APPROACHING OF ICT IN CO-CREATION OF DIGITAL EDUCATIONAL MATERIALS WITH SUPPORT OF AUTHOR’S TOOLS

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Abstract

The objective of this study is to integrate ICT (Information and Communications Technology) in a pedagogical environment and understand how it is related to the digital competences of the university instructor. In this context, our research seeks to demonstrate how we can generate, disseminate, and manage digital educational materials by using authoring tools and learning objects.

This study highlights the linking of co-creation components, focusing on the involvement of both instructors and students in the generation of digital educational materials. It should be noted that the co-creation concept comes from marketing. It implies the collaboration and participation of parties involved in various production processes and services. The study also addresses the co-creation issue as a factor which contributes to the generation of digital educational materials.

We review the current academic literature and analyze journals indexed in databases such as ISI Web of Knowledge, EBSCO, and Proquest SpringerLink, published during the last five years.

Our contribution to this field is to integrate the digital competences of the university professor, supported by ICT, into the pedagogical environment.

Keywords: digital competences, authoring tools, learning objects, co-creation.

1 INTRODUCTION

We live during a time of permanent technological development in information and communications - ICT. “Twenty-first century society, known as the knowledge society or information society, is characterized by the inclusion of mass communications media, computers, and social networks in all environments” [1, p.4]. Thanks to ICT and the digital world, information is everywhere and within reach of everyone. This reality has altered traditional educational principles, theories, and concepts. Education is one of the main human undertakings. Its goal is to facilitate better learning and teaching [2]. Under current conditions, “technological development and the work and practice of teaching should orient themselves towards a new paradigm that incorporates new methods of co-learning with the educational challenges of contemporary society” [1, p.4].

2 ICT (DIGITAL) COMPETENCIES IN TEACHING

Several authors have contributed to research on the competency levels of instructors with regard to the use of ICT [1]. “Terms such as virtual educational spaces, adaptive learning portals, education via the Internet (e-learning), and cognitive apprenticeship objects are being rapidly introduced into the vocabulary of educational professionals” [3, p.2]. Contributions to educational environment are made more complex because of the set of factors, issues, and agents involved, even more so if virtual spaces of teaching/learning are utilized [4]. The MUVE (Multi-user Virtual Environments for Teaching and Learning) demands techniques and competencies from the virtual instructor-tutor in order to make use of unique communications tools, as well as to mobilize differing strategies to teach the student to learn, rather than to serve merely as a content repository. In the higher education milieu, learning to work in a complex society demands both information and knowledge [5]. It is not solely a matter of polyvalence, but also of multiple competencies [6].

Institutions of higher education are applying ICT more and more to the task of supporting teaching within individual and group learning environments [7]. Under the circumstances, universities need to transform their teaching models and incorporate “blended learning” situations in which technology is a key resource in teaching innovation [8, p.3]. Combinatory learning modalities are one of the factors that have been and continue to be widely studied. Interest in them has evolved from a focus on their technical aspects to more didactic and curricular ones [9].
Teacher education and continual learning are essential to high quality education. Without a doubt, ICT extends bridges of teaching/learning and interrelationship between all those involved. In the teaching environment, the application of ICT requires the professional to demonstrate both technical and pedagogical competencies. That is to say, we must combine accessibility to these resources with their pedagogic implementation [10]. We need to produce educational resources that are integrated with ICT use, regardless of whether they are for on-campus or distance learning situations, or whether they are used synchronously or asynchronously. ICT is not merely a set of long-distance learning tools, but it also facilitates the capture, preparation, storage, and distribution of information [3].

In the teaching/learning process, the instructor is a central figure. Therefore, he/she needs to be familiar with and utilize skills and tools that expose ICT to learners. In the classroom, ICT includes various features that reflect familiarity with these resources, teaching methodology, resource selection, and assessment of the education received [10]. The instructor is the most important person in this matrix. The instructor has the responsibility to foster learning opportunities and an appropriate classroom ambience that facilitates learning and communication. Therefore, it is essential to develop ICT competencies and management skills for instructors [6]. In this context, teaching competencies consist of a set of concepts, skills, and attitudes (motivation, ethical values, emotions, interests, personality traits, and other social and behavioral components) that educational professionals need to resolve challenges that they face in a satisfactory manner [1].

Authors Mishra and Koehler have proposed the concept of TPACK (Technological Pedagogical Content Knowledge) as a framework for determining the set of knowledge domains and abilities necessary to teach effectively using technology. TPACK is made up of the following domains of knowledge: three domains of basic knowledge (content knowledge, pedagogical knowledge, and technological knowledge) and three domains of related knowledge (pedagogical content knowledge, technological content knowledge, and technological-pedagogical knowledge).

Content knowledge refers to the epistemological domain of curricular understanding that the instructor teaches. Pedagogical knowledge is the instructor's pedagogical practice, in terms of teaching/learning methods, classroom management, class planning, and student evaluation. Technological knowledge includes the skills for managing software and hardware, as well as a variety of other ICT-related tools. Pedagogical content knowledge is the organization, planning, and practical evaluation methods and processes that improve comprehension and content learning. Technological content knowledge encompasses the technology that influences content teaching and any transformations of technology that are due to teaching. Finally, Technological-pedagogical knowledge is an understanding of the potential and limitations of technology for educational use [11].

If we want to interconnect these knowledge domains, both basic and related, the instructor needs to balance them and demonstrate his/her competence in pedagogy, technology, and content. Together, the instructor can develop good educational practices using these technological tools. These competencies are developed in stages, according to their function in the teaching/learning process, the distinctive features of each student, and the interests of the instructor.

There is no doubt that ICT offers benefits and advantages. Nevertheless, two closely related problems often arise. First, teaching materials used in real virtual educational spaces often lack quality. Second, new technologies often represent a barrier to many instructors that results in a type of technological ostracism from current educational trends [3].

3 INTEGRATING ICT IN PEDAGOGIC PRACTICE

In order to live, learn, and work in an increasingly complex society that is knowledge-based and information rich, both students and instructors must use digital technology effectively. ICT “can help students acquire the abilities necessary to become competent in the use of information technology. They need to be information researchers, analysts, and evaluators. They must evolve into problem solvers and decision makers. They must be creative and effective users of productivity tools, communicators, team members, publishers, and producers responsible and capable of making contributions to society” [6, p.4].

The pedagogical process requires instructors to incorporate the advantages offered by ICT. Therefore, instructors must possess those competencies and resources that allow them to teach the classroom content in an effective manner. “Interactive simulations, open educational resources (OER), and sophisticated data collection and analysis tools, are some of the many resources that permit teachers
to offer students open possibilities that were previously unimaginable so that they can assimilate key concepts" [6, p.3]

Current teaching practice, knowledge disciplines, and a combination of ICT competencies demand innovations in teaching that affect curricula, academic organization, and teaching/learning strategies. These innovations lead to quality improvements in the educational system. One should emphasize that the quality of learning is not just centered on what student learn, but also the manner in which they do so. The instructor acts as a guide and administrator of the learning environment.

Pedagogy forms the main axis in knowledge creation. It focuses the discussion on critical points, offers solutions, responds to the various contributions that students make, and synthesizes them. It requires participants to shape a rich collaborative environment, functional standards, and certain technical aspects for available resources [4].

Integration of ICT within the teaching practice in the classroom depends on the abilities and competencies that instructors have to structure the learning environment into a non-traditional space. The idea is to foster dynamic classes and stimulate cooperative interactions, collaborative learning, and teamwork. "Changes to pedagogic practice assumes the use of technologies, tools, and a variety of digital content as part of teaching activities both individually, in groups, and in the class as a whole" [6, p.15]. The activities that support teaching should include the use of computers and software, network access, and web content. The competencies relevant to teaching include basic ICT competencies, curricular objectives, defined evaluation focuses, curricular modules or thematic cores, didactic methods, and proof of learning. Instructors who are supported by ICT are able to manage class data and develop themselves professionally.

In this environment, pedagogy produces changes in the evaluation process, since it is focused in solving complex problems by applying collaborative learning. In this type of learning, teaching/learning is student-focused; it generates, implements, and monitors projects and potential solutions. It emphasizes teamwork for longer-term projects. The role of the instructor is to structure tasks, guide understanding, and support individual and group projects. Besides using ICT within the classroom, instructors use networks to contact experts and collaborate with other teachers, with the goal of accessing information that contributes to their own professional development. "Skills such as problem solving, communication, collaboration, experimentation, critical thinking, and creativity are converted by themselves into curricular objectives, which then evolve into objects for new evaluation methods" [6, p.13]. In collaborative learning, both classroom structure and classroom time become more dynamic, which lets students better grasp its main concepts.

ICT-based educational resources should not be created by information technology and communications experts, but rather they should be defined pedagogically in order to create customized tools with interfaces that facilitate and integrate learning. Moreover, these applications should allow users to construct virtual spaces that incorporate educational components of three types: content, service, and authoring tools [12].

4 LEARNING OBJECTS AND AUTHORIZING TOOLS

In line with [13], the teaching/learning process, distributing educational content requires quality didactic materials. Likewise, didactic materials utilize both educational resources as well as didactic media. In this context, one can point out that didactic media facilitate teaching and learning with the goal of developing student skills, abilities, and competencies.

ICT offers an infinite number of possibilities to instructors for generating educational activities that students can use in the classroom [14]. According to [15], new technologies demand new knowledge transfer bases that are adapted to the new classroom tools. Consequently, they introduce components that increase visual modalities and that facilitate student interaction in distinct learning stages: self-evaluation and space-time distribution in learning.

Given these effects, we want to elaborate on one of the digital educational resources used for knowledge transmission: the learning object (LO). According to [16], LOs are independent digital units that are used repeatedly for educational purposes are basically limitless in scope.

For [16], learning objects (LOs) are characterized as being basic units of content. Consequently, they are more discrete than lessons or courses. They are, moreover, reusable. Likewise, [17] state that LOs self-containing and reusable units applied for educational purposes. Their minimal content includes relevant material, learning activities, and contextualization components. All LOs are editable.
To this framework, we can note additional features of LOs: “modifiable, interactive, with standardized formats and properties (metadata, SCORM, etc.), and variable granularity (adjustible in terms of having more or fewer components)” [15, 157].

To complete the set, we need to discuss authoring tools (AT), applications that instructors use to create educational materials and, in accordance with [18], reduce the time instructors need to invest in producing educational materials, since they offer a a variety of user-friendly, interconnected components.

Uriarte, Berasaluce, and Gómez state that the essential characteristic of ATs is that “they do not require instructors to receive any specific training in order to use them” (138). Moreover, they explain that ATs are applications with predefined templates that instructors can use to create learning content with multimedia links.

According to [19], ATs offer several important advantages, among which are: student autonomy, a collaborative work approach, and instructor evaluation. These stand in contrast to what was previously mentioned, that is, disadvantages such as technical problems, instructor training, accessibility problems, etc.

Among the authoring tools that stand out, we want to note: ARIES, commonly applied to augmented reality simulations; COGNITOR, used for course creation; HOT POTATOES, designed for simple and multiple choice, crossword design, fill-in-the-blanks, etc.; and SMARTNOTEBOOK, an application that facilitates simple and multiple choice activities, pairing, sound identification, word order, etc.

5 LINKING CO-CREATION TO GENERATING DIGITAL EDUCATIONAL MATERIALS

Knowledge co-creation is based on distinct processes in which knowledge is not only shared, but also is developed together among all parties involved. Applying co-creation to the educational environment is achieved with active collaboration with the student, using alternative means through which students assume a key role in their own teaching and learning activities.

The application of ICT in this context regains a prominent role when solutions appear that represent engaging and fun means of learning (virtual games). Students become co-creators of content, initiating collaborative activities and interaction between members of a virtual community. This type of system leads to the development of activities based on narration, imagination, exploration, and knowledge co-creation. In these types of virtual environments, activities are co-created with the participation of all agents, enabling teamwork skills. In his study, [20] analyzes the impact that developing these imaginary worlds has on education, where context is developed free of restrictions. Rather, it fosters analysis and reflection in its participants. By using entertaining activities in virtual contexts, creativity in language is encouraged. The students feel they are working in an atmosphere of trust and humor. These digital technologies permit participants to develop pedagogical views centered on the student as an active member and co-developer of content during the learning process. ICT becomes a differentiating component that makes this pedagogical transition possible. When students co-design their learning tasks, the process propels autonomy and creative initiative [21].

When knowledge co-creation is strongly supported in the teaching/learning interchange, it can be promoted using other communications technologies such as blogs, in which information is generated and shared, and e-mail, which transmits knowledge. Likewise, we also encounter learning object repositories, or the LOR, defined as “a digital store box that provides services to designated communities by hosting collections of digital resources for learning and teaching” [22, p.333]. These LORs promote community learning, enhancing social interaction and digital knowledge co-creation with a high level of member participation through sharing resources and information.

There are other important electronic environments available through the web. Combined with in-classroom learning (b-learning), they offer high levels of human and technological potential. Thanks to these web-based resources, learning can be personalized in connection with the particular needs of each student. Co-participation is facilitated by on-line, creative learning activities that permit collaboration and long-distance teamwork. Thanks to these media, participation among interested parties is promoted [23].

Since they are content development and management technologies, blogs, wikis, and RSS (Really Simple Syndication) also encourage interactive and collaborative activities between students and instructors [24]. They set up a flow within co-produced content, empowering "individual and collective
reflection regarding learning experiences” (p. 1). By exploiting co-creative spaces, this technology develops cognitive abilities in students, which then permits them to solve problems within the digital environment. Wiki’s potential, for example, is based on the fact that it allows one to interact with a document. By using interactive documents, both instructors and students can follow up on the development of any specified task. Such documents facilitate monitoring and streamlining of group projects.

ICT applications serve as powerful solutions to create co-creative spaces in the educational environment. By using digital educational materials, knowledge and information flow is enhanced between students and instructors. Although there are alternatives that can be easily applied, the need to enhance the skills of participants remains. It is in our interest to have a better grasp over the alternatives, as well as to strengthen the technological infrastructure that encourages correct use of this technology.

6 EVIDENCE FROM CASE STUDIES OF IMPLEMENTING DIGITAL EDUCATIONAL MATERIALS

According to [25], the Universidad de Salamanca (University of Salamanca) undertook a research project in which it adapted the European Higher Education Area (EHEA). The project’s aim was to learn how instructors use the tools mentioned above, and what competencies instructors need to acquire in order to use these tools effectively. The results from the research are as follows. 65% of instructors integrate ICT in their activities. These activities include Internet access, resource searches, information for class preparation, web site searches related to themes that they can recommend to students, communication using electronic media, and PowerPoint presentations for teaching. Between 35-65% of instructors are in the process of implementing such activities. These would include student-initiated information searches using virtual media directed at problem solving; specific, professional computer programs for managing issues; and publishing activities on the Internet related to the subjects taught. Finally, less than 35% of the instructors engage in less frequent activities, such as designing multimedia materials for student use, using ICT to collaborate with colleagues on identifying activities and resources, and using on-line tutorials to follow up on student learning activities. We can conclude that more than 50% of the university instructors at the Universidad de Salamanca use ICT as a means to create and distribute content and didactic materials, and that their students can access resources that foster the instructor-student bond. We don’t doubt the utility of these tools in helping instructors to offer more personalized attention and continual supervision. They definitely empower various competencies in those being educated, including autonomy, responsibility, continual education, collaborative learning, etc.

In addition, as [26] notes, the incorporation of ICT can be applied to education in a critical manner. For example, various strategies can be implemented to improve university-level teaching practices, such as the creation of a new technologies department made up of engineers and psychologist dedicated to developing educational applications; the development of awareness and training programs whose aim is to incorporate ICT into the teaching/learning process; and the acquisition of technological resources to support two-way audio and videoconferencing. These are some of the management strategies that educators and administrators can implement. Beyond this, there are also strategies aimed at improving teaching practice: creating an institutional program that includes a web catalogue, virtual classroom, digital classroom, on-line classes, and a multimedia educational materials program (MEM) that aids instructions in producing and evaluating those materials that are integrated into the curricula. The results from the Universidad del Norte (University of the North, Colombia) reinforce this impression. This institution currently has 49 virtual environments for undergraduates, 40 for graduate programs, and 25 available to extension services. Academic programs that offer virtual courses include: business administration, law, nursing, systems engineering, civil engineering, electrical engineering, industrial engineering, social communications, psychology, childhood education (B.S.), various specializations (finance, pedagogy, environmental management, and clinical psychology), and business administration (M.S.). Currently, the university has developed seven educational software applications for its Schools of Health, the Engineering Schools, Administrative Sciences, Humanities, and Basic Sciences, that are the result of a training program in educational software design implemented by the institution. In addition to this, the institution has also created a catalogue of didactic material for different educational fields. Its goals is to provide instructors with educational resources according to their specialization. The adoption of these strategies indicates that implementing new information and communications technology encourages positive teaching/learning practices; improves the ability of instructors to teach classes; contributes to the development of skills,
both in students and instructors; and serves as a key pillar for transforming regions and nations both socially and culturally.

Finally, [27] shows that learning objects are a key tool that complements the development of educational content using authoring tools. LOs allow users to exploit all the potential that ICT offers. They increase easy-of-use and other benefits received when applied to distance education. To achieve these benefits and maximize technological-pedagogical potential, we recommend experimenting with authoring tools and Web 2.0 to develop learning objects. This should be done within the framework of the Support Project for Improving Teaching in the First-Year of the Programs in Exact Sciences, Chemistry, Economic Sciences, and Information Technology (PACENI, Argentina). The goal of this program is to improve academic performance indices, the teaching/learning process, and the students’ comprehensive education. Therefore, in line with what we have reviewed above, the Instituto Universitario Aeronáutico (University Aeronautics Institute) has undertaken the difficult task of adopting collaborative tools to develop learning objects. IUA has evaluated the following: LO integration tools geared for specific management applications; structural development and packaging according to the international standards that apply to LO production and implementation; and tools from contextual content editions of LO, which are applications that empower on-line resource development in a collaborative manner. Therefore, we used a total of seven authoring tools, two from the first group (exeLearning and RELOAD), and five from the fifth group (Youtube, MindMelater, Dipity, Issuu, and ScreenCast-O-Matic). Given that the creation of didactic materials should be oriented towards improving teaching practice and identifying the student as the core player, we can say that these tools have facilitated collaborative participation between the instructors and the development team. These tools create a module for planning and evaluating the teaching, learning, and communications processes. They result in an increase in educational practices that foster meaningful knowledge acquisition based on support from the above mentioned resources.

7 CONCLUSION

Information and Communications Technology plays a huge role in the educational environment, but the successful and beneficial incorporation of these technologies depends not only on educational centers, but also on the whole institutional framework. Using ICT is a key component in studies of the teaching/learning process, since this technology serves as an engine of growth for practical knowledge. Instructors need to demonstrate competency in various areas, such as openness toward and familiarity with instructional resources; technological and didactic innovation; strategies that favor educational processes; new forms of organization and evaluation; communications methods, and a results-oriented approach. Instructors will know how, where, and when to use (or not use) ICT to carry out activities and class presentations so that they can fulfill management objectives and obtain knowledge that contributes to their own professional development. But in spite of this impressive technological development, ICT continues to be a medium that is a complement to, rather than a substitute for, educational practices. That is, instructors will retain their capacity to create and freedom to make decisions. It is the instructors that will guarantee, whether or not, that these strategies satisfy educational needs and concerns.

We need to think about the following: integration in a content-based, virtual educational space; the platform upon which tools are organized; and the services that allow instructors to manage knowledge. Interactive content development evolves in a sequential manner until it reaches a point where authoring tools that support instructional work are being developed to match specific aspects of education. This evolution should flow in harmony with the emergence of instructional competencies. We also recognize the need of instructors to receive training in the use of tools; the design of materials, content, and objects; and the use of available resources that create effective and real virtual educational spaces supported by active educational components that work alongside ICT.

Using ICT to create digital educational materials exposes certain adaptation factors that we need to keep in mind in order to achieve satisfactory results. Among these we should mention the instructors’ education in digital competencies that allow them to manage the authoring tools and also, at the same time, think about using alternative teaching methods.

Digital tools that are used by both students and instructors to co-create content form an innovative alternative in educational environments. With the goal of empowering both students and instructors, it is essential to develop the ability to exploit these tools, as well as to create the physical infrastructure that favors their implementation.
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