

Educational resources with digital contents for pedagogical and research formation in technologies of knowledge and learning

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Abstract. When teaching in education, we confront pedagogical challenges due to continuous changes in technologies and adjustments to curriculums in academic programs of informatics and computational sciences. These emerging technologies require of a student to appropriate of new challenges, concepts and models for their performance in their labor. One way to achieve this is through courses or diplomats, looking for having a professional and informed future according to the vanguard of changes in new technology. In this context, it is presented an educational experience centered in cooperative learning with design, development and implementation of a diplomat. Five virtual objects were used. This was a qualitative and descriptive research with a case of study as an investigation model. Results were positive in the construction of significant knowledge as well as in the characterization of collaborative learning in evaluating category.

Keywords: Education, Education resources, Digital Systems, Technologies of Knowledge and Learning.

1 Introduction

This document plasms the results of a research that seeks to strengthen integration strategies with the new information and communication technologies in informatics and computational sciences using five virtual learning objects. These objects are used as learning strategies of clear design and application allowing interactive navigation and access to different web pages in order to build significant learning, and due to the previous, it can be used with students to characterize collaborative learning.

2 Description of the problem

Law 1341 of July 30th of 2009 establishes the priority to access and use of Information and Communication Technologies (ICT) in no discriminative conditions for all Colombian society, prioritizing access to production of goods and services. In the same way, guide number 21 highlights the importance of training competent students for them to carry out, effectively, a skill or skills in specific tasks. General and specific competences, as well as civic and basics, which must be developed through youth, are described as integrant part of the Colombian educational system. In chapter 1 of the Decennial plan of education 2006-2016 [1], a third subject is named as pedagogical renewal. Also, the uses of ICT in education in Colombia with the following macroeconomic objectives are described: Strengthening of pedagogical processes through ICT. Pedagogical innovation and interaction of educative actors. Strengthening educational projects and follow-up mechanisms

According to previous studies, it has been shown that one of the lines of thought that guide educational change is that linked to collaboration. The collaborative systems try to find a model that includes the different participants, the tasks to be carried out and the modes of collaboration. The role of technology is to facilitate communication, but it can also play the role of promoter and organizer by supporting the work of a group of people in learning tasks [2]. Therefore, the training activities carried out with systems engineering students have revealed new problems that make it necessary to advance the conceptualization of collaborative learning through educational research. One of the first elements to take into account as the basis of each learning, and especially the collaborative learning, is the communicative interaction.

When analysing the topic of collaborative learning it is necessary to make some clarifications. According to some researchers [3], it is necessary to differentiate problem solving from cooperation learning and collaboration. From a psychological point of view, it is considered that learning and problem solving share similar processes, but for the computational sciences these are different. According to the above, [4] other authors describe this subject in a similar way.

Likewise, [5] it is described that collaborative learning involves the participation of "two or more people with the common goal of acquiring knowledge, who are willing to share their knowledge and experiences, within a framework of interaction and directed communication actions to achieve these goals".

In this way, collaborative learning is offered as an alternative to learning and improving competition and individualism.

Similarly, [6] it is indicated that a collaborative team must have a positive interdependence, individual responsibility, promote interaction and proper use of social skills, are elements that generate conditions for effective collaboration. Collaborative learning is characterized by its autonomy, leadership, assignment of tasks, time management, responsibility in activities and others; although the collaborative work is intended to build new ideas, the teacher predetermines the working groups and gives working guidelines.

2.1 Research question

What are the characteristics of collaborative learning when implemented as a strategy in a diploma with open digital resources for undergraduate students in informatics and computer science?

2.2 General objective

Characterize collaborative learning by developing a didactic strategy that strengthens cognitive skills with open digital resources for undergraduate students in informatics and computer science

2.3 Specific objectives

- Design a didactic strategy to strengthen cognitive skills for collaborative learning with open digital resources for undergraduate students in informatics and computer science
- Implement the didactic strategy in students of the degrees in computer science and computer science to strengthen the social appropriation of meaningful knowledge
- Analyze collaborative learning in the category of social habits through the application of the didactic strategy

3 Theoretical framework

ICT can be defined in two ways: traditional communication technologies, consisting mainly of radio, television and conventional telephony; and modern technologies such as information technology and telematics. ICT can contribute to universal access to education, equality in teaching, teaching experience and high-quality learning, as well as professional development. ICT is a tool for new education [7].

From a pedagogical approach this proposal is framed in a constructivist model considering that learning virtual objects are a set of digital resources, as it is stated in the

web page Colombia Aprende, and can be used in different contexts [8].

In the approaches of social constructivism there are open paths for the development of collaborative learning. Psychologists [9] developed theories that, rather than the psychological contribution, make a social contribution that serves as a basis for what collaborative learning implies. Constructivism states that each individual, as his name implies, is able to build his own learning using his skills and, from Vygotsky's perspective, through the social. Constructivism seeks to help students internalize, reorganize, or transform new information. This transformation occurs through the creation of new learning and this comes from the appearance of new cognitive structures [10].

The present research work from the socio-constructivist position requires a flexible design, which facilitates the construction of meaningful knowledge, through progressive research, participation, organization and structuring of activities, directed and accompanied by the tutor.

In the case of the implementation of collaborative learning in LVO design, some authors [11] mention that they are the same partners that make up the social environment. They carry out different processes of intervention, contributions, corrections, revisions, suggestions, among others, thus building a network of support and development of collective learning. Group processing, according to researchers [12], can be defined as reflecting on a group activity to see which actions of its members are useful and which are not useful and to make decisions about which actions to maintain and which ones to change.

The purpose of group processing is to clarify and improve the individual effectiveness of each group member and, therefore, the group as a whole.

It is suggested a relationship between the conception of knowledge with the new technologies and the area they cover for the execution of projects and group work that need constant interaction between subjects asynchronously. According to research [13], the main characteristics of collaborative learning are positive interdependence, interaction, individual contribution and personal and group skills. Some [14] affirm that collaborative learning develops critical thinking, knowledge development, continuous reflection, the transformation of initial learning and the use of ICT.

Collaborative learning is characterized by three families of analysis: collective interdependence, social habits and evaluation processes. For this project we have focused on the analysis of the family: social habits.

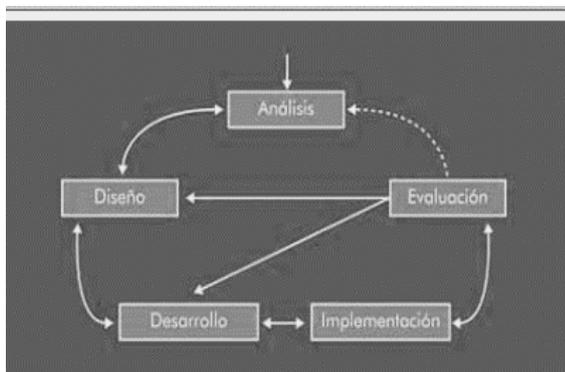
The subcategories and descriptors within this family are described in Table 1

Table 1. Family analysis of the social habits category. Source: Johnson and Johnson (1999)

SOCIAL SKILLS		
INDIVIDUAL RESPONSABILITY	COEXISTENCE RULES	DEFINITION AND UTILIZATION OF DEVELOPMENT AREAS
<p>It recognizes itself from its powers and makes them available to the group.</p> <p>-Learns to respect the participation and collaboration of others.</p> <p>-He acquires skill in the planning and administration of his time and his competences to develop the actions proposed by the group against the intention to achieve the objective demanded in the task.</p>	<p>-You learn to listen actively. The basic techniques and procedures for collectively interacting are recognized.</p> <p>- Learn to build consensus and assume responsibilities assigned by the group.</p> <p>-You learn to build good relationships between the members of the group.</p> <p>-You learn to accept and ask for help, how to respect and tolerate to the rhythm of others.</p>	<p>-Use of oral communication, graphic communication and textual communication as an element of support to the argumentative construction around the decisions that are made.</p> <p>- Management of scenarios where the representation of the processes and principles involved become explicit and tangible and differentiating the communication processes.</p> <p>-It is learned to make use of the design, as of the technologies and computer tools to assure the coordination and congruent construction of collectively of the product.</p>

There are several models of instructional design such as the Insured Model and the Instructional Model of Dick and Carey [15], among others. An instructional model containing a structured methodology is ADDIE, composed of five basic activities: analysis, design, development, implementation and evaluation. For the development of the present work we follow the ADDIE model [16] that we show in Figure 1.

Figure 1. ADDIE model [16]. Source: <http://bit.ly/13tnOxv>



4 Methodology

The methodology that is implemented in this study is qualitative, being a descriptive and interpretative study, considering the methodological rigor proposed by different authors [17]. The piloting was carried out with 70 students of the last semester of programs of degrees in computer science and computer science of different universities of the country. These adult students, who have a variety of electronic mobile devices and wireless connectivity, enrolled and met the requirements criteria. They interact through activities defined in learning virtual objects (LVO), which contain readings, case studies and problem solving.

For the construction of the LVO, two main aspects were considered: pedagogical design and content.

Content design: The thematic structure of the LVO was organized by sub-themes that were presented in tabulation format without transition. Each tab represented a topic. The content of the modules was provided with reference material from various sources and formats. In total, open digital educational resources, as well as Creative Commons licensed materials were used: PDF documents, ppt slides, flash, embedded HTML video with embedded code, images and links to specialized web pages. In the evaluative component, in addition to the disciplinary component oriented from the theoretical and practical, the student should have basic knowledge in the management of the platform and its automated protocols such as chats, forums, wikis, concept maps and online simulators.

Pedagogical design: The type of learning supported by the LVO focuses on the need to guide the student towards collaborative learning. The role of the tutor is: to design and develop the LVO, to accompany the student, to guide the development process of the thematic contents, to promote collaborative work through the discussion and analysis of the phenomena in the forums.

The analysis of the automated protocol "forum" was developed as follows:

- The category "Social Habits" and the "Individual Responsibility" subcategory of the category system [18] are developed (see Table 1)
- Based on the category system [18] the descriptors are created (see Table 2)
- 3 Forums are selected for a chat and a wiki for the application of the system of categories-subcategories-descriptors
- Each forum is independently coded
- The coding unit chosen is the complete message because some messages can be encoded with more than one descriptor

- Selected instruments (forums, wikis and chat) are independently coded and compared to the encodings made

- New situations encountered are included within the categories generated

- Each new category is defined and described so that it can be correctly integrated into the initial classification

- At the end of this process the quotations of a system of categories for the analysis of the collaborative learning or crowdsourcing with LVO are obtained. The triangulation of the information obtained in the instruments of forums is realized from its transcription and analysis line by line using the Atlas Ti software. The information obtained in the forums is intersected with the categories of analysis (shown in Table 1).

The initial codes are acquired from the criteria of relevance for the assertiveness at the crossing. The initial codes grouped into categories are the object of the realization of networks of analysis from which cross relations are established that allow initiating the interpretation of the data.

5 Results

The diploma with open digital resources for undergraduates in computer science and computer science was supported by five LVO.

The characterization of collaborative learning was obtained by crossing the three automated protocols (forums) with the narrative analysis of the messages (line by line). These activities gave data per line of text as follows: forum 1 (325 textual lines), forum 2 (458 lines), forum 3 (227 lines) Wiki (122 lines) chat (729 Lines). The characterization of collaborative learning was supported through the development of a system of categories of filters.

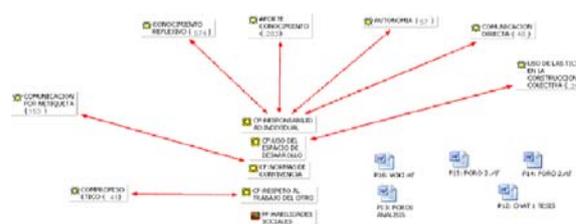
Table 2. Categories, subcategories and descriptor analysis

CATEGORIES	SUBCATEGORIES	DESCRIPTORS
Social skills	-Individual responsibility. -Respect to the other's work. -Coexistence rules. -Using the development space.	-Contribution to knowledge. -Autonomy. -Direct communication. -Reflective knowledge. -Ethical Commitment. -Netiquette communication. -Use of ICT in collective construction.

SOURCE: Own elaboration (2017).

These categories of filters were the descriptors identified by the investigators as shown in Table 2. The number that accompanies the subcategories and descriptors represent the relative frequency of the element once processed in Atlas TI software. The qualitative study carried out with Atlas TI generated the semantic network shown in Figure 3. This research was able to identify categories of narrative support that allow the collective interdependence of an approach [18] as shown in Table 2. These Categories describe criteria such as: Individual responsibility (Contribution to knowledge, autonomy, direct communication, reflective knowledge), Respect for the work of the other (Ethical commitment), Norms of coexistence (communication with netiquette), Use of development space In collective construction) as an emerging element, reflective knowledge) as sources of validity in learning.

Figure 3. Semantic network generated with Atlas TI software



The family of social skills is related to respect for the work of the other, ethical commitment with 41 interventions, the crossing of the 5 instruments 3 forums, a chat and a wiki, as well as the norms of coexistence given by the amount of netiquette In the dialogues with 153 interventions, the use of the development space, with the use of ICT as mediator and complement of information 29, individual responsibility observed with 574 reflective knowledge interventions, contribution to knowledge 283, autonomy 57 interventions, direct communication 48 interventions.

It can be inferred in this respect that reflective knowledge presents the greatest increase with 574 interventions when contributions are made from its practice, reflecting continuously on its work and the impact of it on the social collective.

In these graphs we can observe the highest percentage in each of the subcategories belonging to the category of social skills, the highest percentage versus reflective knowledge with 574 interventions and reflective knowledge with 283 interventions. In this category of social skills communication by netiquette is emphasized, the cordial, respectful and inclusive dialogue that allows the strengthening of ties of fellowship.

This confirms the importance of collaboration as an essential element in human communication systems. These categories are in convergence with the descriptors [18], alluding to a connection with individual processes, which induce autonomously to improve communication skills. These are refined to the extent that communication mechanisms and strategies relate to each member of the group.

6 Conclusions

The following research was able to characterize collaborative work in systems engineering students participating in a text mining diploma. Being able to design LVO in engineering areas becomes an excellent virtual pedagogical resource that can be used no matter where the person is. These learning objects fulfill the organizational scheme that is extracted from a pedagogical planning that allows improving and enriching the educational learning.

The use of LVO in the degree of mining of texts showed the benefits that can be obtained, which consist of having the ability to organize, classify and retrieve texts automatically, as well as the time management in an independent way allowing the accessibility to the contents of Learning, creating scenarios for the co-evaluation and facilitation of synchronous and asynchronous communication, breaking the barriers of space-time. These objects can be focused towards collaborative learning and can be identified as an exercise in determining the association scheme. This tool is positive because it reinforces communication, reflection, teamwork and helps strengthen the educational role that is expected to give today.

Collective interdependence was observed in the construction of learning supported by collaborative instruments in which there was no evidence of positions of competence but of group interaction. The interests were shared in the vocational training against their daily practice and work experience.

From the collaborative learning and the area of the computer science was propitiated the construction of significant knowledge in the subject of the mining of texts.

The process of analysis with the Atlas TI tool contributed to the characterization of collaborative learning, evidenced through the semantic network.

The analysis process can be said to have been a good strategy. The analysis in Atlas TI contributed to the characterization of the collaborative learning and with the description of the categories was achieved the analysis of the learning.

This affirms the importance of collaboration as a prevailing element of human communication systems. With these categories we can analyze that they are in convergence with the descriptors [18] referring to a connection with individual processes, that autonomously

induce to improve communication skills, these are perfected in the measure in which the mechanisms and communication strategies are related to each member of the group.

7 Recommendations

As a continuation of this work we intend to analyze the categories collective interdependence and evaluation processes to fully characterize collaborative learning with open digital resources for undergraduate students in computer science and computer science.

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