Technology educational affordance: Bridging the gap between patterns of interaction and technology usage

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Summary

This paper reports on an empirical and descriptive investigation into how teachers and learners use technology in three prototypical learning activities in a higher educational online learning environment. Additionally, the relationship between the educational uses of technology and the overall educational patterns of interaction between teachers and learners, and among learners themselves was analysed. Detailed teacher and learner self-reports about their teaching and learning activity; the asynchronous written messages teachers and learners sent as educational interaction in the online learning environment; and documents produced by students were all obtained. The results from the three learning activities indicated six overall educational uses of technology in an online learning environment. Moreover, the results also indicated differences in technology usage in some different patterns of educational interaction in each learning activity. In conclusion, we argue that the notion of technology educational affordance is useful as an effective bridge between the real use of technology and instructional aims. Therefore the distribution of educational uses of technology is not only related to some attributes of both technology and instruction but also to its interaction.

Keywords

Online learning environments; Educational technology usage; Patterns of educational interaction; Educational technology affordance; Higher education

I. Introduction

Current theories in Educational Psychology are mainly based on the cognitive and social processes of teaching and learning (Salomon and Perkins, 1998; Anderson, Greeno, Reder, and Simon, 2000). From this perspective, learning is considered to be the individual construction of knowledge resulting from social educational interaction among participants and by interaction between students and the tools used for educational purposes.

Online learning environments are particularly suitable for the study of social and individual aspects of learning. To investigate these educational contexts one must consider the fact that technological environments, which include educational resources, technological tools and participants, form a complex and comprehensive system in which a collection of educational interactions take place that are uniquely accessible and analysable from a systemic perspective (Wilson, 2004).

From a psycho-educational point of view, the online learning environment is nowadays seen as a new educational context with its own specific nature, in particular when web-based instruction is used alone, without any type of face-to-face teaching (Berge, 2000; Mishra, 2002). Within this new educational context, online learning environments based on asynchronous and written communication (Blignaut and Trollip, 2003) are considered an important development area of teaching in higher education, as well as being an important current research trend in the psycho-educational and education technology fields of research (Winn, 2002).

Online learning environments are characterised as being systems composed of a diversity of interrelated technological tools that enable teachers and students in higher education to develop a complex dynamic of educational interaction based, in many cases, on a student-focused learning approach. Internet based technology allows teachers to influence the management of the learning process, provide educational material, promote knowledge building, communicate with students and assess their learning. This technology also enables students to take an active role in their learning process by allowing them to access information and communicate from anywhere at anytime (Lim, 2004). These two specific aspects—the educational use of technology and the educational interaction between teachers and students, and among students themselves—are two of the main dimensions used to analyse the educational quality of online learning environments (Barbera, 2004).

II. Theoretical framework

a. Online dialogue as a pattern of educational interaction

From the point of view of a student-focused approach to learning, it is considered that students' activity mediates and determines their learning. Students' learning activity depends on the type of instructional strategy used and the way in which this strategy is carried out using technology, or rather, how students use and adapt this technology for the purpose of learning within the framework of the instructional strategy (Wilson, 2004).

The instructional strategy can be considered—at a pedagogical level and from a social and communicational point of view—as a written dialogue between participants, carried on by means of educational actions, which form interconnected patterns of interaction. This dialogue is demonstrated through a collection of patterns of educational interaction between the participants. According to some authors (Burbules, 1993) four basic types of dialogue between teachers and students, and between students themselves, can be identified: a) inquiry; b) discussion; c) instruction; and d) conversation. These types of dialogue can easily be applied to educational activity and teaching and learning actions in online learning environments (Xin, 2002).

a) Cooperative or collaborative group work is a typical example of a learning activity based on 'dialogue as inquiry'. The role of the computer in the classroom relative to collaborative learning was studied more than a decade ago. However, not until more recently have studies been carried out into cooperative group learning in online environments, whether analysing the design, development and implementation of online learning environments to favour collaborative learning (Kirschner *et al.* 2004), or whether studying the use of Internet based technologies and the analysis of social interaction (Resta and Laferrière, 2007). In specific relation to cooperative group learning, the different ways in which technology can support this learning are well known (Van der Veen, 2001), such as favouring knowledge building processes in cooperative groups to resolve complex learning problems (Beers, Boshuizen, Kirschner and Gijselaers, 2005; Puntambekar, 2006), and social interaction produced in asynchronous discussion groups (Schrire, 2006). In Schrire's work the relationships that can be established between the type of social interaction among participants and certain characteristics of the academic task are identified, for example, the phase in which students find themselves in the task of critical inquiry, and the 'movements' within social exchange structures.

b) and c) Online discussions or debates are a typical example of a learning activity based on 'dialogue as discussion and conversation' to different levels of demand. Study into learning through debate forums did not appear as a specific field of investigation until recent times (Zhu, 1998), and especially focusing the study on the analysis of participation roles in electronic discussions. Within the specific field of asynchronous written discussion, the main line of investigation has focused on the study of certain specific dimensions of educational interaction between participants from different perspectives, such as dealing with the quality of the participation (Järvelä and Hääkkinen, 2002) or the types of educational interaction between participants (Dysthe, 2002; Jeong, 2003, 2005). Other studies have applied more complex perspectives to the analysis of educational interaction. Aviv, Erlich, Ravid and Geva (2003) analysed knowledge building in asynchronous learning networks using various methods. Two of the aspects to focus on are the quality of the knowledge building process (evaluated by analysing the content), and the structure of social relationships (evaluated using Social Network Analysis of the response relationships among participants during online discussions). Schrire (2004) also analysed online discussions through different dimensions of social interaction and cognition. In her study she identifies a group of patterns of interaction in three online discussions. Although the three online discussions had similar patterns, she identified certain distinct patterns in each of them, and maintains that these differences were due to factors such as the role of the moderator and the structure of the instructional task, among others.

d) Individual work, through monitoring and assessing the process and results of students' learning, is a typical example of a learning activity based on 'dialogue as instruction'. Most research has focused on the study of how to involve students in online learning environments (Lim, 2004). Another large part of the investigation in this field has focused on comparative studies of the differential effects of collaborative learning, as opposed to individual learning during computer based instruction (Cavalier and Klein, 1998), or on learning in small groups as opposed to individual learning (Lou, Abrami and d'Apollonia, 2001).

As previously mentioned, to understand and explain teaching and learning processes that take place in online learning activities one must bear in mind, among other aspects, the way in which the design and the type of instructional strategy influence the dominant patterns of educational interaction between teachers and students, and among students themselves. However, the way in which teachers and students use the technological devices available, and their interrelation with the development of an instructional strategy carried out through a specific kind of learning activity must be also taken into account.

b. Technology usage in online learning environments

The main technological characteristic of these environments is that various technological tools are made available to participants for use in their educational activity. When considering the educational use of technology—as opposed to the technological characteristics of these tools—Van Braak *et al.* (2004) distinguishes between the use of technology during the instructional design and the use of technology during the instructional process.

We have focused on the second of these uses of technology proposed by Van Braak *et al.* and expanded on the contribution of Kirschner and Strijbos (2004) as well as considering studies carried out by Gibson (1977) and Greeno (1994). Based on these studies, we believe that the term *'technology educational affordance'* constitutes a sound conceptual framework to define any proposal to classify the educational uses of technology in learning activities in specific online learning environments based on asynchronous and written communication (see Chart 1).

By *'technology educational affordance'* we are referring to the fact that the real and potential possibilities of using technology for educational purposes, the characteristics of the user (teachers and students), and the characteristics of the educational context, all determine the particular educational interactions that really take place between users and technology in a learning activity.

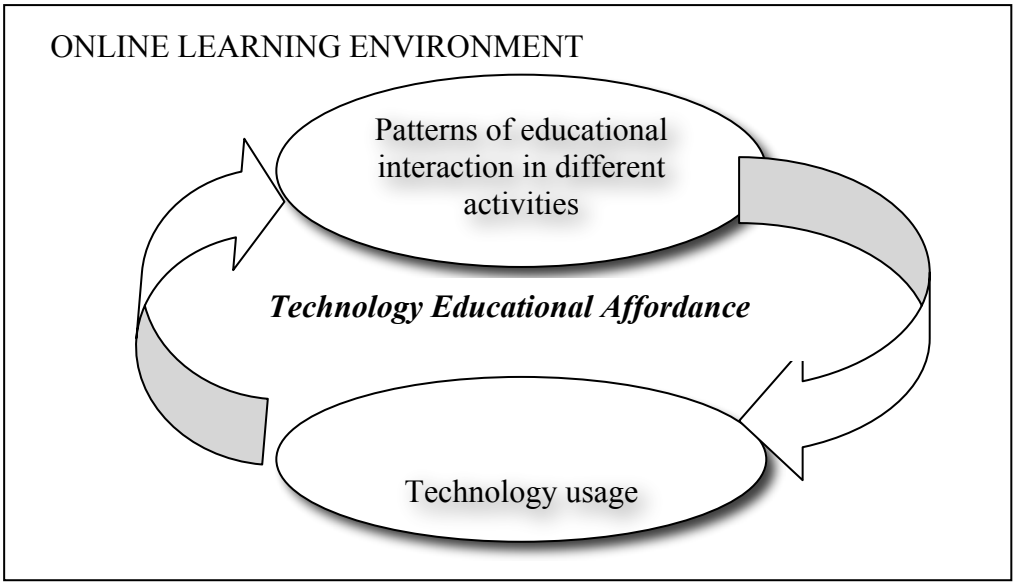

Figure 1. Interrelationship between patterns of interaction and technology usage

Within this contextual perspective of the educational use of technology, various classifications could be included, such as: the use of technology as a cognitive tool (Jonassen and Reeves, 1996; Lajoie, 2000); the use of technology within student-focused models (Barab, Hay and Duffy, 2000); or the use of technology as a learning tool (to develop skills, knowledge and understanding in a curriculum area), mathetic tool (to develop students' ability to learn and enhance their approaches to learning) and affective tool (to support and enhance the affective aspects of students' learning) (Twining, 2002). Or rather, understanding information and communication technologies (ICT) as having the potential to reproduce, process, transmit and share information (Coll, 2004) in teaching and learning processes, in such a way that the teacher, students and content do not have to physically be in the same training location. In spite of these studies, very little is known about the effective use made of technology in asynchronous learning environments.

III. Purpose of the study

This study attempts to reveal the dominant patterns of interaction displayed among participants in three different online learning activities in higher education, and their relationship to the technological use of tools.

The research questions included the following:

1. What are the predominant patterns of educational interaction in an online learning environment and how are they distributed within each learning activity?
2. How is technology used in an online learning environment and what is its presence in each learning activity?
3. What is the interrelationship between patterns of educational interaction and technology usage in each learning activity?

The rationale behind these questions is make an explicit relationship between patterns of interaction (question 1) and uses of technology in this framework (question 2) that traditionally are been investigating separately. Thus with this interrelation we will explore the position and level/category of affordance by revealing the need of a new element in the overall representation of an online teaching and learning process (question 3).

IV. Methodology

This research was based on case studies methodology. This methodology focuses on the study of the singularity and complexity of an individual case, with the aim of understanding the activity that develops. The case that was selected was made up of three suitable activities from a course considered to be representative of an asynchronous teaching and learning environment.

a. Participants

In accordance with Burbules' proposal, three learning activities with 758 exchanged messages were selected from to the same subject area. Two teachers and 77 students from the Instructional Psychology course at the Open University of Catalonia (a completely online course conducted through asynchronous and written communication) participated in these activities.

The online classroom is organised into different spaces: the planning area (syllabus, calendar…); the communication area (teacher's bulletin board, a forum and a discussion area); and a continuous assessment mailbox for students to send work to the teachers. There was also a space for resources and learning materials and a space with information about assessment. In addition to these areas, the teacher's and students' personal mailboxes and the group-work space were used.

The 758 messages exchanged were distributed as follows: bulletin board 26; forum 146; discussion space 377; and continuous assessment mailbox 209.

The three learning activities took place over a period of five weeks. The activities consisted of:

> 1st activity: partly individual work, and partly work in small groups consisting of the analysis of a subject. For group activities the students could also use a different space (outside the classroom) for group work which the teacher had access to.
>
> 2nd activity: asynchronous debate. The students were asked to participate in this space taking into account the contributions of their comments and the suggestions made by the teacher.
>
> 3rd activity: individual assessment activity, consisting of answering four questions about the content of the first and second activities.

b. Data collection

Two instruments were designed. The first was a protocol for carrying out interviews at the beginning, during, and at the end of the three learning activities. The aim of the first interview was to find out about the expectations for the planning and nature of the interactions between teachers and students. The following interviews had a double objective: to collect information about whether these expectations were met and to collect documentation students had created during the educational activity. The final interviews were designed to gather information about discrepancies or gaps that were produced during the learning activities.

The second instrument designed was a self-report form for teachers and one for students. The use of self-reports enabled us to collect information about the participants' activity outside the online classroom.

During the data collection phase four different types of data were obtained:

a) Messages exchanged between the teacher and the students in the communication spaces of the online classroom.

b) Documentation collected from the students and the teacher: interviews at the beginning, during, and at the end of the three learning activities and self-reports.

c) Documents related to the selected course: Instructional Psychology: syllabus, didactic material etc.

d) Learning products of the three activities.

c. Data analysis

The content of the online messages and the self-reports were codified into actions. One action is a basic unit of what the teacher and students did with the course content and in a particular online communication space at a particular time, for example: read messages from colleagues, print them, post a contribution to the forum, study the modules etc. 385 actions were identified. The collection of actions made up a database which enabled us to:

- Define regularities (repetition of dominant actions) from which consequent patterns of educational interaction emerged.
- Identify the presence and type of technology usage made in each of these (Coll, 2004).

V. Results and discussion

In response to the first question posed by this research—relating to the characterisation of dominant patterns of interaction in an online context—the following were identified:

a. Who the participants were and the direction of the interaction between them (initiative → reception);

b. What type of technology was used for the interaction;

c. What specific actions characterised the interaction.

The percentage of appearance for each of the patterns in relation to the total number of actions identified (Table 1) was also determined, and the distribution of the patterns in relation to the learning activities (Table 2) is presented below.

Pattern	a. Participants	b. Space in online classroom	c. Actions	% (n=385)
P1-Joint organisation and management of activity in the online classroom	T	Online classroom planning space	Location of calendar, lists of students…	14.72
	T ←→ Ss S ←→ Ss	Group work	Creation of working groups	
	T ←→ Ss	Forum and debate	Presentation, individual tests and exchange of doubts/questions	
P2-Individual organisation and management of activity in the online classroom	T ←→ S	Personal mailbox	Modifications to date of individual test	2.28
P3- Reading and study	T → Ss	Teacher's bulletin board. Outside the platform	Writing study guide. Reading. Underline and summarise the modules	29.70
P4-Presentation of group activity	T → Ss	Group work	Preparation and presentation of group work	1.78
P5-Carry out group activity	Ss → SS → T → Ss → T	Group work	Individual work, exchange of work, preliminary presentation of work, correction with comments, amend work to be handed in	18.78
P6-Close of group activity	T → Ss	Group work	Final correction of work and reading comments	5.33
P7-Presentation of debate	T → Ss	Debate	Preparation and presentation of debate activity	2.54
P8-Carrying out debate	T←→ SS →T	Debate	Preparation and presentation of interventions and selection for assessment	10.42
P9-Close of debate	T → Ss	Debate	Preparation of final summary	6.34
P10-Presentation of individual test	T → S	Personal mailbox	Preparation and presentation of the test	1.77
P11-Carry out the individual test	S → T	Personal mailbox and continuous assessment	Preparation and presentation of answers	4.06
P12-Close of individual test	T → S	Personal mailbox and continuous assessment	Correction of test and reading comments	2.28

Table 1. Characterisation of dominant patterns

KEY: (T) Teacher, S (Student), Ss (Students), SS (Students among themselves).

The patterns are grouped into three blocks of differing instructional nature (table 1): a) Management (P1 and P2); b) Study (P3); c) Learning activity (P4 to P12):

a) Management: P1 refers to actions related to the joint management of the online classroom that are connected to the three continuous assessment activities. P2 refers to classroom activity connected to the individual management of activities. This mainly consisted of managing the individual learning test carried out at the end of the three learning activities, and appeared through private messages between teacher and student in relation to doubts or questions about the procedure for handing in the activity.

b) Study: P3 refers to all the actions related to individual work with course materials—mainly carried out without the use of ICT.

c) Learning activity: From the fourth pattern onwards the rest of the patterns follow a similar outline in which each activity is reflected (group, debate, and individual test): 1) the start or presentation of the activity (P4, P7 and P10); 2) the development and carrying out of the activity (P5, P8, P11); 3) the finalising or closing of the activity (P6, P9, P12).

The role played by transversal patterns related to the management and organisation of activities (P1+P2=17%), and to study (P3=29.70%) stands out clearly, and accounts for almost half of the total patterns (46.70%). In fact these patterns do not appear chronologically at the beginning of the three learning activities but are mixed in among other activities. These results show the categorical importance of questions related to the organisation and management of online teaching of this type, as well as revealing the real importance of individual work carried out by students using study materials outside the platform itself.

In relation to shared content in the three online activities, two different points were observed. First, the greatest specific number of phases was when the three activities were being carried out (P5, P8 and P11) as opposed to during the initial phases (P4, P7 and P10) and closing (P6, P9 and P12). Second, there was a greater complexity of patterns, given that they involved the teacher and students following various communication flows. The patterns of interaction profiled at the beginning of the different activities are all the same and the same as the patterns represented in the closing of the three activities. This is the most common pattern and follows the simple unidirectionality of teacher to students (or student in the case of the individual test).

Of the total of 385 actions, 88 were carried out without the use of technology (studying units of content: 73.8% in the first activity; 15.9% in the second activity; 10.2% in the third activity), while the remaining 297 corresponded to actions carried out in the different spaces of the online classroom. Given that our objective was to determine the distribution of patterns of interaction according to the learning activities, those actions carried out using ICT were taken into account. The following results were obtained:

Learning activities / Patterns of interactions	Group (n= 173)	Debate (n=81)	Individual (n=43)	Total (n=297)
P1	25.43	4.94	23.26	19.53
P2	1.73	3.70	6.98	3.03
P3	23.12	1.23	2.33	14.14
P4, P7, P10	4.05	11.11	16.28	7.74
P5, P8, P11	34.10	50.62	30.23	38.05
P6, P9, P12	11.56	28.40	20.93	17.51

Table 2. Percentage of actions distributed into patterns and learning activities

A study of the similarities (a greater number of actions taking place during all of the activities) and the resulting differences (in the group work activity higher percentages were recorded in P1 and P3, and in the debate activity P8, but in the individual work activity P1 and P12) indicate that it is the pedagogical design, and not as much the technological design of the learning activities that has a strong influence on the patterns of interaction that appear predominately in the overall carrying out of each learning activity. The nature of the cognitive demand and the instructional characteristic of the learning activity have a determining influence on the type of educational interactions that will take place in that activity.

The second research question was to identify and characterise the different uses of ICT and the concatenation of the most frequent uses of ICT within each learning activity. The actions carried out by students using ICT were selected excluding those actions that did not use ICT.

The results obtained in relation to the total educational uses of ICT are presented in the following table.

Educational usage of ICT	Actions	Total (n=297)
Communicative usage	Exchange of messages in the public spaces—forum and debate—or via personal mailbox in order to carry out the learning activity	52.86
Instrumental usage	Saving or printing documents or messages of interest in order to follow the course	19.87
Collaborative usage	Exchange of documents created through a joint learning activity	11.45
Cognitive usage	Writing and rewriting documents	7.74
Learning assessment usage	Sending partially or totally finished documents corresponding to continuous assessment activities	5.72
Content management usage	Sending attached documents (articles, websites,…) related to course content by means of a document presentation message	2.32

Table 3. Percentage of educational usage of ICT

Results show a collection of educational uses (not detailed in the previous table) that were not found in the three learning activities analysed or, if found had a frequency of less than 2% of the total. Uses that did not appear were those relating to: a) teacher action (help, expand on or substitute teacher action); b) monitoring, control and assessment of teaching and learning processes; c) interaction between students and the learning content (searching, selection etc of learning content). We consider that the main reason why these educational uses of ICT did not appear in the data obtained was due to the impossibility of making suitable use of the technological tools available in the online environment to carry out these educational functions. For this reason they cannot be developed in a satisfactory way even though it is clear that they could be necessary in certain learning activities. One example of this could be the possibility of the teacher being able to monitor, control and assess the teaching and learning processes in individual work.

A more detailed analysis of the results obtained shows that a high percentage of frequency of educational uses of ICT in the total instructional process is associated with the use of *communication technology* (CT), in this case designed using an 'adapted and varied' use of email to a particular type of online classroom. So, 70% of the total actions were carried out through the educational use of ICT for communication, collaboration and assessment of learning (52.86%+11.45%+5.72%=70%).

The rest of the educational uses of ICT that appeared in the three learning activities: the instrumental use; the use of ICT as a cognitive instrument; and the use of ICT as a repository for content—associated with the use of *information technology* (IT), appeared in a smaller percentage of occasions (19.87%+7.74%+2.32%=30%). They consisted specifically of students' use of computer software (document management and printing programmes, and word processing programmes) not directly linked from the point of view of the techno-pedagogical design of the online classroom.

With the same analysis applied to each of the three learning activities, the following results were obtained:

Learning activities / Educational uses of ICT	Group (n=173)	Debate (n=81)	Individual (n=43)	Total (n=297)
Communicative usage	52.02	58.02	46.51	52.86
Collaborative usage	13.87	11.11	2.33	11.45
Learning assessment usage	3.47	3.70	18.60	5.72
TOTAL CT	69.36	72.83	67.44	70.03
Instrumental usage	24.28	14.81	11.63	19.87
Cognitive usage	2.89	11.11	20.93	7.74
Content management usage	3.47	1.23	0.00	2.36
TOTAL IT	30.64	27.15	32.56	29.97

Table 4. Percentage of actions distributed into learning activities and uses of technology

The first consideration according to the data obtained is the strong similarity between the three learning activities in relation to their share of percentages of CT and IT use. As shown, there is an insignificant difference in the percentage of educational use of CT and IT across the three learning activities.

However, there are considerable differences between the three learning activities relative to the diverse uses of CT and IT. In relation to the use of CT, although the profile of use in the group work and debate activities is fairly similar, the profile identified in the individual learning activity clearly shows a significantly greater educational use as a learning assessment tool and less as a collaborative tool. There are considerable differences between the three profiles of educational use of IT in the three learning activities. In group work most of the learning actions consisted of instrumental use of technology; in the debate activity most of the learning actions are divided between instrumental and cognitive use; and finally, in the individual learning activity there were only two uses, cognitive and instrumental, the first with a percentage almost double that of the second.

Identifying concatenation of the educational uses of ICT means identifying the internal and inseparable relationships between certain uses of ICT during the course of carrying out the three learning activities. Below, a summary of some of the most frequent concatenations differentiated by learning activity is presented.

- In the group work activity the concatenation of the use of technology as a communication tool + collaboration tool + instrumental use (58.82% of total concatenations) stood out. An example being: reading students' messages about the organisation of the group, and the action and production of the activity and printing the document;

- In the online debate activity what stood out was the use of technology as a communication tool + instrumental tool (53.85% of total concatenations), for example: students reading forum messages and printing some messages;

- In the individual work activity most important was the use of technology to assess learning + for instrumental use (33.33% of total concatenations), for example: students reading teacher's messages on the bulletin board and printing the individual learning test.

This data indicates that, relative to the three learning activities analysed, the differential characteristics of the pedagogical design of each activity could strongly influence the appearance of significant differences in the concatenations of educational uses of the available ICT.

Of the indicated concatenations it should be added that certain other actions exist that are also intrinsically linked to and shape less frequent relationships. These have sufficient presence to be considered. They are simple concatenations of two types of ICT usage, for example:

- For the group work activity: the use of ICT as a communication tool + instrumental use (reading teacher's messages with guidelines and saving onto hard disk or printing);

- For the online debate activity: the use of ICT as a communication tool + collaboration tool (reviewing messages in the forum and answering a question or doubt, or reading messages in the debate space and answering by means of a message);

- For the individual work activity: the use of ICT as a communication tool + instrumental tool (reading messages from the teacher with individual test and saving the test to the hard disk).

The third research question was to identify the interrelationship between patterns of educational interaction and the distribution of technology usage in each learning activity. The following three tables show the results obtained for each learning activity, presenting each of the percentages resulting from the combination of a particular pattern of educational interaction developed through a specific educational use of ICT.

Patterns of interaction / Educational uses of ICT	P1 (n=44)	P2 (n=3)	P3 (n=40)	P4 (n=7)	P5 (n=59)	P6 (n=20)	Total (n=173)
Communicative usage (Com)	18.50	1.73	12.72	1.73	12.14	5.20	52.02
Collaborative usage (Coll)	1.16	0.00	2.89	0.00	9.83	0.00	13.87
Learning assessment usage (Lea)	0.58	0.00	0.00	0.00	1.16	1.73	3.47
Instrumental usage (Ins)	5.20	0.00	4.05	1.16	9.25	4.62	24.28
Cognitive usage (Cog)	0.00	0.00	0.58	1.16	1.16	0.00	2.89
Content management usage (Cont)	0.00	0.00	2.89	0.00	0.58	0.00	3.47
TOTAL	25.43	1.73	23.12	4.05	34.10	11.56	100.00

Table 5. Percentage of actions distributed into patterns of educational interaction and educational use of ICT in the group working learning activity

Patterns of interaction / Educational uses of ICT	P1 (n=4)	P2 (n=3)	P3 (n=1)	P7 (n=9)	P8 (n=41)	P9 (n=23)	Total (n=81)
Communicative usage	4.94	3.70	1.23	6.17	30.86	11.11	58.02
Collaborative usage	0.00	0.00	0.00	0.00	11.11	0.00	11.11
Learning assessment usage	0.00	0.00	0.00	0.00	0.00	3.70	3.70
Instrumental usage	0.00	0.00	0.00	2.47	6.17	6.17	14.81
Cognitive usage	0.00	0.00	0.00	1.23	2.47	7.41	11.11
Content management usage	0.00	0.00	0.00	1.23	0.00	0.00	1.23
TOTAL	4.94	3.70	1.23	11.11	50.62	28.40	100.00

Table 6. Percentage of actions distributed into patterns of educational interaction and educational use of ICT in the debate learning activity

Patterns of interaction / Educational uses of ICT	P1 (n=10)	P2 (n=3)	P3 (n=1)	P10 (n=7)	P11 (n=13)	P12 (n=9)	Total (n=43)
Communicative usage	23.26	6.98	0.00	0.00	2.33	13.95	46.51
Collaborative usage	0.00	0.00	2.33	0.00	0.00	0.00	2.33
Learning assessment usage	0.00	0.00	0.00	9.30	6.98	2.33	18.60
Instrumental usage	0.00	0.00	0.00	4.65	4.65	2.33	11.63
Cognitive usage	0.00	0.00	0.00	2.33	16.28	2.33	20.93
Content management usage	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	23.26	6.98	2.33	16.28	30.23	20.93	100.00

Table 7. Percentage of actions distributed into patterns of educational interaction and educational use of ICT in the individual work learning activity

Considering the interrelation between the educational uses of ICT and the patterns of educational interaction (named *set of actions*), great differences in the specific development of the *technology educational affordances* were found.

During group work, 8 *sets of actions* were produced, accounting for 77.46% of total learning actions: P1-Com; P1-Ins; P3-Com; P5-Com; P5-Coll; P5-Ins; P6-Com; and P6-Ins. And, more

concretely, 45.09% of the total learning actions were carried out only using a combination of four patterns of educational use of ICT: P1-Com; P1-Ins; P5-Com; and P5-Ins.

In the debate, 6 *sets of actions* were produced which alone, accounted for 72.84% of the total learning actions. These were: P8-Com; P8-Coll; P8-Ins; P9-Com; P9-Ins; and P9-Cog. And specifically, 53.08% of the total learning actions were carried out only using a combination of three patterns of educational use of ICT: P8-Com; P8-Coll; and P9-Com.

In the individual work, 6 *sets of actions* were produced, accounting for 76.74% of the total learning actions. These were: P1-Com; P2-Com; P10-Lea; P11-Lea; P11-Cog; and P12-Com. And specifically, 53.49% of the total learning actions were carried out only using a combination of three patterns of educational use of ICT: P1-Com; P11-Cog; and P12-Com.

VI. Conclusions

During the last two decades an important part of research into educational processes in online learning environments has focused on two areas: the analysis of educational uses of ICT and the study of patterns of educational interaction. As we have highlighted in this article we consider that an interrelated approach to both subjects using the concept of *technology educational affordances* offers a research focus which provides greater knowledge about the complex interrelation between technology and educational interaction.

The concept of *technology educational affordances* refers to the properties and the potential of technology that enable the educational interaction between teachers and students needed to carry out their educational plans. According to Kennewell (2001), technology educational affordances should not be considered as lists of the properties or the potential inherent in technological features. On the contrary, they are by nature dynamic and therefore should be identified and analysed in the development of each educational situation. Therefore, we have proposed using the term technology educational affordances in this study to offer an explanation more focused on the process of interaction within educational activities in terms of real exchanges between technology and education as the presented results recommend.

This research presents us with three interesting considerations for a greater definition of the significance of technology educational affordances applied to online learning environments. Firstly, the technological design influenced the differential appearance of educational uses of ICT and patterns of educational interaction in each of the three learning activities that were analysed. Secondly, the pedagogical design of each learning activity also influenced the appearance of diverse profiles of ICT use and patterns of educational interaction. Thirdly, we also showed that each learning activity possessed a group of very diverse learning actions which were characteristic of each learning activity. These three considerations enable us to confirm that it is possible to identify, at least for the three learning activities analysed, very diverse profiles of technology educational affordances.

The conclusions reached in relation to technology educational affordances obviously have a limited reach because of the focus of the study. However they could have relevant implications in the technological and pedagogical design of learning activities typical in online learning environments, such as group work, debate and individual work.

VII. References

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