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VNiVERSiDAD D SALAMANCA

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ORIENTACIONES PEDAGÓGICAS PARA EL DISEÑO Y APOYO DE TAREAS DE CONSTRUCCIÓN COLABORATIVA DEL CONOCIMIENTO

Resumen: La investigación en aprendizaje colaborativo mediado por ordenador demuestra que proponer a los estudiantes trabajar en grupo no implica aprender mejor o mayor motivación. Es esencial diseñar tareas de aprendizaje apropiadas y un apoyo pedagógico y tecnológico adecuado. El objetivo de esta investigación es identificar indicadores pedagógicos en el diseño y apoyo de tareas de construcción del conocimiento colaborativo en educación a distancia. Realizamos un estudio de caso en la Universitat Oberta de Catalunya en el que llevamos a cabo dos experimentos: el primero centrado en cómo los profesores diseñan y apoyan tareas colaborativas en línea y, el segundo, basado en el control ejercido sobre las tareas. Como resultado de la investigación, caracterizamos el tipo de tareas que promueven el aprendizaje colaborativo, el papel y funciones del profesor en el apoyo de este tipo de tareas, e identificamos diferentes etapas en la regulación de las tareas. Basándonos en estos resultados, proponemos indicadores pedagógicos para el diseño y apoyo de tareas colaborativas en línea divididos en 4 etapas: 1) diseño de la tarea y preparación individual, 2) organización de la tarea y negociación grupal, 3) realización de la tarea y construcción colaborativa del conocimiento, y 4) evaluación crítica.

Palabras clave: CSCL; diseño instruccional; aprendizaje en línea; diseño de tareas.

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PEDAGOGICAL DIRECTIONS TO DESIGN AND SUPPORT COLLABORATIVE KNOWLEDGE BUILDING ON-LINE TASKS

Abstract: Research on Computer-Supported Collaborative Learning (CSCL) demonstrates that proposing that students work in groups does not improve their learning or increase their motivation. It is essential to design appropriate learning tasks and suitable pedagogical and technological support. The aim of this research is to identify pedagogical directions to design and support collaborative knowledge building tasks in on-line education. We conducted a case study at the Open University of Catalonia where we carried out two experiments: the first focusing on how teachers design and support collaborative on-line learning tasks and, the second, based on the control exerted over the tasks. As a result of the investigation we characterize the type of tasks that promote collaborative knowledge building, the teachers' role and functions supporting these types of tasks, and we identify different stages in task regulation. Based on these results, we propose pedagogical directions to design and support collaborative on-line tasks divided into 4 stages: 1) Task design and individual preparation, 2) Task organization and group negotiation, 3) Task performance and collaborative knowledge building, and 4) Critical evaluation.

Keywords: CSCL; instructional design; on-line learning; task design.

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PEDAGOGICAL DIRECTIONS TO DESIGN AND SUPPORT COLLABORATIVE KNOWLEDGE BUILDING ON-LINE TASKS

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1.- INTRODUCTION

Research on collaborative (and cooperative) learning has a long history in the field of education (i.e., Piaget, 1950; Vygotsky, 1978; Slavin, 1983; Johnson & Johnson, 1986; Dewey, 1994; Dillenbourg, 1999) which has recently been impacted by the advent of the Information Society and the advancement of technology. The Information Society has led changes in how to integrate technology into society, which has also produced transformations in education. As a result of the emerging society challenges, characterized by globalization and the speed of change, the European Higher Education Area (EHEA) has been developed.

Among the emerging elements of the EHEA we can distinguish the implementation of Information and Communication Technologies (ICT) in Higher Education and the definition of learning competences related to technologies. This integration of ICT into Higher Education has promoted different teaching models. The commitment to technology has strengthened e-learning which has involved new teaching skills in supporting students of the new digital generation (Net generation). Among the competences of these students we emphasize technological and teamwork skills.

Some authors have distinguished different ways of teaching taking into account the technological support (Duggleby, 2001; Battezzati *et al*., 2004; Bautista *et al*., 2006, Barberà, 2008). We focus on the structuration established by Barberà (2008), who proposes five education models regarding the presence of ICT: on-line courses (100% ICT presence), bottom-up on-line courses (+50% ICT presence), balanced courses (50% ICT presence), bottom-up face-to-face courses (-50% ICT presence), and face-to-face courses (without ICT presence). We are interested in virtual courses where the interaction is fully on-line. This means that collaboration between students becomes more difficult to be managed and to be performed because there are no face-to-face interactions. In this

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regard, the three main elements in e-learning (teachers and students, contents and virtual environment) established by Barberà (2008) have to be adapted to allow collaboration.

ICTs present advantages for distance collaborative learning processes that can stimulate interpersonal communication through communication tools; facilitate collaboration and sharing information, documents and decision-making processes; allow to the teacher to monitor and manage groups and its members; and enable access to information sources and varied content (Casamayor, 2008). He distinguishes the following applications that promote collaboration: group calendars, notice boards, newsgroups and mailing lists, hypertext, shared space systems, videoconferencing, audioconferencing, editor cooperative, workflow system, cooperative blackboard, and decision support systems.

There is a distinction between virtual environments that *facilitate collaboration* and virtual environments that promote *collaborative learning* (Onrubia *et al*., 2008). The environments that facilitate collaboration are known as *groupware* which can be defined as the software and telematic networks used to promote a shared virtual environment that supports teamwork. The environments that promote collaborative learning are those that are designed specifically to support and establish collaboration in educational contexts (i.e., FLE3, Negotiation tool, Belvédère, Synergeia). According to these ideas, Prendes (2007) considers that virtual environments already have telematic tools that promote collaborative learning (i.e., forum or chat); however, he indicates that there are tools that have been conceived specifically for collaborating: collaboration network tools. Collaborative processes in virtual learning have been highly interesting due to the importance of collaborative knowledge building.

Focusing on the notion of knowledge building defended by Scardamalia & Bereiter (1994), knowledge is built on collaboration and learning becomes a process of interaction and reflection. Based on the concept of learning as a knowledge building process, Stahl (2006) developed the theory of collaborative knowledge building, in which knowledge is conceived as the product of individual interactions in a group and collaborative learning as the process of constructing meaning. According to this definition, our interest remains in investigating how teachers can design and support tasks, to be performed through a virtual environment, allowing students to build knowledge in collaboration which means something more than just working in groups, it requires interaction, reflection and constructing meaning jointly.

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2.- DESIGN AND SUPPORT OF CSCL TASKS

The implementation of ICT in education has promoted both research and a proliferation of technologies to support collaborative learning, receiving the name of Computer-Supported Collaborative Learning, CSCL (Koschman, 1996). This way of using ICT to support collaborative learning processes has led to changes in the role of students and teachers who must acquire and use new skills to adequately implement it and profit from it. But what are the keys to successful practices of CSCL? The use of technology is not enough in itself; it is essential to design appropriate learning tasks and pedagogical and technological support.

Proposing to students to work in groups does not guarantee collaboration (Soller *et al*., 1998), it is necessary to carefully select the type of tasks that can promote collaboration, to know how to interact with students to motivate their collaboration, and to design a virtual environment that enhances learning. If the task is too simple, the transaction costs involved in communication and coordination outweigh the profits of working together. Only when the task is so complex that these transaction costs are less than the benefit gained by working together (in terms of time, grade achieved, and feasibility) will learners actually collaborate. In other words, the task must be such that the benefits of working together on a task outweigh the costs (Kirschner *et al*., 2008).

Complexity, thus, is an important aspect of learning tasks. Furthermore, research on computer-based tasks (Lund & Rasmussen, 2008; Van Amelsvoort, 2006; Salmon, 2004) identifies some features to promote interaction among students, such as: open and real-world activities that require different types of solutions and a students' negotiation process, with debatable topics that allow different opinions, and ideas or issues with no right or wrong answers.

Teachers also play an important role in students' collaboration processes. There are several functions that teachers must acquire to support collaboration:

a) To create the collaboration context and consolidate the relationship between theoretical representations and real life experiences (Mukkonen *et al*., 2005),
b) To organize the classroom taking into account the learning and technological needs of the students, to design learning tasks, to facilitate and monitor the quality of learning, and to guide students technologically (Hertz-Lazarowitz, 2008),

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c) To direct the group's work productively and ensure that there are no members excluded from the interaction (Chen, 2004; Mukkonen *et al*., 2005),
d) To prompt positive interdependence, individual responsibility, and interaction, use social skills properly, and organize the group's process (Johnson & Johnson, 2008).

To sum up, the teacher must be a guide on the side, which involves not to taking part in discussions giving his(her) opinion, but to guide students through the knowledge building process (Veldhuis-Diermanse, 2002). Teachers' support is necessary during the students' learning process but must decrease, while the complexity must increase, when the student's expertise increases (Corbalán, 2008).

Current research on collaborative knowledge building focuses on improving the technological features of software that supports collaborative knowledge building tasks. This may be because, as Öner (2008) suggested, the design of the tool affects the task. Instead of simplifying the task, he proposes developing software that can lead students to confront task complexity. Lund and Rasmussen (2008) investigated the relationship between tasks and tools in activities related to the construction of collective knowledge and proposed pedagogical designs aligned with technology, in order to support these efforts.

Applying this concept of pedagogical and technological co-design, Mukkonen *et al*. (2005) analysed the role of technological mediation and tutoring in directing students' knowledge building in inquiry-based learning. The results showed that the combination of these two practices (technological mediation and tutoring) offered a potential for developing in-depth inquiry and the advancement of knowledge practices.

There are some proposals that attempt to systematize the learning process and support problem-solving and knowledge building tasks, including the problem solving ontological sequence (Slof *et al*., 2010), the progressive inquiry model (Heikkilä, 2007), the cyclic research model (Overdijk, 2009), the Five Step Model of knowledge construction (Salmon, 2003), the method to measure the quality of knowledge construction in CSCL based on the SOLO-taxonomy (Veldhuis-Diermanse, 2002), the five phases of knowledge construction associated with computer conferencing or debate (Van Der Meijden, 2005), or the roles of argumentation in CSCL environments in higher education (Veerman, 2000).

These proposals are all based on a systematic teaching sequence that tries to structure pedagogical practices of knowledge building. Our proposal aims to define pedagogical directions to guide the design and support of collaborative practices in on-line education. The proposal is based on the results of a study on collaborative knowledge building in virtual environments where we investigate different variables involved in the design of collaborative practices: type of tasks, teacher's functions, control distribution, and technological affordances.

3.- METHODOLOGY

The aim is to identify pedagogical directions to design and support collaborative knowledge building tasks in on-line education. We have defined four research questions in order to investigate the success factors in the design and support of interaction among on-line students:

- How should tasks be designed to promote collaborative knowledge building?
- What roles should teachers play in supporting collaborative knowledge building tasks?
- How should control tasks be distributed between teacher and students to achieve collaborative knowledge building?
- Which technological affordances should comprise a virtual campus to promote collaborative knowledge building?

We conducted our experiments at the Open University of Catalonia (UOC), where all the interaction between students and teachers is carried out on-line. The cases were selected from experience and quality criteria and were applied following these considerations:

- Expert teachers, or with a defined research and teacher path in the field of computer-supported collaborative learning.
- Teachers leading a common subject.
- Use of collaborative activities (i.e., case study or problem based learning).
- An evaluation system in line with the collaborative approach, in which students also participate during the process.
- A subject running for a number of years.

We selected the subject *Planning training processes with ICT applications* from the Master's course in *Education and ICT*, and focused on the two expert teachers who taught this subject in 2009 (see Table 1). The subject is structured on the basis of case studies, performed and evaluated collaboratively. The virtual campus consisted of a virtual board

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(where the teacher communicated news to students), a forum space (for publishing organizational and informal information), a debate space (groupwork space), and wikis (created by each group) to support learning products. Teachers also used the *Annotation tool* (an anchored discussion tool).

Table 1. Cases

	Teacher A	**Teacher B**
Teaching this subject	Since 2004	Since 2007
Students	48 Latin American students	31 Catalan students
Activities	- Presentation of participants (forum) (1 week). - First activity: To identify the steps and actions involved in the process of introducing innovative uses of ICT in educational institutions, through case studies of collaborative work groups. (1 month) - Second activity: To discuss critically and develop a proposal to improve the corporate strategy (based on the case selected from the three reviewed in the first activity) in order to optimize the educational value of ICT. (1 month)	
Tools	Virtual board, Forum, Debate, Wiki, *Annotation tool*.	

We carried out two studies: the first, focused on how teachers design and support CSCL tasks and, the second, based on the control exerted over the tasks. Study 1 was centred on activity 1, and study 2 was based on activity 2. According to the course design, the first activity was simpler, requiring less work and more collaborative presence of the teacher, while the second activity was more complex, requiring more collaboration, and less teacher presence. To collect the data we implemented several techniques: interviews with teachers prior to the first study (questions about activities' planning and CSCL background) and after the second one (opinions about task responsibility), a questionnaire to students (perceptions about the process of performing a knowledge production task), logged activities (amount and type of teacher and students' interventions), and learning results.

We arranged the interviews of the first study (one per teacher) the week before starting the course. This consisted of a battery of 12 questions concerning the background,

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knowledge and pedagogical positioning on collaborative learning. The interviews were conducted face-to-face, recorded and transcribed. They lasted approximately one hour. During the second study, we conducted the interviews two weeks after the end of the course and they consisted of a battery of 10 questions concerning the control and distribution of responsibility of the teacher and students in the development of collaborative tasks. Both interviews lasted approximately one hour.

Throughout the course we conducted a passive participant observation of the tools of the virtual campus (virtual board, debate and forum) and the *Annotation tool*. The *Annotation tool* is an application designed to display on a single screen, a document and comments on it (see Fig. 1). This tool allows groups to be created and documents uploaded in each one.

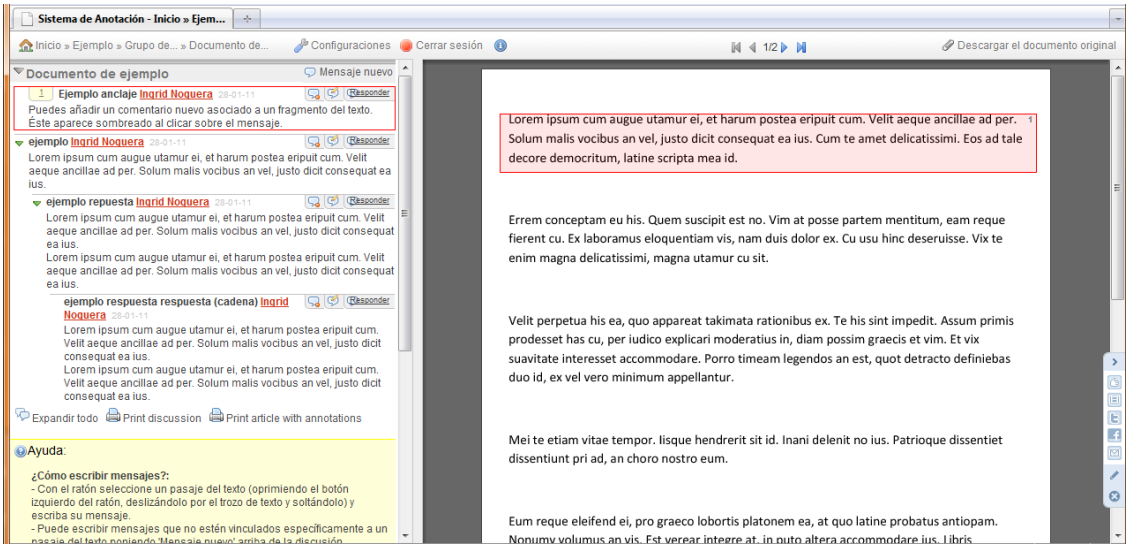

Fig. 1. *Annotation tool*

We recorded the number and type of interventions by teachers and students in the virtual campus and the *Annotation tool*. To analyse the types of interventions on the virtual campus and the *Annotation tool*, we reduced the data using a deductive coding system developed by Veldhuis-Diermanse (2002) in her doctoral thesis. This system divided the students' learning activities into *cognitive learning activities* (i.e., debating, using external information and experiences, linking or repeating internal information), *affective learning activities* (i.e., reacting emotionally, asking for general feedback, 'chatting' or

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'social talks'), and *metacognitive learning activities* (i.e., planning, keeping clarity, monitoring). We selected the group with the best and the worst collaborative learning product in each course to analyse, in depth, the type of students and teachers' contributions (debate and *Annotation tool*). During the first activity, teacher A did not use the *Annotation tool*.

In both studies we collected data on learning outcomes. We used this information to choose two working groups of each course to analyse the type of interventions. We chose two groups considering their qualifications (a group with a good collaborative process and a high score, and another group with a less satisfactory collaborative process and a low score).

To triangulate the data, we conducted a questionnaire with students in both the courses. Questions were orientated to students' perceptions about collaborative activities performed in the course and their positions with respect to the overall collaborative learning. The questionnaire contained 14 questions (combining open-ended and closed-ended questions).

4.- RESULTS

4.1.- Qualitative analysis of the interviews

The findings with regard to task design show that teachers selected complex, open, authentic activities based on real life to be performed in collaboration, which promoted the discussion of different viewpoints (interdependence), and required the creation of a collaborative product. Both teachers selected a case study activity, which is consistent with their opinion about the features of tasks promoting collaborative knowledge building. Task design should ensure that initial activities were less complex (less demanding cognitively and collaboratively) than final activities. The evaluation design should be consistent with the methodological approach of the activities, being part of the learning process, evaluating students as a group and allowing them to, at least, share and know the evaluation criteria.

> Must be open and complex tasks, I mean, in the sense that they involve the development of different procedures, different processes, different strategies, right? This is very important, I mean, tasks that are open, complex, why? Because it implies that the student is not able to perform the task individually. But if you ask them to carry out a complex activity, an analysis' activity, etc. You're preventing the student from doing it individually, if, for example, s(he) tells you: 'listen, this is very long, I cannot do it myself'. (Teacher B)

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The teachers argued that collaborative learning implies better learning, although it is essential that teachers provide management tools for collaboration, guidance, help in planning and organization, promote a positive attitude among students toward collaborative learning, stimulate discussions, encourage participation, and remain visible to students (teaching presence). They consider that a way to avoid problems of collaboration is to provide guidelines for successful collaborative tasks, insist on planning and carry out visible monitoring. In this course, teachers have carried out intensive monitoring of students' work through the virtual space and external tools. In their opinion, monitoring improves students' learning success but involves time and effort costs for the teacher.

> It is very important to attend the first stage of work organization. Not to postpone it, to help them to decide which tools to use to support their discussions, how they will distribute the work, planning the time... I force them because I have observed, through research, that they don't plan, skip it and, then, start the stage of sharing information, believing that this is a contribution… but if there isn't a schedule you don't know why... you can't discuss this information, it goes from an information exchange to a quick synthesis... without discussion. I ask them to plan: 'come here, make an individual and group planning'. (Teacher A)

According to teacher B, students' responsibility affects learning success. Initial activities require greater control because they are the basis of the following activities, in terms of dynamics and procedures. Although the control changes, the teacher's presence and monitoring should be continuous. Students should control the task as a group. As the course progresses, greater task complexity should be promoted, greater collaboration and, therefore, greater responsibility of students as a group.

> I have a very clear reference... the student has to take a great deal of autonomy in his(her) learning, if not, things go wrong. So I am assuming that, in the early stages of the activity, the teacher has more control, some mechanisms of educational influence. And, gradually, you must give it to students, to transfer the control. I recover it when necessary and, if I see that things are going fairly well, I like students to work independently. (Teacher B)

We distinguish four phases of control over the task: design, organization, execution, and evaluation. As teachers argued, the teacher, who determines the type of task and learning objective, should exert control over the design. Control over the organization can be divided between teacher and students; the teacher helping to organize the group and time, and students taking control over the procedure and the roles within a group. Control over execution has to be taken by students, with minimal guidance from the teacher. Students

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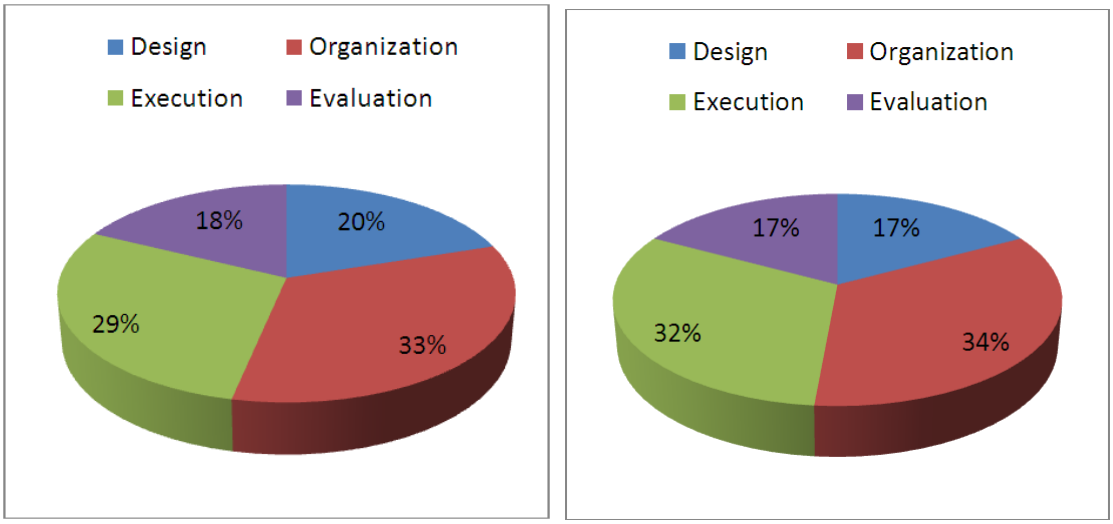
must make decisions about what to do, what processes to follow, and how to perform the task. Finally, control over evaluation must be shared, not forgetting that the accrediting function corresponds only to the teacher. Students can assume control over the critical reflection on their work and/or that of their partners, although the teacher should control the process of reflection and establish appropriate qualifications.

The virtual environment was designed including three types of tools: forum (virtual board, informational forum, and debate group space), wikis (to develop the collaborative product), and an external *Annotation tool* (anchored forum to assess the products collaboratively). To afford the collaborative process through on-line tools, teachers demanded a synchronous tool (i.e., chat), a concept map tool (i.e., co-mapping), and to integrate a collaborative assessment tool (i.e., *Annotation tool*) into the virtual campus and a better collaborative writing tool (i.e., googledocs).

4.2.- Quantitative analysis of the questionnaire, logged activities and learning results

The findings of the questionnaire show that 85% of students from teacher A's course (TA), and 60% on teacher B's course (TB), considered that the first activity required collaborative work (i.e., elaborated work). Regarding the second activity, 90% of students from TA, and 67% of TB, affirmed that it required collaborative work (different viewpoints, knowledge sharing).

Most of the students maintained the same team during both activities (100% of students of TA, and 73% of students of TB), and 80% of students (both courses) considered that they were responsible as a group for the course activities. 55% of TA students argued that there was no difference between activity 1 and activity 2 responsibility demand, and 53% of TB considered that the second activity demanded more responsibility . Most of the students (65% of TA and 80% of TB) affirmed that the teacher guided both activities equally. Regarding the control exerted over the task, in both groups students considered that they had control in the four stages (see Fig. 2).



Teacher A Teacher B

Fig. 2. Task control

Taking into account the logged activities, we showed that teachers contributed less than students in forum and debate spaces. During the first study, in the forum, TA contributed 14 times, and her students 72, and in the second activity she intervened 3 times, and her students 12. TB participated 17 times during the first activity and his students 110, during the second activity he contributed 3 times and his students 11. In the debate space (see Tables 2 and 3), TA participated an average of 5.25 times in each group during the first activity, and an average of 5.62 times in the second activity. TB contributed an average of 3 times per group during the first activity, and did not contribute, or contributed between 1 and 3 times, in some groups in the second activity.

Table 2. Study 1 interaction debate TA and TB

Topics	TA	Std.	TOTAL
Rebuts	0	0	0
Activitat 1	0	0	0
G1	6	100	106
G2	3	95	98
G3	1	72	73
G9	4	51	55
G5	1	52	53
G6	3	49	52
G7	5	290	295
G8	1	76	77
G4	2	61	63
G10	4	44	48

$\bar{x}$ Teacher (5,25/group), students (98,25)

Topics	TB	Std.	TOTAL
Recibidos	0	0	0
Grup 1 act 1	1	31	32
Grup 2 act 1	8	201	209
Grup 3 act 1	5	171	176
Grup 4 act 1	8	134	142
Grup 5 act 1	4	14	18
Grup 6 act 1	5	86	91
Grup 7 act 1	10	121	131
Grup 8 act 1	1	28	29

$\bar{x}$ Teacher (3/group), students (89)

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Table 3. Study 2 interaction debate TA and TB

Topics	TA	Std.	TOTAL
Recibidos	0	0	0
Grup 1 act 2	2	21	23
Grup 2 act 2	10	174	184
Grup 3 act 2	10	104	114
Grup 4 act 2*	2	92	94
Propuesta mejora	5	45	50
Grup 5 act 2	5	19	24
Grup 6 act 2	5	41	46
Grup 7 act 2	3	101	104
Grup 8 act 2	3	20	23

$\bar{x}$ Teacher (5.62/group), students (68,5)

Topics	TB	Std.	TOTAL
Activitat 2	1	1	2
G1	0	52	52
G2	0	33	33
G3	1	38	39
G5	0	23	23
G6	3	40	43
G7	0	48	48
G8	0	35	35
G9	3	43	46
G10	0	35	35

$\bar{x}$ Teacher (2,3/group), students (38,5)

In the *Annotation tool*, TB and his students contributed more during the second activity. TB participated an average of 1.3 times more than in the first activity, and his students an average of 3.89 times more in each discussion than in discussions of activity 1. TA used this tool during the second activity participating more than students. The debate space was the place where students controlled the execution of the task and where they interacted more, and also where students and teacher interacted more. The *Annotation tool* was the tool that TB used to control the evaluation.

The types of teachers' contributions vary depending on the group (see Table 4). We defined three types of contributions: affective (social and motivational messages), metacognitive (planning, monitoring and clarifying messages) and cognitive (discussion, information searching, knowledge sharing, summarize, assessment messages). TA participated more affectively (in a social way, motivating participation) in groups with better results, and metacognitively (helping to plan and manage the work) in groups with the worst results. TA promoted social communication through the virtual board, debate, and forum. In the debate space, TB participated by helping to plan and explaining some concepts in depth, and in the *Annotation tool* he discussed theoretical concepts, reflected on students' contributions, and asked for feedback.

Table 4. Type of teachers' interventions (TA and TB) in the debate regarding the study (S1 and S2)

S1	*Emot.*	*Mtcgn.*		*Cgn.*
TA	1 (B)	1 (W)		-
TB	1 (B)	4 (B)	2 (W)	-

S2	*Emot.*	*Mtcgn.*	*Cgn.*
TA	2 (B)	3 (W)	-
TB	-	-	-

(B) Best collaborative product group
(W) Worst collaborative product group

In the *Annotation tool*, TB contributed with more cognitive messages than in the debate. In the group with the worst results he contributed by helping students to plan, and in the group with the best results by promoting the discussion and with affective messages (see Table 5).

Table 5. Type of teacher B (TB) interventions in the *Annotation tool* regarding the study (S1 and S2)

S1	*Emot.*	*Mtcgn.*	*Cgn.*
B	4	3	5
W	2	3	2

S2	*Emot.*	*Mtcgn.*	*Cgn.*
B	2	-	2
W	1	4	3

Regarding students rates, in general terms, students maintained the same marks in both activities. In TB course, the marks were lower than in TA course. In TB course, 9 out of 10 groups improved their marks in the second activity. The group with the best outcomes of TA course participated in the debate with more metacognitive messages than affective, however during the second activity contributed more with affective contributions than metacognitive (see Tables 6 and 7). No cognitive messages were written. The group with the worst rates contributed more with metacognitive messages than affective in both activities. During the first activity they also contributed with five cognitive messages. The group with the best rates in TB participated with more affective messages in both activities. During the first activity they participated with 194 affective messages and 88 metacognitive. The group with worst results did not use the debate space during the second activity.

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Table 6. Type of students' interventions in the debate regarding study 1

TA	Emot.	Mtcgn.	Cgn.
B	13	18	-
W	11	12	5

TB	Emot.	Mtcgn.	Cgn.
B	194	88	7
W	34	27	-

Table 7. Type of students' interventions in the debate regarding study 2

TA	Emot.	Mtcgn.	Cgn.
B	12	9	-
W	8	12	-

TB	Emot.	Mtcgn.	Cgn.
B	40	8	-
W	-	-	-

The most frequent interventions in the debate were affective and metacognitive, which we consider as categories of planning and affective membership. Students collaborated more in the debate space and the *Annotation tool* (in TB), nevertheless in the debate space students did not construct knowledge, they used it as a group work space, to organize and plan the work, creating a group identity. However, in the *Annotation tool*, students interacted by constructing knowledge collaboratively. Students of both courses interacted (collaborated) more during the second activity.

5.- PEDAGOGICAL DIRECTIONS TO GUIDE THE DESIGN AND SUPPORT OF COLLABORATIVE TASKS

Inspired by a set of models which have developed a process to support problem-solving tasks or knowledge building (see introduction), and also by the results of our investigation, we propose some directions to design and support collaborative knowledge building tasks, classified in four stages: 1) Task design and individual preparation, 2) Task organization and group negotiation, 3) Task performance and collaborative knowledge building, and 4) Critical evaluation. In the following sections we explain these stages in more depth (see Fig. 3)

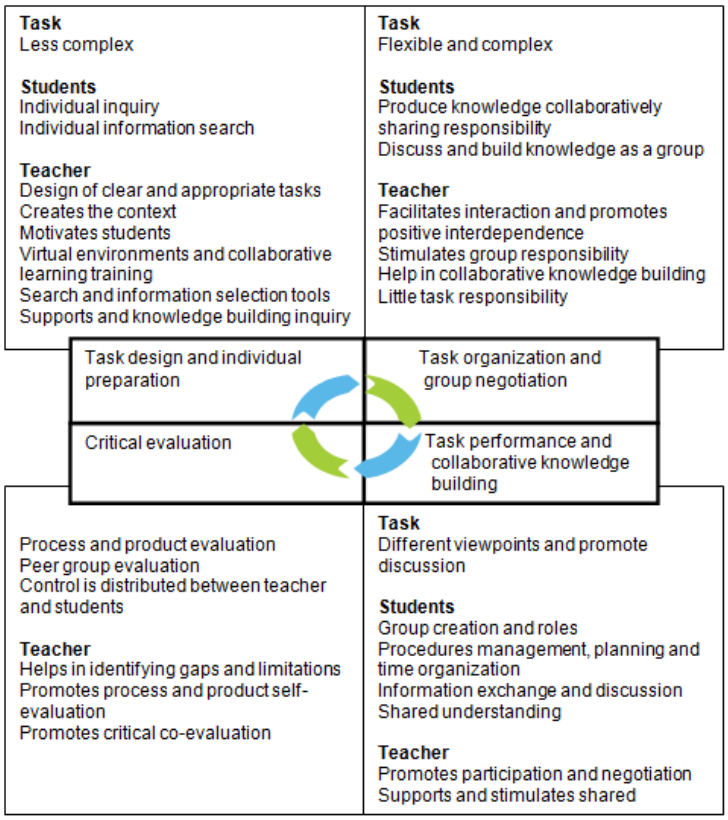

Fig. 3 Pedagogical directions to guide and support the design of collaborative building tasks

Stage 1. Task design and individual preparation

This phase centres on the individual learning that allows students to reflect on their own knowledge and their own ideas, and on the design of appropriate tools (see Table 8). During this stage, the teacher has more responsibility than students. The importance of individual preparation was shown in research conducted by Van Boxtel *et al*. (2000) which found that imposing individual preparation on students gave them an extra tool that supported the exchange of ideas and promoted higher scores.

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Table 8. *Techno-pedagogical guidelines Stage 1*

Pedagogical guidelines
➲ Task design is decisive in this stage and throughout all the stages. The task is less complex than following tasks and promotes individual inquiry. ➲ Students work individually creating and using their own theories by searching for information to strengthen their ideas. Some of the questions that may be answered individually in this stage are: What is the goal of the task? What problem needs to be solved? What product needs to be produced? What do I know about the problem/situation? What do I need to know to be able to solve the problem or produce the product? What is my opinion about it? ➲ The teacher: - Must design the tasks previous to this stage, ensuring that they are understandable and appropriate (i.e., not too complex or too long). After that, (s)he presents them to the students. The teacher has total control over the task; however, (s)he is open to negotiate rules and deadlines. - Helps students set up (i.e., determine) the context for approaching the task, in other words, to create a global task overview. Her/his role is to create the context. - Motivates students' participation, analysis, and reflection in contextualizing the problem/task. - Teaches students about the use of the virtual learning environment and gives guidelines about collaborative learning. - Gives tools (i.e. critical skills) to search for new information and to select the main information. - Supports and asks students to improve their individual knowledge and theories (ask questions, give references).
Technological guidelines
➲ Research on tool appropriation and use considers technological competence in computer-mediated communication in students and teachers to be essential (Salmon, 2003; Overdijk, 2009). If students and teachers lack this competence, training on the use of this technology is required. ➲ The virtual environment provides tools to allow interaction between teachers and students and to allow the uploading of information sources and documents. ➲ The teacher: - Is connected at most times, checking the loggings and the interactions. In other words, (s)he becomes aware of all the interactions. - Offers good examples of netiquette and the use of the tools

Stage 2. Task organization and group negotiation

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During this stage, students share their knowledge and theories and negotiate ways of working together as well as deciding the team's approach to the problem, i.e., the organization of the task (see Table 9).

Table 9. *Techno-pedagogical guidelines Stage 2*

Pedagogical guidelines
➲ Tasks should comprise different viewpoints and promote discussion. ➲ The students: - Create groups and decide the internal roles. - Manage working procedures by establishing the schedule, planning the phases and organizing the time. - Exchange information and discuss their reasoning for the proposed solution, taking into account the ideas of the other group members. Students are individually responsible for reasoning on their principles and for contrasting their own information with other information that they bring to the discussion to support their theories. This information is found by the students on the internet, in books, and so forth, to better shape their ideas and to defend them. - Students build shared understanding by constructing shared criteria (i.e., taking decisions about task performance, procedures, common goals, etc.) with respect to both processes and products, and shared concepts (tasks are always supported by some key concepts which require a common understanding). We propose discussing the criteria and the meaning of the concepts before performing the task in order to clarify the rules and to share the meaning of each concept. This shared understanding will enable the group to work on a common goal. ➲ Each group negotiates the different viewpoints and selects, or builds, conceptions shared by its members. ➲ The teacher: - Mediates between students to improve the negotiation process and to facilitate the creation of a group perspective. The role of the teacher is to promote participation and negotiation. - Supports and stimulates students to define and determine the key concepts of their task and to share them (i.e. what the key concepts mean for the group), in other words, to create shared understanding. - Supports students to share organizational criteria by helping them to answer the key elements (i.e. time to be spent, tasks to be carried out, goals, questions to solve, ideas, etc.). - Scaffolds the process of moving from an individual perspective to a collaborative one. - Helps students to present well developed theories (i.e., contrasted theories). - Control is distributed between teacher and students. ➲ Students (sometimes with individual differences) are chosen to promote discussion.
Technological guidelines

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➲ The environment should allow students to interact, to upload individual products, and to discuss. ➲ This environment has (as a minimum) a forum, a chat, a space to organize documents, and the possibility to upload and download them.

Stage 3. Task performance and collaborative knowledge building

In this stage, students decide how to perform the task and build collaborative knowledge. They become responsible as a group for the task (see Table 10).

Table 10. *Techno-pedagogical guidelines Stage 3*

Pedagogical guidelines
➲ The task is sufficiently open to allow different viewpoints and solutions, and sufficiently complex to require collaboration. The task must stimulate or require interdependence. ➲ Students: - Produce knowledge collaboratively by interacting with other group members, sharing responsibility for the group learning process and the group learning product. - Discuss and construct knowledge as a group involved in a progressive inquiry process, building and re-building the learning product. ➲ The teacher: - Facilitates the interaction between students and promotes positive interdependence. - Stimulates the group's responsibility for the learning product and the learning process - Helps students to build a knowledge product through collaboration. - Has little responsibility for the task.
Technological guidelines
➲ The virtual environment provides spaces for students to work in groups, to create and upload collective knowledge productions (co-writing tools), and supports synchronous and asynchronous communication. ➲ The best suited tools are: forums, chats, and wikis.

Stage 4. Critical evaluation

The learning process comprises not only the process of performing a task but also critically assessing the learning process and product. Regarding this idea, we propose a group assessment in which each group thinks critically about its own group learning process and about a peer group's learning product (see Table 11).

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Table 11. *Techno-pedagogical guidelines Stage 4*

Pedagogical guidelines
The evaluation is based on assessing not only the learning product but also the collaborative knowledge building process. We propose a co-evaluation process with peer groups. ➲ Each group thinks about its peer group's learning and about its own learning (What have they/we learnt?, Which roles have they/we developed in their/our group?, How can they/we improve their/our learning?) and each small-group should constructively criticize the group's work (Have they/we correctly organized the performance of the task?, Have they/we worked collaboratively and equally?, Was their/our product good enough? How can they/we improve their/our way of working as a team? How can they/we improve our task?). ➲ It is essential to generate a group-class view and assessment of the products of the small groups as well as the learning processes. ➲ This assessment allow groups to know what 'mistakes' they may have made (i.e., process mistakes and product mistakes) and how they can improve their proposal for carrying out the task and/or solving the problem. At this point, learners can reformulate their questions, and redefine new working theories. ➲ Through the assessment of process and product, and the detection of the strengths and weaknesses, groups begin a new process of inquiry, discussion, and knowledge building. ➲ The teacher: - Helps groups to identify gaps in their knowledge and the limitations of their explanations, by promoting participation and reflection. - Promotes the small group's self-assessment of the process and product. - Promotes critical co-evaluation between groups. ➲ The control is distributed between teacher and students.
Technological guidelines
➲ The virtual environment provides discussion spaces, tools to assess both the tasks and the processes carried out, and options for collaborative revision and edition of the tasks produced by students. ➲ The environment allows teachers to review groups' learning processes and products. ➲ A tool like *Annotation tool* is ideal.

6.- DISCUSSION

The results of our research show that there are different task features to promote collaborative learning (i.e., complex, open, authentic) and different teachers' functions have been identified in leading collaborative practices (i.e., guidance, dynamize, monitor). The teacher must exercise greater control at the beginning of the activity and at the beginning of the course, gradually ceding control to students as the activity and the

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course progresses (Corbalán, 2008). Task complexity seems to be one of the most significant features, which has to be taken into account when designing tasks and courses.

The use of tools, regardless of their technological affordances, without the support of collaborative interaction does not ensure the construction of knowledge. In this research, the affordances of asynchronous communication spaces have promoted communication and collaboration (as seen in the debate on group organization and exchange of information). The performance of the *Annotation tool* has prompted reflection (promoting processes of debate, reflection and collaborative assessment, and strengthening the collaborative construction of knowledge).

Previous research into models and teaching sequences showed a need to systematize the process and stages to design and support collaborative knowledge building tasks. Our contribution is based on the proposal of a set of indicators divided into four stages of task performance, guidance and control. The guidelines that we propose emphasize a) a tasks' design based on features like openness, complexity, interdependence and discussion, b) the role of the teacher as a guide (guide on the side), and c) the group self-regulation.

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