge over time.	Lee, & Brunskill (2012)
Nonnegative matrix factorization	To define a matrix M of positive numbers with student test outcome data that may be decomposed into two matrices: Q, which represents a matrix of items, and S, which represents student mastery of skills.	Assessment of student skills.	Desmarais (2011)

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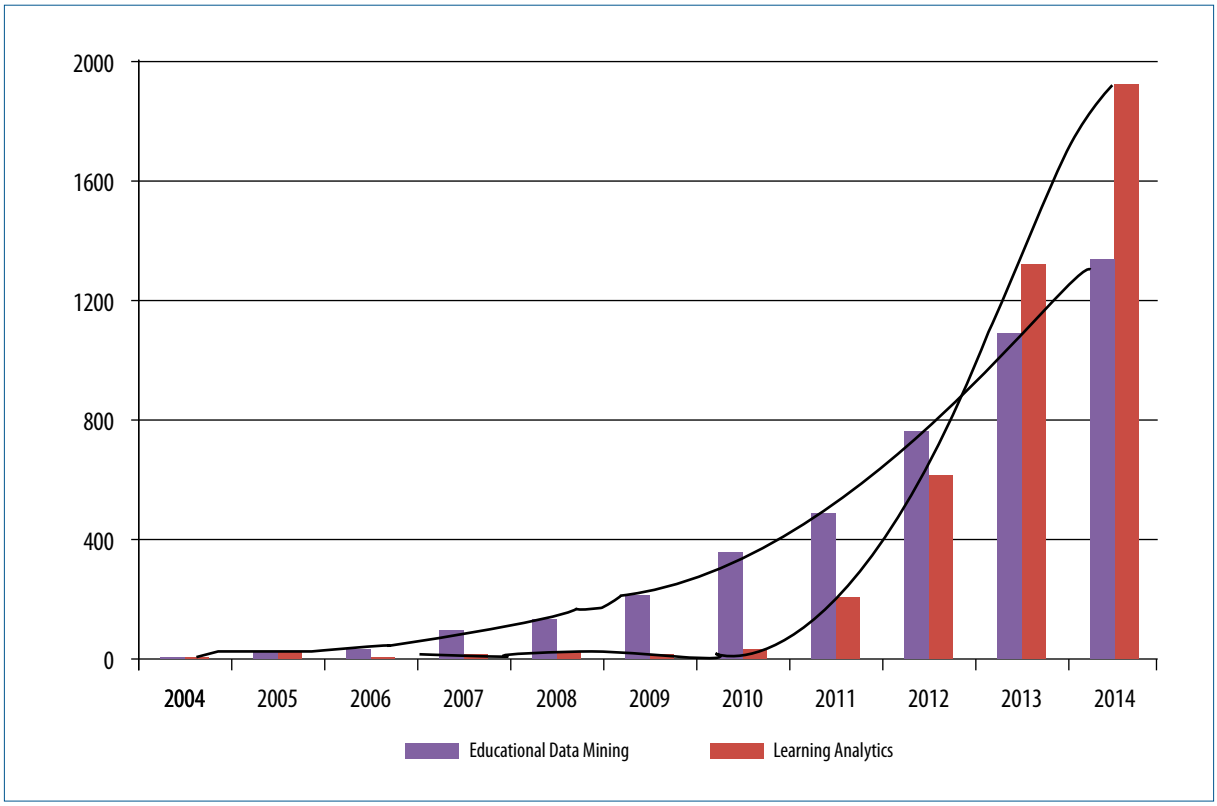
5. Similarities and differences between EDM and LA

The overlap between both fields of research is certainly considerable. Even so, some differences are highlighted in the literature. EDM and LA have the same goal: improving education quality by analysing huge amounts of data to extract useful information for stakeholders. Representative companies in other sectors, such as industry, finance or healthcare, have already introduced statistical, machine-learning and data-mining techniques to achieve better performance through decisions based on historical data. The popularity of these fields of research has been growing since the early 2010s (Figure 3), although EDM research started a few years beforehand. It is expected that these fields will continue to expand (Johnson, Adams, & Cummins, 2012), due to the potential benefits (for students, instructors, administrators, researchers and society in general) and the relevance of current research based on Big Data.

Figure 3. Evolution of EDM and LA references in Google Scholar (May, 2015)



According to Siemens & Baker (2012), it is possible to identify five key distinctions between EDM and LA. These are:

- Discovery: in EDM, researchers are interested in automated discovery, and leveraging human judgment is a tool for that; in LA it is quite the opposite, leveraging human judgement is the aim.
- Reduction and holism: EDM reduces systems to components and explores them and their relationships, while LA wants to understand whole systems.
- Origins: EDM is rooted in educational software and student modelling; in contrast, LA origins are related to the semantic web, "intelligent curriculum", outcome prediction and systemic interventions.

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- Adaption and personalization: EDM performs automated adaptation, whereas LA informs and empowers instructors and students.
- Techniques and methods: EDM employs more techniques and methods of classification, clustering, Bayesian modelling, relationship mining, discovery with models, and visualization; while LA focuses on social network analysis, sentiment analysis, influence analysis, discourse analysis, learner success prediction, concept analysis and sense-making models.

According to the above authors, these differences represent broad trends in each community and, as a consequence, they do not define the corresponding scopes. A similar idea is expressed in Baker & Inventado (2014), where it is stated that "the overlap and differences between the communities is largely organic, developing from the interests and values of specific researchers rather than reflecting a deeper philosophical split".

Bienkowski et al. (2012) consider that LA covers more disciplines than EDM does. In addition to computer science, statistics, psychology and the learning sciences, LA is related to information science and sociology. Therefore, even if the border between both fields is fuzzy and their differences are partly based on their origins and trends, they are still significant for these authors. Moreover, as upheld in Siemens & Baker (2012), the co-existence of both research communities leads to a more diverse and relevant contribution to society. Consequently, communication and competition between both should be encouraged.

6. Challenges and new trends

In spite of the high expectations and the relatively extensive literature on EDM and LA, they are relatively new fields of research and, as a result, several issues still need to be addressed. In addition, technological progress is driving us to the era of Big Data, which represents an important paradigm shift and offers multiple opportunities.

An important barrier to the implementation of EDM and LA methodologies is the lack of knowledge (Wolf, Jones, Hall, & Wise, 2014), both theoretical and practical, among a significant proportion of instructors and managers with regard to employing the required tools, correctly understand the outputs, drawing the appropriate conclusions or deciding which actions to take. In order to mitigate this problem, it is important to increase acceptance and develop a data-driven culture in educational environments (Romero & Ventura, 2013). Researchers are already helping in this transition by disseminating their results, collaborating with a high number of instructors and/or students to assess their proposals (e.g., García et al., 2011) and detailing their experiments (data, methods, etc.). As shown in this article, there are numerous tools to facilitate data analysis, but many have been implemented in small experiments. We will only be able to obtain more satisfactory and generic results by analyzing more students, courses and institutions.

Another significant barrier, discussed in Greller & Drachsler (2012), is related to ethics and personal privacy. Ethics must be taken into account in all stages, from data gathering to the interpretation of outputs and decision making, for instance, by avoiding statements that could lead to discriminatory treatments when working with gender, social status, race, home country, religious beliefs, ideology or disability. Similarly, issues related to the ownership of student data, which differ from country to country, need to be considered.

Numerous applications of EDM and LA methodologies in online environments deal with the use of Big Data in educational environments. Big Data refers to data with sizes beyond the ability of common software tools to capture, store, manage and process in a reasonable amount of time (Snijders, Matzat, & Reips, 2012). The main

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differences between Big Data and Analytics are volume, speed and variety (McAfee & Brynjolfsson, 2012). In the past, obtaining, storing and processing data was an expensive and time-consuming procedure. Consequently, most studies attempted to draw conclusions from a sample of individuals that could be generalized to a population. However, current technology enables researchers to work with much more individuals and variables, obtaining richer information and insights. It leads to faster and more robust results, which should translate into more efficient decisions. The combination of Big Data and LA constitutes a promising field for governments (e.g., Johnson, Adams, Cummins, Estrada, Freeman, & Ludgate, 2013) and universities (http://openthoughts-analytics.blogs.uoc.edu/) to explore.

Also, Massive Open Online Courses (MOOCs), typically managed by recognized instructors from prestigious universities, represent a new and prominent research topic. Besides being a marketing strategy for universities, they enable students from around the world to take modern and diverse courses for free, which helps to reduce the educational-opportunity divide associated with economic inequalities. According to Siemens (2013), the term "MOOC" is employed to refer to two different concepts: connectivist MOOCs (cMOOCs), which are based on a connectivist pedagogical model that uses freely available online resources, and edX MOOCs (xMOOCs), which replicate online the traditional model in which instructors share their knowledge and experience, and grade student assignments. The popularity of xMOOCs has been growing since 2012, when several large universities started to offer them. Coursera, edX, or Class2Go are some well-known platforms. These courses are usually characterized by a large number of enrolled students, which generates a scalability challenge (Kay, Reimann, Diebold, & Kummerfeld, 2013), very high dropout rates and very different patterns of participation (Clow, 2013). Nevertheless, several authors agree that even if a high dropout rate raises concerns about a course, it is needed to take into account two elements: (a) the first exploratory phase, where students assess the content, structure and resources, and may decide not to continue; and (b) the diverse objectives, learning styles or schedules of students. Therefore, non-completion cannot be directly interpreted as a failure or problem. The maximum potential of EDM and LA in MOOCs stems from two facts: the diversity of students and the extremely high student-instructor rate. Participants may have different origins, backgrounds, maturity, experience, education levels, language skills, objectives, needs and learning styles, among others. This, in turn, suggests the relevance of personalizing courses. However, given the student-instructor rates, this is impossible without automated systems. Despite the fact that research on this topic is just emerging and that current MOOC platforms provide limited data storage, a few interesting works on adaptive MOOCs (aMOOCs) already exist. For example, Daradoumis, Bassi, Xhafa, & Caballé (2013) propose the use of software agents to improve and personalize management, delivery and evaluation. Agents could help to redesign MOOCs for future cohorts by gathering information on usage patterns, navigation, problematic content areas, tool usage, student profiling, etc. Regarding content, learning/prediction algorithms could be applied by agents to dynamically adjust course content to suit each participant's profile. Furthermore, agents could be also employed to improve automated testing by adjusting assignment questions according to the participant's educational level. Sonwalkar (2013) describes the development of the first aMOOC platform, which is implemented using Amazon Web Services' cloud architecture. A case study of a course of molecular dynamics is analyzed. It considers different learning strategies based on five pedagogies (apprentice, incidental, inductive, deductive and discovery). The adapted learning path of each student is set at the beginning with a diagnostics quiz. As Clark (2013) critically notes, many MOOCs may be described as a set of linear sequential videos, quizzes and assessments reviewed automatically or by peers, while big companies like Google or Amazon employ algorithmic approaches to tailor searches, ads and recommend purchases. Therefore, aMOOCs are expected to become the focus of much more research attention over the coming years.

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7. Conclusions

Educational Data Mining (EDM) and Learning Analytics (LA) are both relatively new and promising fields of research that aim to improve educational experiences by helping stakeholders (instructors, students, administrators and researchers) to make better decisions using data. Their growth has been boosted by increasing computer capacity to store and analyze huge amounts of data and the availability of statistical, machine-learning and data-mining methods and techniques.

Online environments are a highly important area of application. On the one hand, they continuously generate data from a number of events such as reading files or participating in forums, with different formats and levels of hierarchy. At the same time, online courses have higher dropout rates than traditional courses. EDM and LA are mainly employed to monitor students and groups (allowing the identification of students that are likely to dropout or fail, or that are not contributing enough in collaborative activities), suggest changes in course structure and tailor learning experiences (recommending material according to motivations and skills, for instance). There is a wide variety of methods and techniques adapted from other disciplines or specially designed to analyze educational data.

Numerous similarities exist between both fields of research, such as goals, methodologies and techniques. However, there are several differences, attributable mostly to their origins and trends. The co-existence of their respective scientific communities leads to competition with positive effects on society.

Despite the high expectations and the amount of works on EDM and LA, their application in educational environments still comes up against some important barriers, such as the lack of a data-driven culture and of fast, comprehensive and easy-to-use and understand tools that could be integrated in the most popular LMSs.

In the era of Big Data, the combination of the current capacity to capture, store, manage and process data in a reasonable amount of time, and data from online learning environments represents an opportunity for researchers into EDM and LA to better explore student learning processes and efficient ways to improve them. An important application is in MOOCs, where data from thousands of students can be employed to redesign courses for future students, relying on navigation and tool usage for example. A much more challenging approach consists in the development of adaptive MOOCs, in which the courses are automatically personalized according to student profiles (needs, objectives, background, country, learning style, etc.) and performance. This is a relatively new research topic that is currently getting much attention from both researchers and companies.

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Learning Analytics: Intelligent Decision Support Systems for Learning Environments

Log Analysis in a Virtual Learning Environment for Engineering Students

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Abstract

The use of information and communication technologies (ICTs) at different educational levels has impacted the teaching-learning process. ICTs have effectively become tools that support educational environments and, hence, have become educational technology. Virtual learning environments (VLEs) are widely used, offering advantages to both students and instructors. Different platforms include various activity modules, within which collaborative learning communities are built, file sharing and grade handling are facilitated, and navigation log statistics are provided. These logs shed light on the daily use of the platform. The resulting information creates an overview of users' online navigation characteristics and preferences. Through the analysis of these navigation logs, relevant information can be extracted that may help in understanding the teaching-learning processes within VLEs. In this study, the navigation logs of students enrolled in a course offered at a School of Engineering were analyzed. The objective of this project was to analyze the characteristics of the students' navigation by identifying, summarizing and characterizing the way in which they interact with the platform. Based on the results, it is inferred that students apply different learning strategies and follow individualized navigation paths.

Keywords

logs, educational technology, educational data mining, virtual learning environment, Moodle

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Análisis de la navegación en un entorno virtual de aprendizaje de estudiantes de ingeniería

Resumen

La inclusión de las tecnologías de la información y comunicación en los distintos niveles educativos ha impactado los procesos de enseñanza-aprendizaje y se han convertido en herramientas que brindan soporte a los entornos educativos, convirtiéndose así en tecnología educativa. Los entornos virtuales de aprendizaje son ampliamente utilizados, ofreciendo ventajas tanto a estudiantes como a instructores. Las distintas plataformas incluyen diversos módulos de actividad, dentro de los cuales se construyen comunidades colaborativas de aprendizaje, intercambio de archivos, manejo de calificaciones, estadísticas de uso de la plataforma en donde se alojan los registros de navegación. Dichos registros dan cuenta del uso diario que se le da a la plataforma. La información que de ello resulta genera un panorama acerca de las características y preferencias de navegación en línea por parte de los usuarios. Por medio del análisis de los registros es posible extraer información relevante que puede ayudar a entender los procesos de enseñanza-aprendizaje dentro de los entornos virtuales de aprendizaje. En la presente investigación se analizaron los registros de navegación de estudiantes dentro de un curso de una facultad de ingeniería. El objetivo de este proyecto fue el de analizar las características de navegación de los estudiantes a través de la identificación, caracterización y síntesis de la forma en la que interactúan con la plataforma. Se infiere, derivado de los resultados, que los estudiantes aplican estrategias diferentes de aprendizaje y que siguen trayectorias de navegación individualizadas.

Palabras clave

registros de navegación, minería de datos educativa, tecnología educativa, entornos virtuales de aprendizaje, Moodle

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Introduction

Education has been reshaped since the advent of information and communication technologies (ICTs) as well as by the rapid incorporation of the Internet into educational processes. Changes have occurred at different educational levels, affecting all involved: students and teachers, even the institutions themselves. The use of virtual learning platforms has grown and is now commonplace in many educational practices (Lavigne, Backhoff-Escudero & Organista-Sandoval, 2008; Backhoff-Escudero, Lavigne, Organista-Sandoval, & Aguirre-Muñoz, 2007; Concannon, Flynn, & Campbell, 2005).

Among current research possibilities, one encounters new objects of study, such as the navigation logs that are automatically generated when using virtual learning platforms. This study seeks to understand how this technology is employed by students. Such research can improve the use of teaching tools, taking into account instructional design, as pointed out in Rochefort and Richmond (2011). Hershkovitz and Nachmias (2008) mention that monitoring student motivation through the analysis of navigation logs allows the instructor to get involved when necessary, with the aim of improving the efficiency of the learning process.

Background

Valuable information about users' online browsing characteristics and preferences is generated through the daily use of platforms. The information in navigation logs records the behavior of users of the website where the platform is located, regardless of the willingness of these users to provide such information (Martínez, Mateo, & Albert, 2004). However, the analysis of these data involves several challenges, including those of a technical nature, such as sample size, organization and subsequent database management.

This type of analysis is called *data mining* and, when applied to the field of education, *educational data mining* (Baker & Yacef, 2009). Online course management systems such as Moodle or Blackboard have their own programs for recording the number of times the system is accessed and the activities that each user undertakes in the virtual space.

According to Hardy, Bates, Antonioletti, and Seed (2005), the analysis of activity logs has been effective for questioning certain aspects of online learning, but in some cases it becomes clear that the implementation of virtual learning environments (VLEs) does not yield the expected results (Buelens, Roosels, Wils, & Van Rentergem, 2002).

Some authors (Feng & Heffernan, 2005, 2007) suggest that the analysis of logs can be useful in building learning support systems or, as noted in Bisson, Bronner, Gordon, Nicaud, and Renaudie (2003), to identify students' cognitive gaps or difficulties in adapting to the online environment. According to Hoskins and Van Hooff (2005), little is known about the impact of online courses on students' academic achievement. Dringus and Ellis (2005) attempted to uncover the navigational structure of students that had written texts that were added to forums with the aim of ascertaining their participation. Dönmez, Rosé, Stegmann, Weinberger, and Fischer (2005) performed a multidimensional analysis of collaborative learning by means of linguistic treatment of forum content in order to develop automatic analysis technology. This type of analysis also revealed the operations of collaborative working groups (Perera, Kay, Koprinska, Yacef, & Zaiane, 2009).

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At the Autonomous University of Baja California (UABC), Mexico, students have been subjects of research via the navigation logs of several courses on Moodle. Organista-Sandoval, Lavigne, & McAnally-Salas (2008) analyzed students' online activity and its relation with statistics learning. Students were classified into four clusters, of which two had a great deal of online activity and also showed a tendency toward better grades. Analyses have also been performed on learning styles (Díaz, 2010) and collaborative learning (Vasconcelos, 2011).

The contemporary pedagogy that forms the foundation for e-learning requires that the whole concept of educational material focus on the student. Moreover, the hybrid process of teaching-learning needs new approaches that will lead to more flexible teaching, such as the use of an instructional design based on the characteristics resulting from students' navigation in VLEs. However, there is a lack of knowledge about the behavior of students in virtual environments. Therefore, this project, which is preliminary in nature, explores to what extent, based on the use of the Moodle platform, learning strategies likely to affect students' academic performance can be identified.

Method

For this cross-sectional study, which employed a descriptive-exploratory approach, quantitative techniques were used to analyze approximately 15,000 navigation logs from the Moodle[1] platform.

Participants

The research was done through an analysis of the navigation logs of 33 students enrolled in a 16 week course titled "Numerical Methods in Computer Engineering" in the School of Engineering, Architecture and Design at the UABC. Based on existing data, we were able to identify the participants' gender: three women and thirty men. Course instruction was mixed, consisting of both onsite and virtual teaching. The onsite classes were conducted in a computer lab where all the students were connected to the course, performing online tasks under the supervision of the instructor.

Study context

Of the possible options in Moodle that could be used, the instructor included the following virtual activities:

- Forums: These were not mandatory but did account for 10% of the final grade; the forums had an evaluative function, offering students the opportunity to present evidence of their performance in order to provide feedback and assess learning.
- All of the suggested readings for the course were on the platform or on some other virtual site; not all the readings were mandatory and students were not penalized if they failed to do them.

1. Modular Object Oriented Dynamic Learning Environment; open code, with 41,364,118 registered users in 214 regions, available in 78 languages. Consulted in 2011, http://moodle.org/stats.

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- Questionnaires and assignments, which were all mandatory and delivered virtually via the platform, had deadlines, and students were penalized if they were turned in late.
- Feedback for each assignment was given through the platform; the final grade was given by the instructor.

Data collection

For the data collection, the navigation logs, which were available as reports, were extracted from the Moodle platform by accessing the server logs, selecting the course and, within the course, all the students and their respective activities. The data were exported to Excel and a database was generated. The students' final grades – for the activities carried out on the platform only – were also extracted.

Variables

The extracted data (retrieved directly from Moodle) were subsequently transformed into generic variables, from which derived variables were inferred. As the platform offers seven types of resources and 22 types of activities, plus tailored modules, the resources were stored in a single category, *Resources*, and the activities were reorganized into three categories: *Assignments, Users*, *Forums* – plus the *Homepage*.

The variables used are as follows:

- **Connection date.** Obtained by identifying the date (month and day) when the student logged into the platform.
- **Connection time.** Obtained by identifying the exact time (hour, minutes and seconds) when the student requested log-in. At the analysis level it was divided into five periods: 1:00 am to 5:59:59 am; 6:00 am to 10:59:59 am; 11:00 am to 3:59:59 pm; 4:00 pm to 8:59:59 pm; and 9:00 pm to 12:59:59 am.
- **Actions performed on the platform.** Obtained by identifying the module the student accessed: homepage, forums, resources, activities and user.
- **IP address.** Obtained by identifying the IP address from which the student logged into the platform; these were divided into two categories: those belonging to the UABC and those that did not.
- **Final grade.** Obtained by identifying the grade that the instructor gave each student for the activities undertaken on the platform.
- **Total number of HITS.**[2] Obtained by counting the total number of times the student requested access to any page and/or module within it.
- **Total number of log-ins.** Obtained by identifying the number of times the student logged into Moodle.
- **Mean length of each HITS.** Obtained by dividing total length of time by the total number of HITS.
- **Mean session length.** Obtained by dividing total amount of time logged in by the total number of sessions.

2. HITS is an acronym for Hypertext Induced Topic Selection, an algorithm designed by Jon Kleinberg to assess the importance of a web page through the analysis of its links.

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- **Total HITS per student in each of the modules or activities.** Obtained by identifying the user's name within the activity modules and counting the number of HITS.
- **Log-in interval.** Obtained by identifying the time when the student logged into the platform as well as the time when he or she logged out.

Analysis tools

For the descriptive and inferential analyses, we used the Statistical Package for Social Sciences (SPSS). Cluster analysis, as in Pérez & Santín (2006), consisted in dividing the group of students one or more times based on specific characteristics; the agglomerative clustering method was used.

With the Organization Risk Analyzer (ORA)[3] for dynamic meta-network assessment, paths were identified using the database developed in Excel specifically for use in ORA. As the use of this tool for this type of research is uncommon, a sample was taken and the paths of ten students were analyzed and plotted, although in this article just one case is presented as an example.

Procedure

First, the navigation logs for each student were retrieved and exported to Excel; the data were filtered by removing irrelevant information. Statistical analysis was performed using SPSS software. Subsequently, the navigation paths were developed using the ORA application.

It is worth remembering that Moodle does not identify the log-ins themselves. It was necessary to identify them based on the date, mean length of log-in, URL and the type of web page accessed before and after what appears to be a new log-in, and sort them into chronological order. Likewise, the time format needed to be adjusted so that it was possible to display seconds.

Results

Navigation characteristics

The descriptive elements of the main variables are revealed through the navigation characteristics. The time format is expressed in days (dd), hours (hh), minutes (mm) and seconds (ss). The use of all or some of these time elements is case dependent.

As can be seen below, the total number of log-ins throughout the course was 997, with a standard deviation of 27.63; the total number of HITS was 15,779, with a mean of 478.15 and a standard deviation of 176.83, which

3. Organization Risk Analyzer, an analysis tool developed by the Center for Computational Analysis of Social and Organizational Systems (CASOS) at Carnegie Mellon University.

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underscores the vast differences between students. The mean time per HITS was 1 minute and 34 seconds; the minimum was 41 seconds and the maximum, 2 minutes and 32 seconds.

Table 1. Description of the main variables

Variables	*Total*	*μ*	*σ*	*Minimum*	*Maximum*
Log-ins	997	30.21	27.63	12	151
HITS	15,779	478.15	176.83	284	1,187
Session length	16:20:35:23 (dd:hh:mm:ss)	12:15:37 (hh:mm:ss)	4:34:42 (hh:mm:ss)	3:48:42 (hh:mm:ss)	21:11:55 (hh:mm:ss)
Mean HITS (mm:ss)	51:50	01:34	00:27	00:41	02:32

As a group, the students invested a total of 16 days, 20 hours, 35 minutes and 23 seconds on the platform, a mean of 12 hours, 15 minutes and 37 seconds per student. Table 2 shows the modules in which all the available activities were grouped. Assignments had a total of 7,314 HITS, while the four remaining modules together received a total of 8,458 HITS. It should be noted that *Homepage* indicates the course access page as well as the page to which one returns from loop trajectories, such as when the *back-space* key is pressed.

Table 2. Description by activity module

Modules	*Total HITS*	*μ*	*σ*	*Minimum*	*Maximum*
Assignments	7,314	221.64	60.02	138	447
Resources	2,485	75.30	31.57	21	188
Forums	2,516	76.24	37.82	20	210
Homepage	2,870	86.97	56.61	37	285
User	587	17.79	23.11	1	136

Table 3 shows the description of the time frames in which the students were logged into the course. The nighttime and early morning periods from 9:00 pm to 12:59 am and 1:00 to 5:59 am represent 42.89% of the total log-ins; those that occurred between 4:00 and 8:59 pm, comprising 49.95% of the log-ins, correspond to sessions at the onsite laboratory.

Table 3. Description by time of log-in

Schedule	*Total Log-ins*	*%*	*μ*	*σ*	*Minimum*	*Maximum*
1:00 - 5:59 am	260	24.78	7.88	11.621	0	54
6:00 - 10:59 am	44	4.19	1.33	1.88	0	8
11:00 am - 3:59 pm	28	2.66	0.85	1.34	0	5
4:00 -8:59 pm	524	49.95	15.88	8.46	9	47
9:00 pm- 12:59 am	190	18.11	5.76	9.41	0	51

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The following table shows descriptions grouped by month and HITS, as well as the mean time per HITS and log-in. Two peaks of activity can be observed, in September and November, but the length of time per HITS decreased steadily.

Table 4. Description grouped by month

Month	HITS			Length hh:mm:ss		Length dd:hh:mm
	Total	μ	σ	Mean per HITS	Mean per log-in	Total of log-ins
August	3,135	95	4.7	00:02:17	03:28:03	04:18:25
September	4,665	141.3	63.0	00:01:39	04:11:30	05:18:19
October	3,538	107.2	66.6	00:01:21	02:27:17	03:09:00
November	4,215	127.7	64.2	00:00:53	02:03:37	02:19:59

Table 4 above shows the distribution of the mean length per HITS by month. A steady drop in the mean time per HITS can be observed, which indicates faster navigation and better use of time. Likewise, the total duration of sessions per month rose during the second month and decreased steadily thereafter.

Cluster Analysis

Given the size of the standard deviations of some variables, the idea arose that there might be groups within the student group as a whole. A non-hierarchical k-means cluster analysis (Pérez & Santín, 2006) was performed on the data collected.

Table 5 shows the ANOVA analysis results, where the F values for the main variables can be seen, as well as the significance level, which was less than 0.05 for the four variables.

Table 5. ANOVA result

	Cluster		Error		F	Sig.
Main variables	Mean square	df	Mean square	df		
Total HITS	169,625.7	1	26806.4	31	6.328	0.017
Total log-ins	3,440.313	1	677.2	31	5.080	0.031
Length of log-in (in seconds)	6.115E9	1	8.320E7	31	73.496	0.000
Mean length of HITS (in seconds)	12,294.789	1	391.7	31	31.382	0.000

The characteristics of the two groups are shown in Table 6. The total number of HITS for Group 2 was 2,843 lower than for Group 1. The total number of log-ins for Group 1 was 682, double that of Group 2, which logged in 315 times. The mean final grade, for the activities on the virtual course only, was 99.6 % for Group 1 and 98% for Group 2, that is, almost the same for both groups.

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Table 6. Characteristics by group

Descriptive characteristics by group	Group 1	Group 2
Total students	17	16
Total HITS	9,311	6,468
Mean length of HITS (mm:ss)	01:53	01:15
Total log-ins	682	315
Mean number of log-ins	40	20
Mean length of session (mm:ss)	32:49	27:04
Mean length of session per course (hh:mm:ss)	15:55:43	08:21:45
Mean grade	99.6	98

Table 7 shows that the assumption of equality of variances was supported by Levene's test, since a value of 0.000 was obtained; therefore, the observed values for Student's *t*-test of 2.929 are taken into account, with a significance level of 0.006.

Table 7. Contrast *t-student* for independent samples

Final Grade	Levene's test for equality of variances		Student's t-test for equal means				
	F	Sig.	t	df	Bilateral sig.	Mean Diff.	Dif. standard error
Equality of variances assumed	16.176	.000	2.929	31	0.006	1.51651	0.51776
Equality of variances not assumed	-	-	2.854	17.606	0.011	1.51651	0.53140

These results indisputably point to the existence of two groups.

Navigation paths

Navigation paths that shed light on the way the student negotiates the platform while making use of the different options available can be inferred by identifying what he or she accesses during each session. To date, we have been unable to find any software specifically for analyzing the students' navigation paths, making it necessary to do the analysis by hand; therefore, we present the results for just two students, one from each group.

In the condensed report of the two students' sessions, important differences in navigation stood out immediately. Student 1 logged in 34 times and participated considerably more in the forums and consulted the available learning resources more times than Student 2, who only logged in 12 times and focused on completing the assignments, both at the beginning and the end of the course. The first received a grade of 100% and the second 94.7%.

The following figure shows the navigation paths followed by the students throughout the course. Student 1 showed greater activity; of the 308 HITS recorded for this student participating in the course, 205 took place in the assignments module, compared with 232 for Student 2, which means that Student 2 dedicated 65.5% of his or her online time to performing learning activities, while Student 1 dedicated 44.8%.

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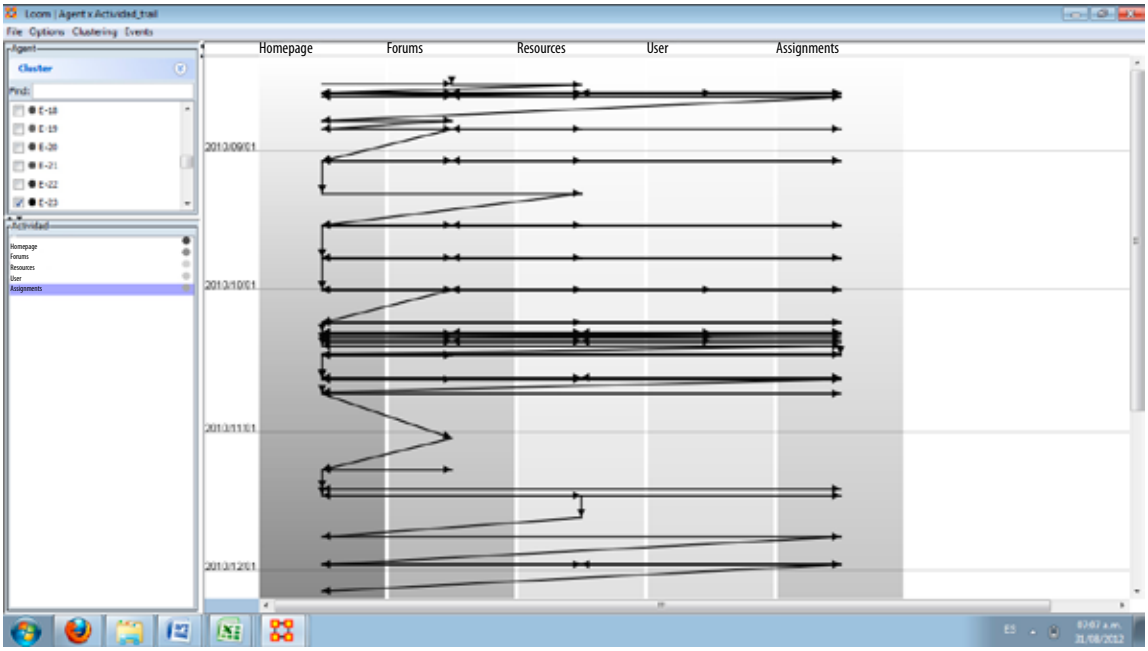
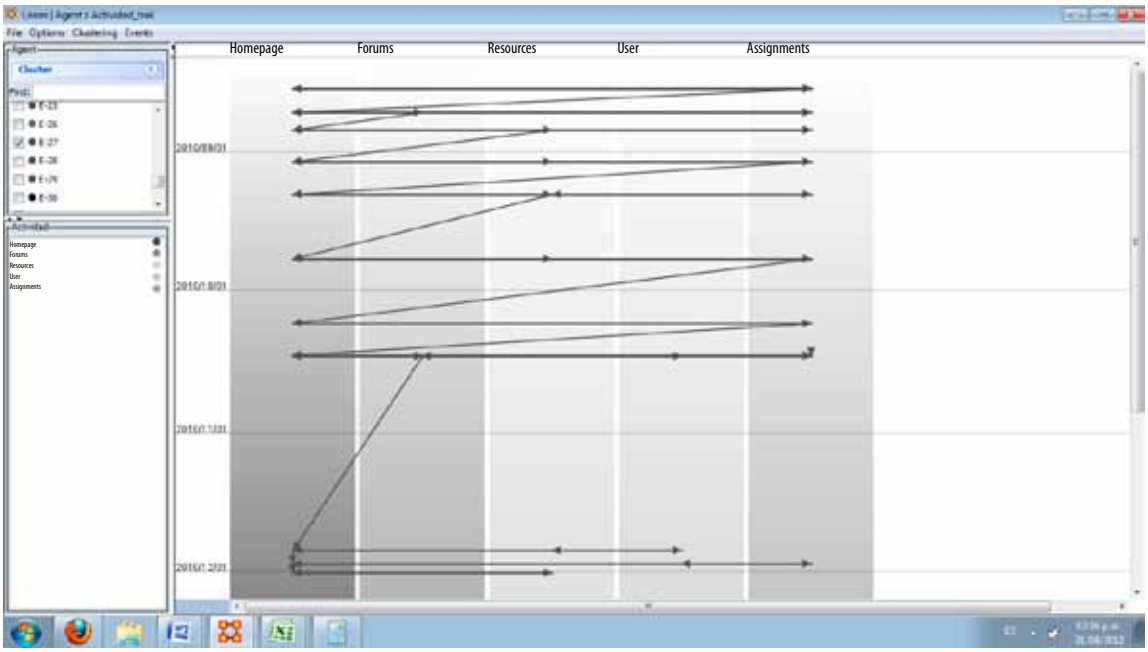
Figure 1. Navigation paths of the two students analyzed, produced as they accessed different modules of the platform during the course, divided into months

Student 1



Student 2



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Students in Group 1, characterized by greater activity on the platform (in terms of the number of accesses and time spent), obtained a higher mean grade (99.6%). Students in Group 2, characterized by less activity on the platform, obtained a lower mean grade of 98%. Thus, each group had a learning strategy that was almost the complete opposite of the other's. For Group 1, it was achieving the maximum grade, regardless of the time spent online, while for Group 2, it was spending less time online to achieve an optimum grade. It should be noted that the difference between the two mean grades, despite being small, was statistically significant.

Discussion

In this study, key elements of the teaching-learning process, whether virtual or not, became evident through the students' accessing the various elements within the different modules, such as assignments and resources, which included questionnaires and lectures (Coll, 2004). Around 9,700 of the 15,779 total HITS made throughout the entire course by the students were presented. The importance of the processes of socialization (Ávila & Bosco, 2001) and communication (Barajas, 2002) have been recognized, evidenced in this case by the 2,500 occasions on which the students accessed the forum module. As in Boneu (2007), the students had the option of using the platform at any time of the day or night from any location.

The students' success in finding different ways of navigating within the VLE demonstrated the potential to which Díaz (2010) refers. While the virtual platform offers the same range of possibilities to all users, each inherently determines the results of its use, regardless of the platform structure or the design intent that the instructor implements. By utilizing the information at the time it is generated to provide the instructor with feedback, navigation logs may have a positive impact on teaching practice by guiding instructors in their performance and helping them choose the content and strategy to employ in order to obtain the best academic outcomes.

Do students follow the learning paths established by instructors? Yes; the logs analyzed suggest that they make use of the resources more independently. Do students apply something similar to free will in managing their navigation paths in VLEs? Most definitely; students decide how to access the platform and how to navigate within it, within its design limits.

From this preliminary analysis, some observations were made that could be transformed into knowledge through further studies of this type. According to Lavigne, Organista and McAnally (2008), and Lavigne, McAnally-Salas, Organista-Sandoval, Díaz-López, and Vasconcelos-Ovando (2011), it appears to be usual for the duration of HITS to decrease over time, with a mean length of approximately one minute. This observation raises certain questions: What can students do in one minute? How can instructors design activities under these circumstances?

Based on their navigational characteristics, it was possible to identify two groups of students, each with very different learning strategies in terms of the use of the navigational possibilities offered, but with relatively similar success. It should be emphasized that these two groups had very different navigation patterns, which were the result of the different learning strategies chosen and, consequently, each one's use of time in the virtual space. Nevertheless, the final grades were equally high in both groups. This element, which was also observed by Lavigne et al. (2008), should be the object of further study in order to define lines of flexibility in instructional design. As this is an emerging topic, the tools and techniques available for the treatment of data are currently not the most expedient. Comparative studies using samples comprising students with different profiles and technological abilities could be conducted. Furthermore, qualitative analysis could clarify behaviors thus far unexplored and, therefore, unknown.

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Learning Analytics: Intelligent Decision Support Systems for Learning Environments

Temporal learning analytics visualizations for increasing awareness during assessment

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Abstract

Visual representations of student-generated trace data during learning activities help both students and instructors interpret them intuitively and perceive hidden aspects of these data quickly. In this paper, we elaborate on the visualization of temporal trace data during assessment. The goals of the study were twofold: a) to depict students' engagement in the assessment procedure in terms of time spent and temporal factors associated with learning-specific characteristics, and b) to explore the factors that influence the teachers' Behavioural Intention to use the proposed system as an information system and their perceptions of the effectiveness and acceptance of our approach. The proposed visualizations have been explored in a study with 32 Secondary Education teachers. We adopted a design-based research methodology and employed a survey instrument – based on the Learning Analytics Acceptance Model (LAAM) – in order to measure the expected impact of the proposed visualizations. The analysis of the findings indicates that a) temporal factors can be used for visualizing students' behaviour during assessment, and b) the visualization of the temporal dimension of students' behaviour increases teachers' awareness of students' progress, possible misconceptions (e.g., guessing the correct answer) and task difficulty.

Keywords

temporal learning analytics, visualizations, awareness, monitoring, assessment, acceptance

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Visualizaciones del análisis temporal del aprendizaje para aumentar el conocimiento durante la evaluación

Resumen

Las representaciones visuales de datos de trazas generados por el alumnado durante las actividades de aprendizaje ayudan tanto a los estudiantes como a los profesores a interpretarlos intuitivamente y a percibir con rapidez aspectos ocultos. En este trabajo, describimos la visualización de datos de trazas temporales durante la evaluación. El estudio tenía un doble objetivo: a) describir la implicación de los estudiantes en el proceso de evaluación en cuanto a tiempo invertido y factores temporales asociados con características concretas del aprendizaje, y b) explorar los factores que influyen en la intención comportamental del profesorado en cuanto a emplear el sistema propuesto como sistema de información y sus percepciones de la efectividad y la aceptación de nuestro enfoque. Las visualizaciones propuestas se han examinado en un estudio con 32 profesores de educación secundaria. Adoptamos una metodología de investigación basada en el diseño y utilizamos un instrumento de encuesta –basada en el modelo de aceptación del análisis del aprendizaje– para medir el impacto esperado de las visualizaciones propuestas. El análisis de los hallazgos indica que a) los factores temporales se pueden utilizar para visualizar el comportamiento de los estudiantes durante la evaluación, y b) la visualización de la dimensión temporal del comportamiento de los estudiantes aumenta el conocimiento del profesor respecto al progreso de los alumnos, posibles conceptos erróneos (por ejemplo, adivinar la respuesta correcta) y dificultad de la tarea.

Palabras clave

análisis temporal del aprendizaje, visualizaciones, conocimiento, monitorización, evaluación, aceptación

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1. Introduction

It is commonly agreed that there is a need to gain insight into students' perceptions and discover how they behave when dealing with assessment tasks that have different requirements. Teachers' awareness of what and how learners are doing is important to assess learner progress.

Furthermore, it is important to build systems that will allow students to monitor their own progress, support self-regulated learning and help them evaluate and adjust their learning strategies to increase goal achievement. According to Economides (2005, p.1), "It would be useful for the examinees to know their current status in order to be challenged, stimulated, motivated, or to design their testing strategies". It has been acknowledged that self-regulation assists the student to self-organize and maintain self-management during learning. "Self-regulation is not a mental ability or an academic performance skill; … it involves the self-awareness, self-motivation, and behavioural skill to implement that knowledge appropriately." (Zimmerman, 2002, pp. 65-66).

In support of self-regulation, analytic dashboards with multiple student-generated data visualizations have been broadly adopted to enable teachers and students to reflect on their activity and compare it with their peers (Economides, 2005; Thomas & Cook, 2005). Visual representations translate data into a visible form that highlights important features, including commonalities and anomalies. They aim to shed light on how students learn, reveal learning habits and learner-strategy patterns, and provide a deeper understanding of learning mechanisms in general (e.g., Morris, Finnegan, & Wu, 2005; Macfadyen, & Dawson, 2010). Soller, Martinez, Jermann, & Muehlenbrock (2005) considered that visual analysis was a key enabler to gain insights into the learning process and provided a basis to support self-reflection, awareness and collaboration among learners or teachers. In a sense, visual representations of student-generated trace data help both students and instructors interpret them intuitively and perceive hidden aspects of these data quickly.

In this paper, we elaborate on the visualization of student-generated temporal trace data logged during assessment procedures. The goals of this study were twofold: a) to depict students' engagement in the assessment procedure in terms of time spent and temporal factors associated with learning-specific characteristics, and b) to explore the factors that influence the teachers' Behavioural Intention (BI) to use the proposed system as an information system and their perceptions of the effectiveness and acceptance of our approach. The proposed visualizations have been explored in a study with 32 Secondary Education teachers. We adopted a design-based research methodology and employed a survey instrument – based on the Learning Analytics Acceptance Model (LAAM) (Ali, Gašević, Jovanović, & Hatala, 2013) – in order to measure the expected impact of the proposed visualizations. The analysis of the findings indicates that a) temporal factors can be used for visualizing and outlining students' behaviour during assessment, and b) the visualization of the temporal dimension of students' behaviour increases teachers' awareness of students' progress, possible misconceptions (e.g., guessing the correct answer), effort needed and task difficulty.

The rest of the paper is organized as follows: in section 2, we briefly review existing work on the visualization of learning data for monitoring purposes. In section 3, we explain the motivation and rationale of our research. In section 4, we briefly describe the tools used for the purpose of our research, and in section 5 we present the methodology followed, the data collection procedure and the data analysis methods that we applied. In section 6, we analyze the results from the evaluation study. Finally, in section 7, we discuss the major findings and conclude with future implications.

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2. Related Work

Learning dashboard visualizations are not new. These dashboards are used in traditional face-to-face teaching, online learning and blended learning settings. Duval (2011) prompted the question of how to model the relevant data that would then be used for the visualization of users' interactions. The author suggested the Contextualized Attention Metadata (CAM) schema (Wolpers, Najjar, Verbert, & Duval, 2007), which defines a simple model to structure attention metadata, i.e., the interactions that people have with objects.

Based on this model, Govaerts, Verbert, and Duval (2011) presented Student Activity Meter (SAM), a visualization tool that focused on providing an overview of activities and resource use in a virtual classroom over time. SAM visualizes time spent on learning activities and resource use in online learning environments. The SAM tool aimed to enable both students and teachers to explore user activities and find patterns, contributing to awareness and self-monitoring. Like SAM, Gradient's Learning Analytics System (GLASS) (Leony, Pardo, de la Fuente, de Castro, & Kloos, 2012) has adopted the CAM schema. It tracks the number and types of events and was developed to support both teachers and learners.

The Tool for Advanced Data Analysis in Education (TADA-Ed) aimed to assist educators in detecting pedagogically important patterns in students' assignments (Merceron, & Yacef, 2005) by capturing frequencies of students' mistakes, frequencies of concepts used erroneously, frequency of logins, etc. Further, CourseViz was developed to work with WebCT to visualize student-tracking data (Mazza, & Dimitrova, 2007). Similarly, Graphical Interactive Student Monitoring System (GISMO) (Mazza, & Milani, 2005) fetches students' data from Moodle logs and performs some statistical calculations. It displays how and when students are engaging with Moodle activities and resources.

More recently, LOCO-Analyst (Ali et al., 2012) was developed as a learning analytics tool aimed at providing educators with feedback on the relevant aspects of the learning process taking place in a web-based learning environment. The generation of feedback in LOCO-Analyst is based on the analysis of user tracking data, including time spent, students' interactions in discussion forums, interactions with the learning content, students' annotations, etc.

3. Motivation of our research

From a more critical view on the above-mentioned related work, it can be seen that most of these tools try to assist educators in exploring social, cognitive, and behavioural insights of student activities in different learning systems. Although TADA-Ed uses simple frequencies of events, however, it presupposes that the users (i.e., teachers) are familiar with data mining techniques and competent enough to choose and apply them as well as to analyze their results, which can be quite complex. Moreover, the CourseViz tool representation lacks the ability to visualize the conversation flow and it is difficult to view the third dimension of the graph. In addition, GISMO was developed specifically for online learning courses and thus only collects data from within Moodle and consequently it is solely associated with this learning environment.

Furthermore, if we analyze dashboards, we find that time spent is a commonly captured trace. According to Govaerts et al. (2011, p.3) "time tracking information allows teachers to assess their initial time estimates with the real time spending of students and find the exercises that consume most time. Time tracking can help the learner to understand his time allocation compared to his peers and assist sometimes to report time spending to the teacher".

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Moreover, Economides (2005) indicated a number of time-oriented graphs/plots for supporting students during Computerized Adaptive Testing procedures, including for example, the average/maximum/minimum time interval the class spent on each task/subtopic/topic, the average/maximum/minimum time interval the student spent on each task/subtopic/topic, etc.

Two cited examples of dashboards that exploit the time-spent factors are LOCO-Analyst and SAM, which both address the issue of being aware of "which resource I and others use". Like SAM and LOCO-Analyst, the Temporal Learning Analytics Visualization (TLAV) tool also aims to visualize time spent on activities, but in contrast to these two (which visualize resource usage over time), TLAV focuses on the time aggregated according to the correctness of a submitted answer during an assessment procedure. In a sense, SAM and LOCO-Analyst use the time-spent factor to evaluate the resources and to provide related interesting learning material or contextualize social interactions among students accordingly. TLAV on the other hand, aims to identify guessing and slipping behaviour, to understand the effort needed by the students to cope with the assessment items and to evaluate the difficulty of these tasks respectively. This differentiates the way the temporal factors are explored in our research and provides additional capabilities in terms of understanding students' learning behaviour in general.

Through the development of TLAV, we wanted to expand the capabilities and address some limitations of the earlier systems. Our intention was to provide instructors and students with a visualization tool that would be independent from any specific learning environment and that would provide feedback on the effort needed to solve each task and infer its difficulty level.

4. The Learning Analytics and Educational Recommender System (LAERS) assessment environment and the TLAV tool

The TLAV tool obtains the necessary temporal and performance indicators from the LAERS assessment environment (Papamitsiou & Economides, 2013), and it constitutes a part of this environment to be used by the instructors during the assessment procedures in order to monitor the students' progress.

The LAERS environment consists of a testing mechanism and a tracker that logs students' temporal data. The testing unit displays multiple-choice quiz questions delivered to students. The students can temporarily save their answers to the questions, change their initial choice, or skip a question and answer it (or not) later. If students choose not to answer a question, they receive zero points for this question. Figure 1 illustrates a student's view of the environment during testing.

The tracker component of the system records students' activity data during testing. Specifically, the tracker logs the following parameters for each student (collected dataset): student ID, the question the student works on, the answer the student submits, the correctness of the submitted answer, how many times the student views each question, how many times the student changes the answer, the timestamp the student starts viewing a question, the timestamp the student chooses to leave the question (saves an answer), the idle time the student spends viewing each question (not saving an answer, but choosing to see another question). In LAERS, Total_Time_to_Answer_Correct (TTAC) is the total time (aggregated) that a student spends on viewing the questions and submitting the correct answers to these questions. Respectively, Total_Time_to_Answer_Wrong (TTAW) is the total time (aggregated) that a student spends on viewing the questions and submitting the wrong answers to these questions.

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Figure 1. The LAERS environment during testing

The system also calculates a) the Actual Performance (AP) for each student (i.e., the aggregated score and how it changes every time the student saves an answer, according to the correctness of the submitted choice. The student's final score on the quiz is the latest value of AP when the student finishes the quiz), and b) average time values for each question and each student.

As stated before, TLAV obtains the temporal data and performance indicators from the LAERS system. Before analyzing the visualizations, it should be noted that these graphs are dynamic and change as the assessment procedure evolves and the students solve more tasks, capturing each student's progress and the overall change of the class until that moment. In addition, the graphs are embedded in the LAERS assessment environment (Figure 2 – The LAERS assessment environment from the teacher's view – progress monitoring) and are delivered to the end-user on demand.

Student data (i.e., login information, final answer submitted for each question and final score) and quiz data (i.e., quiz questions with possible answers, correct answer to each question) are stored on a database, while tracked activity data are stored on a log file. The whole system is developed in PHP 5.4, MySQL 5.1 and runs on Apache 2.4 for Windows. JavaScript, AJAX, JSON and JQuery have also been used for implementing the system's functionalities.

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Figure 2. Teacher's view of the LAERS assessment environment – progress monitoring

5. Methodology

In this research, we firstly applied the design-based research methodology. This methodology relies on rapid prototyping to evaluate ideas in frequent, short iteration cycles (Anderson, & Shattuck, 2012). In our study, we used two iterations: one for the prototype development and one for the first evaluation with real users.

5.1. First iteration cycle: TLAV prototype development – Design and Implementation

During the first iteration, we collected requirements and identified potential usability issues regarding teachers' perceptions of graph visualizations. Our goal was to design TLAV in order to support learners' self-monitoring and teachers' awareness. For that purpose, we asked a sample of 12 Secondary Education teachers (4 females and 8 males) to explain to us what they considered "useful" and "comprehensible" graphical representation. Based on their answers, we initially decided to use simple and clear graph visualizations, using bar charts and lines, in order to provide both students and instructors with an overview of the above-mentioned temporal factors, in a form that would be familiar to them. Moreover, the participating teachers considered it important to visualize the following information: the identification of guessing and slipping behaviour during assessment, the overall effort needed to cope with the assessment items and the inferred task difficulty. The graphs we decided to design and embed into the LAERS system are summarised in this section.

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Before moving on to the presentation of the suggested visualization, we should mention that, during the prototyping phase, we used student-generated data that we had collected in previous experimentations with the LAERS environment for the graph design and construction. More precisely, these data were collected from a total of 96 participating students from a Greek High School, who attended the mid-term exams, from 2 to 7 October 2013. The 12 multiple choice questions in the test were about the basic concepts of Informatics. In the following presentation of the visualizations and for simplicity reasons, we have included only 29 randomly selected students and 8 questions.

Every bar in Figure 3 (a) and (b) represents a student's TTAW – blue bars – (TTAC – orange bars) in the assessment tasks, compared to the class's average TTAW – light blue bars – (TTAC – light orange bars) in these tasks. The horizontal axis represents the assessment task, while the vertical axis represents the amount of time-spent. For example, this particular student spent a lot of TTAW on task 8, while the average student spent less time on that item. Moreover, this student spent a lot of TTAC on task 6, in alignment with the average student who also spent a lot of TTAC on the same task. In addition, from these graphs one can hypothesize the guessing/slipping behaviour of a student. For example, this student answers most of the questions wrongly, spending a lot of time to submit a wrong answer. However, this student quickly submits a correct answer to task 1, which the average student spends a lot of time to answer correctly. This could be an indication that in this particular task, the student has guessed the answer. On the contrary, Figure 4 (a) and (b) depicts the time spent by a student who answers most of the questions correctly and seems to spend little time to answer wrongly in task 2, which most students answered correctly. This is an indication of slipping behaviour.

Figure 3. Student's TTAW vs. Class's TTAW (a) – Student's TTAC vs. Class's TTAC (b)

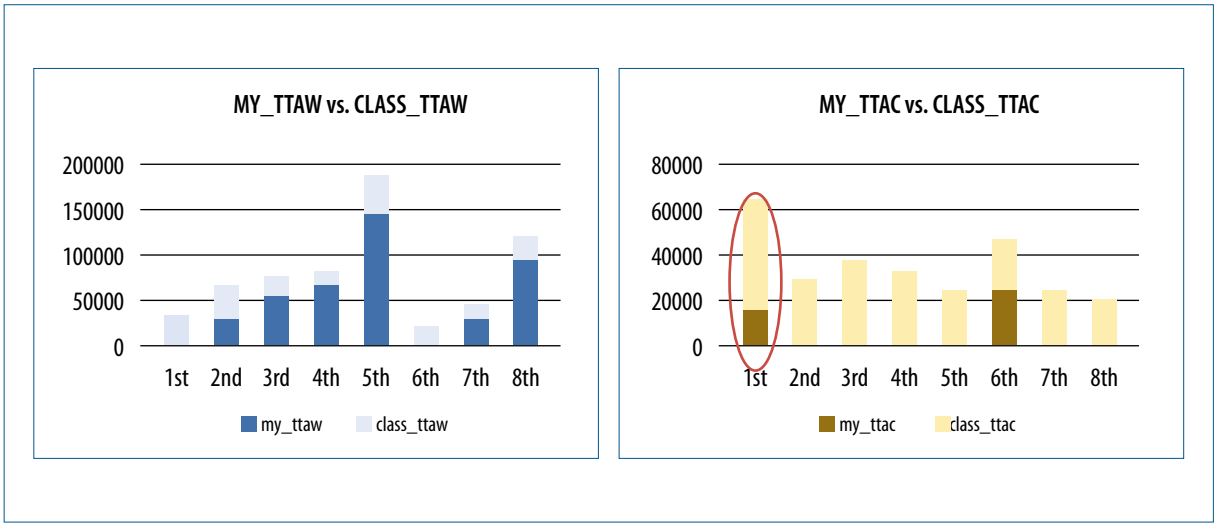

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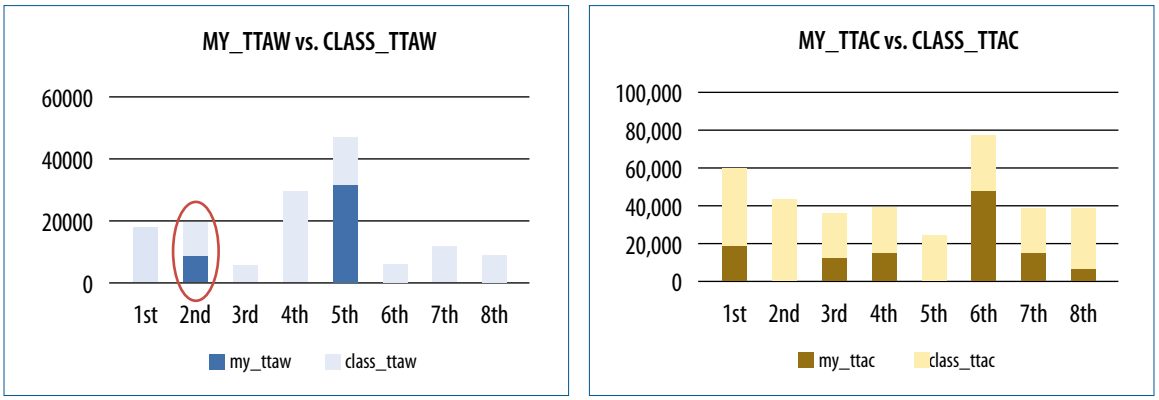
Figure 4. Student's TTAW vs. Class's TTAW (a) – Student's TTAC vs. Class's TTAC (b)



Moreover, Figure 5 displays how each student's overall effort is associated to his/her actual performance in the assessment procedure. For example, student 25 tries hard to overcome the assessment (green line peak) and he/she achieves a high score (red line peak), while student 10 does not try hard enough and gets low score. Furthermore, Figure 6 illustrates a student's TTAW compared to the average class TTAW and the estimated task difficulty of the assessment tasks. For example, the student spent a lot of TTAW on the 5th and 8th tasks, which are estimated to be difficult tasks (yellow line peak). Additionally, he/he spent a lot of TTAW on the 3rd and 4th tasks, which are estimated to be easier tasks. This hint is expected to inform the instructor, that this student has serious misconceptions, even in easy tasks.

Figure 5. Student's effort vs. Actual Performance

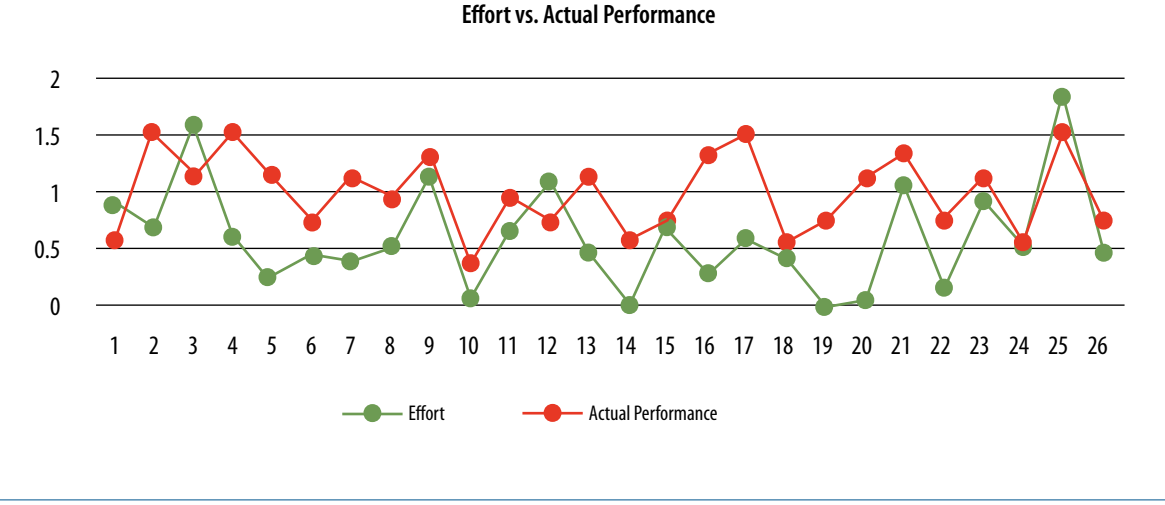


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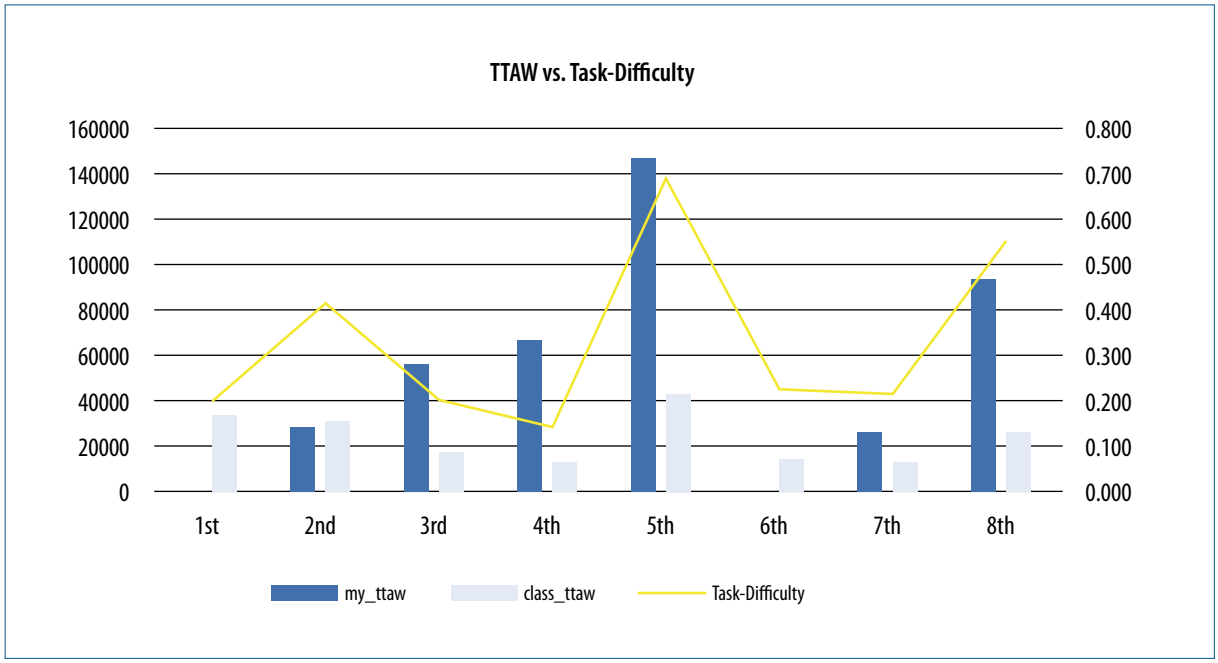
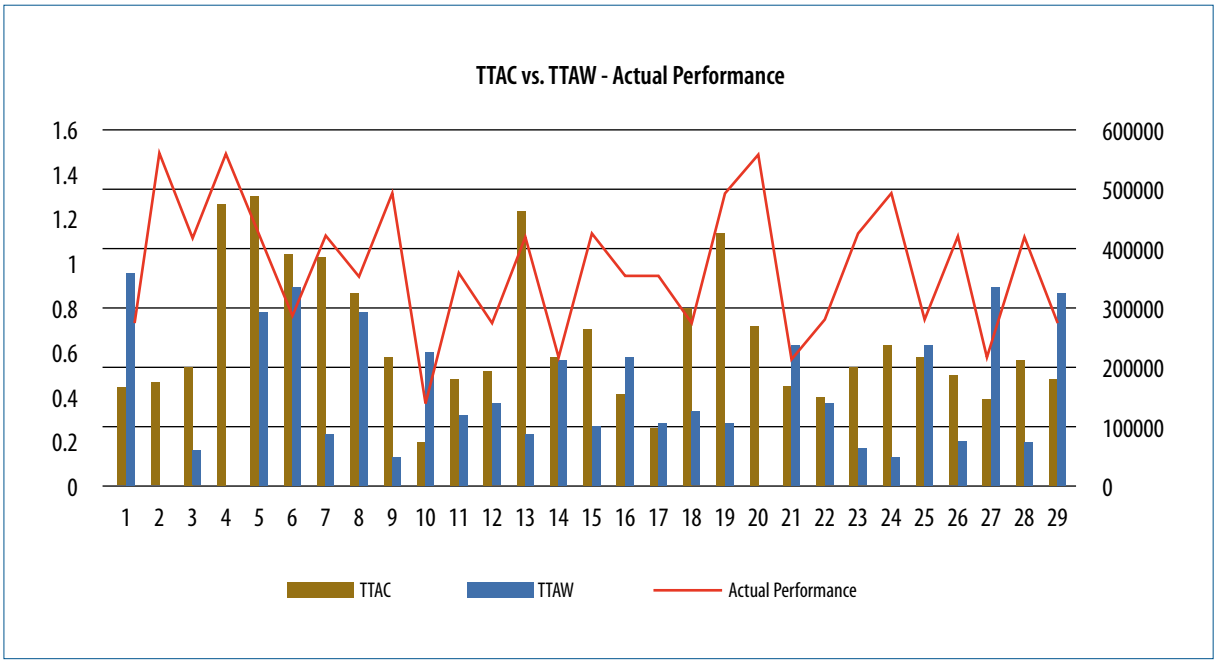
Figure 6. Student's TTAW vs. Task Difficulty



Then we wanted to have an overall comparison of all the students' TTAC vs. TTAW, since these two factors have been found to be significant determinants of actual performance. The graph in Figure 7 displays this comparison with the actual performance curve.

Figure 7. Student's TTAW vs. TTAC – with Actual Performance curve



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5.2. Second Iteration Cycle: Evaluation of TLAVs – Research Model and Hypotheses

During the second iteration of our methodology, we asked 32 Secondary Education teachers (from two different Greek High Schools) to evaluate the TLAVs (18 males [56.3%] and 12 females [43.8%], aged 38-56 years old (M=45.56, SD=6.043, N=32), with expertise in different domains including Language teaching, History, Sociology, Mathematics, Physics, and Informatics). Of these, 12 (37.5%) had also participated in the first iteration cycle. The participants had prior teaching experience in Secondary Education varying from 6 to 30 years (M=15.66, SD=6.39, N=32) and exposure to online learning systems. The majority of participants (30 out of 32 [93.7%]) had Computer Science or Information Systems backgrounds – Certification in using information and communication technologies (ICT). Ten of the participants (31.2%) had previous exposure to similar visualizations (e.g., Google Analytics).

For evaluation purposes, we asked all participating teachers to access the LAERS environment and explore the visualizations provided by the TLAV tool for 30 minutes. The participants were given brief instructions regarding the use and functionalities of LAERS before accessing the environment. All of the participants screened the same visualizations and were aware and agreed on how AP was calculated. For this procedure, we used the same dataset as the one in the previous experiment (see section 5.1).

For evaluation purposes, we used the LAAM (Ali et al., 2013), which is based on the TAM (Davis, 1989). This has been put forward as a way of explaining the adoption of a learning analytics tool. LAAM states that Overall Usefulness perception (which is an extension of Usefulness from TAM) and Overall Ease of Use perception (which is an extension of Ease of Use from TAM) are determinants of BI to adopt the tool. In our study, we wanted to explore the participants' BI to use the proposed visualizations and their perceptions of the overall usefulness of TLAVs regarding their capabilities in terms of improving the teachers' awareness.

TAM posits that BI determines actual systems use. In fact, BI is an indication of an individual's readiness to perform a given behaviour (Ajzen, 2002). Further, according to TAM, Perceived Usefulness (PU) is defined as the degree to which a person believes that using a particular system will enhance his/her job performance, and PEOU is the degree to which a person believes that using the system would be free of effort (Davis, 1989). Likewise, teachers may believe that TLAVs will increase their knowledge and comprehension of what their students know and will provide them with improved awareness. In our study, we also assumed that the teachers may believe that an easy to use visualization system could support them to identify students at-risk at an early stage and assist them with intervening accordingly. Therefore, we hypothesized:

H1: *Perceived Usefulness will have a positive effect on the Behavioural Intention to use TLAVs.*
H2: *Perceived Ease of Use will have a positive effect on the Behavioural Intention to use TLAVs.*
H3: *Perceived Ease of Use will have a positive effect on Perceived Usefulness.*

Moreover, we decided to extend the LAAM by involving Computer Self-Efficacy (CSE) because previous results shown that a causal link exists between CSE and PEOU (e.g., Padilla-Melendez, Garrido-Moreno, & Del Aguila-Obra, 2008). CSE has been defined as the individual's perceptions of his/her capacity to use computers (Compeau & Higgins, 1995). Regarding TLAV's comprehension, CSE is an important factor, because users with high skill on using computer-based systems are expected to feel more comfortable with this kind of visual representations. Thus, we hypothesized that:

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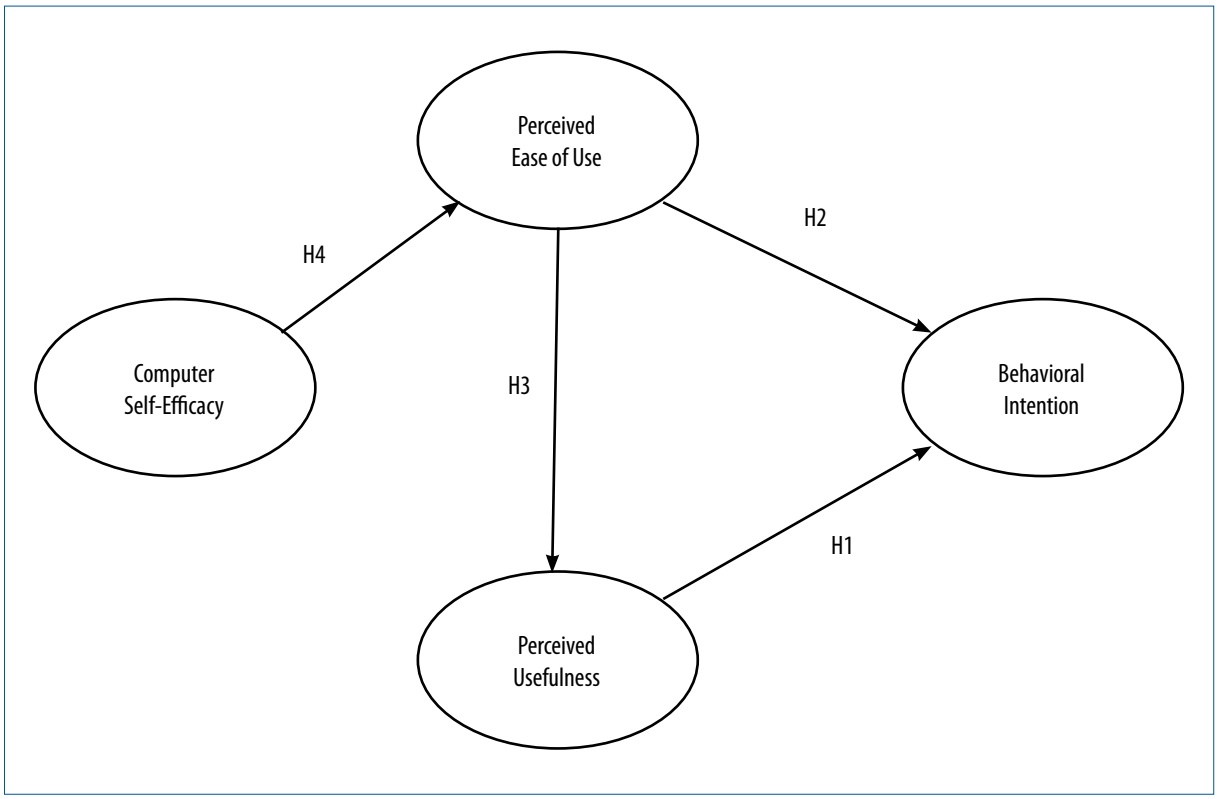
H4: *Computer Self-Efficacy will have a positive effect on Perceived Ease of Use.*

To summarize, in this study we explore the causal model illustrated in Figure 8.

Figure 8. Research model and Hypotheses



5.3 Measures and Data analysis method

In order to examine the four latent constructs of the model, we adapted items based on previous studies. The respective items are summarized in Table 1. In particular, three items for PU, three items for PEOU and three items for BI to use were adopted were adopted from Davis (1989). For CSE, we used three items adapted from Compeau and Higgins (1995), which also have been used by other studies. To conclude, our measurement instrument consists of 12 items and our research model consists of four constructs. To measure these items, we used a seven-point Likert-type scale where 1 = strongly disagree and 7 = strongly agree.

In this study we used Partial Least-Squares (PLS) analysis for the construction of a path diagram that contains the structural and measurement model showing the causal dependencies between latent variables and the relations to their indicators (Chin, 1998). In PLS, the sample size has to be a) 10 times larger than the number of items for the most complex construct, and b) 10 times the largest number of independent variables impacting a dependent variable. In our model, all construct variables have three items. Further, the largest number of independent variables impacting a dependent variable is two (PE and PEOU to BI). Thus, the sample for our group (32) is large enough, since it surpasses the recommended value of 30 (Chin, 1998). Reliability and validity of the measurement model

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are proved by measuring the internal consistency (Cronbach's a and Composite Reliability), convergent validity and discriminant validity (Average Variance Extracted-[AVE]) (Barclay, Higgins & Thompson, 1995). The structural model is evaluated by examining the variance measured (R2) by the antecedent constructs. Variance values equal to 0.02, 0.13 and 0.26 are considered as small, medium and large, respectively (Cohen, 1988). Moreover, a bootstrapping procedure is used in order to evaluate the significance of the path coefficients and total effects, by calculating t-values. In addition, Goodness of Fit (GoF) provides an overall prediction capability of the research model by taking into consideration the measurement and the structural models. GoF values of 0.10, 0.25 and 0.36 are defined as small, medium and large, respectively (Wetzels, Odekerken-Schröder & Van Oppen, 2009).

Table 1. The evaluation questionnaire

Perceived Usefulness of TLAV	PU1. Using TLAVs in my school can increase my awareness of the class's progress
	PU2. Using TLAVs can enhance my effectiveness in assessing my class
	PU3. I find TLAVs useful in my school
Perceived Ease of Use	PEOU1. Learning to use TLAVs is easy for me
	PEOU2. I find it easy to get what I need from TLAVs
	PEOU3. My interaction with TLAVs is clear and understandable
Behavioural Intention to Use TLAV	BI1. I plan to use TLAVs in the future
	BI2. I intend to continue using TLAVs in the future
	BI3. I predict I will try to use TLAVs to monitor my class, whenever I have the chance to do so
Computer Self-Efficacy	CSE 1. I could complete a job or task using a computer if someone showed me how to do it first
	CSE2. I was fully able to use a computer and the Internet before I began using the TLAVs
	CSE3. I could complete a job or task using a computer

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6. Results

Table 2 confirms the adequate values for the measurement model. This table shows the items' reliabilities (Cronbach's a, CR), AVE and factor loadings and confirms convergent validity.

Table 2. Results for the measurement model

Construct Items	Factor Loading (>0.7)[a]	Cronb. a (>0.7)[a]	CR (>0.7)[a]	AVE (>0.5)[a]
CSE		0.932	0.976	0.932
CSE1	0.948			
CSE2	0.980			
CSE3	0.967			
PU		0.801	0.923	0.801
PU1	0.885			
PU2	0.887			
PU3	0.913			
PEOU		0.829	0.936	0.829
PEOU1	0.870			
PEOU2	0.930			
PEOU3	0.931			
BI		0.790	0.918	0.790
BI1	0.900			
BI2	0.853			
BI3	0.911			

[a] Indicates an acceptable level of reliability and validity

In addition, Table 3 shows the correlation matrix for the measurement model. The diagonal elements are the square root of the AVE of a construct. Discriminant validity is confirmed since the diagonal elements are higher than any correlation with another variable (according to the Fornell-Larcker criterion).

Table 3. Discriminant validity for the measurement model

Construct	CSE	PU	PEOU	BI
CSE	**0.96**			
PU	0.56	**0.89**		
PEOU	0.77	0.59	**0.90**	
BI	0.57	0.78	0.57	**0.88**

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A bootstrap procedure with 1,000 resamples was used to test the statistical significance of the path coefficients in the model. The results for the hypotheses are summarized in Table 4. PU has a significant direct positive effect on BI. Moreover, PEOU is a determinant of PU as well, while CSE is a strong determinant of PEOU. Thus, all the hypotheses were confirmed.

Table 4. Hypothesis testing result

Hypothesis	*Path*	*Path coeff.*	*t value*	*Results*
H1	PU->BI	0.68	5.94	Confirmed
H2	PEOU->BI	0.18	4.38	Confirmed
H3	PEOU ->PU	0.59	5.24	Confirmed
H4	CSE ->PEOU	0.77	11.54	Confirmed

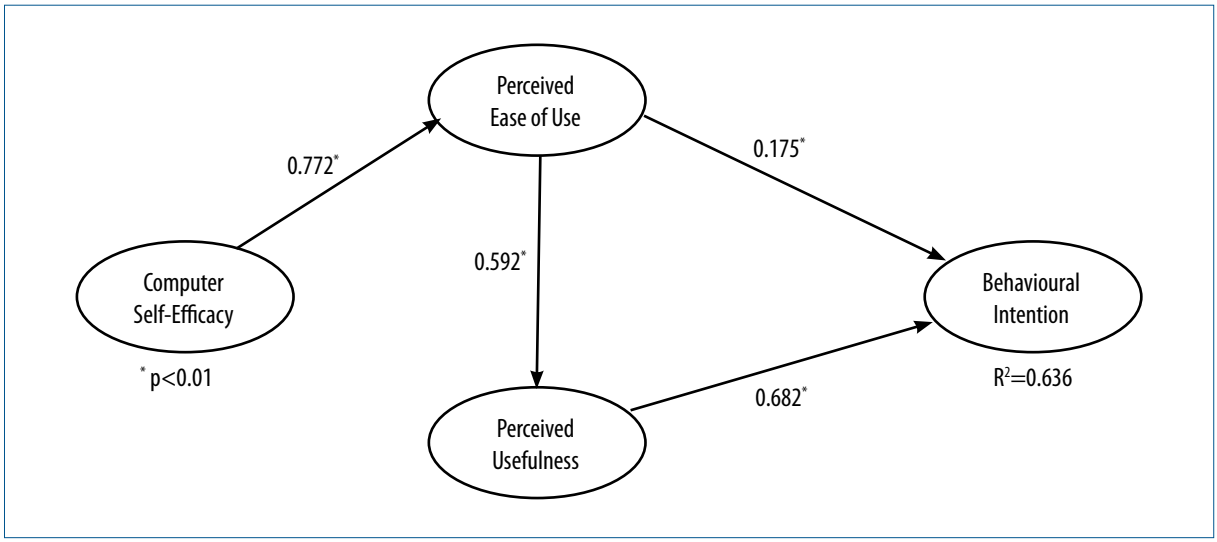
Additional to the direct effects, the structural model also includes indirect effects (Table 5).

Table 5. Hypothesis testing result

Dependent Variable	*R^2*	*Independent Variables*	*Direct effect*	*Indirect effect*	*Total effect*
BI	0.64	PU	0.68		0.68
		PEOU	0.58		0.58
		CSE		0.45	0.45

According to the GoF measure, the model explains almost 64% of the variance in BI (Table 6). These results are summarized in Figure 9. This figure illustrates the path coefficients for all initial hypotheses of the research model. It also depicts the overall variance (R^2) explained by the proposed model for BI to use the proposed visualizations.

Figure 9. Path coefficients of the research model



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7. Discussion

In this study, we present the results from our experimentation during the development and evaluation of Temporal Learning Analytics Visualizations (TLAVs). Our research is based on reported results regarding a) the capabilities of temporal data to explain students' behaviour during assessment procedures and b) the frequency of tracking and logging temporal data for visualization purposes.

For the purposes of our study, we followed a design-based research methodology consisting of two iteration cycles. During the first cycle, we collected the requirements and explored usability concerns regarding the design of the suggested visualizations. Twelve Secondary Education teachers were asked to indicate those characteristics that they considered necessary, useful, and easy to understand and interpret. We next embodied the identified learning-specific characteristics into the TLAVs. During the second iteration cycle, we asked 32 Secondary Education teachers to evaluate the proposed visualizations, according to the LAAM. All hypotheses were confirmed and it was found that the effects of PU and PEOU on BI are both strong (0.68 and 0.58, respectively). Further, we explored the effect of CSE on BI as an extension of this model. It was found that CSE has a strong indirect effect (0.45) on BI to use the learning analytics visualization tool.

The results of this evaluation phase showed that the proposed TLAVs are perceived as well designed, since almost 64% of the users claimed that they intended to use this type of visualization in the future. Moreover, most of them believed that TLAVs were perceived as useful and easy to use. These findings are encouraging, shaping a trend to integrate TLAVs in assessment systems in order to support teachers' awareness of the class's and each individual student's progress.

These results are in keeping with reported results from other related works (e.g., Ali et al., 2012; Govaerts et al., 2012). Indeed, they strengthen those results and further suggest that visualization of time spent on assessment activities could be adopted to help instructors interpret them intuitively and perceive hidden aspects of these data quickly.

Finally, given the larger sample size of our study (32 participating teachers), we anticipate that the findings from our study have a higher degree of validity than previous research on the related topic (e.g., Ali et al., 2012; Govaerts et al., 2012).

Currently, the TLAV tool is integrated into the LAERS assessment environment, but, due to the simplicity and commonality of the tracked data, it could be embedded in any learning environment. As a next step, we are planning to evaluate our approach with students, during an assessment procedure. We want to explore whether TLAVs are able to assist students to self-monitor, self-manage and self-reflect during assessment, and whether this mechanism has an impact on their overall performance.

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