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Project-based learning in virtual groups - collaboration and learning outcomes in a virtual training course for teachers

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Abstract

The pressure on the ability of training to teach useful and applied knowledge is growing, as society becomes more competitive and more information consumer. The aim of this research is to show whether the application of a project-based task in virtual groups has led to a greater significant knowledge to participants. Forty teachers who were studying a master program at a fully online institution participated in the study. Teachers worked in groups of 4 or 5 members through forums where they exchanged messages and files during four weeks. They had to carry out a project on how to integrate technology in schools and classes. Three types of knowledge were analyzed: academic, professional and applied. The results of our analysis show significant improvement in all three types of knowledge. Teachers were able to use more ideas, propose more actions and place them in a given context. Our results support project-based learning in virtual environments to foster meaningful learning.

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Keywords: project-based learning; virtual groups; teacher training.

1. Introduction

In today's life we appreciate a real need of problem solving knowledge, linked to the fact that we are great consumers and processors of information. This type of knowledge requires very different approaches from those that are enhanced by traditional instructional methods with teacher-centred approaches and abstract content.

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A recent report of the European Student Union in collaboration with the European Commission (2014) stresses the need to promote a “shift from more organizational input-oriented curricular design, based on the description of course content, to outcome-based higher education”. Learning methodologies based on problem solving require students to think critically; to analyze the information needed to solve the problems of the society around them (Grabinger, Dunlap & Duffield, 1995).

Project based learning refers to any programmatic or instructional approach that utilizes multifaceted projects as a central organizing strategy for educating students (Ngoh, 2015). Several investigators propose that project-based tasks encourage significant learning and problem-solving skills through self-directed student research (Blumenfeld et al., 1991). Activities involved in a project-based task are typically learner-centred, real-based, and monitored by a teacher who acts as a facilitator, not as an instructor.

The objective of this research is to show that the development of a project-based task in a virtual small group promotes significant learning in higher education students, by means of analyzing prior and final knowledge of students after a collaborative task.

2. Theoretical background

2.1. Project-based learning and project-based tasks

Project-based learning is a response to the lack of contextualization and over-simplification and excessive abstraction of learning in schools. As Resnick (1987) notes "the traditional school often fails to prepare students for the type of learning, behaviour and attitude that is needed outside the school environment." Research that analyzes the learning process outside the educational context, show that the authenticity of a learning activity and its context are integral to knowledge and learning outcomes. Is in that sense where learning is understood as a situational concept (Brown, Collins & Duguid, 1989) and not timeless or out of context. According to LaFey et al. (1998), project-based learning is a modification of what was initially conceived as “contextual statement" a methodology that emphasized knowledge construction and problem solving by students in a given situation and that often happened during a long period of time. Thomas and MacGregor (2005) consider that collaborative development of projects in Higher Education presents an ideal opportunity to provide problem-solving situations present in the real world.

Under the umbrella of a project-based learning a wide type of tasks conducted in all types of training and in different educational levels are brought together: field studies, applied research, mechanics, laboratory practices. These wide range of projects share a set of characteristics: (1) authenticity: learning involves a real problem and an effective solution has to be found; (2) complexity: the problems are complex tasks, and solution requires a significant investment of time; (3) centrality: the activity is significant and central to the curriculum of students, it is not complementary or a peripheral activity; (4) construction research: a goal-directed process, which involves asking students to discuss and build their knowledge and solve problems. The central activity of the project should involve knowledge processing and knowledge construction (Bereiter & Scardamalia, 2003). If project activities are not difficult for students or can be made by applying skills or information already known, the project is an exercise, not a project-based task; (5) use of tools: students use different tools and techniques to investigate, manage, plan, implement and report the project; (7) autonomy: the projects are not led by teachers or packaged in instructions, they incorporate a high degree of autonomy, choice, personal unsupervised work and greater responsibility.

Different researchers have shown better learning outcomes in students who participated in project-based tasks (Taradi, Taradi, Radić & Pokrajac, 2009; Biasutti, y EL-Deghaidy, 2012). However, others (Şendağ & Odabaş, 2009) did not find significant differences between students that participated in traditional or project-based tasks.

2.2. Significant learning in teacher training

In literature on learning and instruction, knowledge has been considered from a wide variety of theoretical frameworks (De Jong & Ferguson-Hessler, 1996). From the perspective of teacher training, significant knowledge often is classified in three well-known types of specific domain knowledge, called academic, professional and applied (Freeman, 1996).

Academic knowledge comes from the study and analysis of specific academic content, it is theoretical and abstract, and it is identified through the use of concepts and ideas from the material under study. Academic knowledge seeks to explain, understand and describe reality. Several investigations (Anderson and Lebiere, 1998; VanLehn, 1996) have found that a deep understanding of a field of knowledge can be achieved through the acquisition of its most important concepts and principles. To focus on the concepts and ideas on a given subject helps students to go beyond the specific experiences in a specific learning situation and encourages the development of a general understanding (Renkl, 2002). The development of specific concepts of a subject can activate processes leading to learning, as students reflect on the relationship between the concepts, in order to identify their distinctive features (Nückles, Wittwer & Renkl, 2005).

A second type of knowledge, professional, is acquired through a process of reflection on professional experiences, occurs when students put into context what they have learned (in theory) to solve specific problems (Schön, 1992). Professional knowledge seeks to intervene in reality through objectives and goals and it is recognized by specific statements regarding the exercise of the profession that students do in a given context, intended to handle a particular situation (Fenstermacher, 1994; Darling-Hammond, Wiese and Klein, 1999; Guile and Young, 2003; Kvale, 2008).

Finally, applied knowledge is knowledge about relevant factors and conditions on situations, which appear in a specific domain, and serve to create a representation of the problem from which conceptual and procedural knowledge can be invoked (De Jong & Ferguson-Hessler, 1996).

3. Methods

3.1. Participants

Forty teachers voluntarily participated in the study. They were all studying an online programme in a fully-online institution that provided graduate programmes using a virtual campus mainly based on asynchronous written communication networks. Twenty-seven participants were female and thirteen were male. The average age was 40 years. They all had previous professional experience as teachers, from 3 to 15 years. The instructor randomly distributed them in groups of four or five members. The purpose of the training was to provide teachers with knowledge on technologies applied to education. All teachers developed during four weeks the same project in a group that was presented on the first day of the course. The project was: 'How would you integrate technology into a school and in classrooms? Write a report establishing the objectives, plans and actions to achieve this aim and explain the reasons for the proposals made. Use information from any source you need to solve the problem and back you proposals'. Educational interactions among participants took place in the discussion forums, where participants were able to work asynchronously by writing messages and sharing files.

3.2. Data collection

Participants had to complete a questionnaire with open-ended questions, to assess prior and final knowledge of the subject. The questionnaire was developed with the help of the instructor responsible for the teaching of the subject. They had to answer the following questions: "You are the director of a public school located in a medium-sized city. You have received public funding to promote the use of ICT within the school and with your teachers. What would you do? Elaborate a report proposing actions, to whom they are addressed and justify your proposals". It was closely linked to the content of the course. The questionnaire allowed assessing the types of knowledge identified by Freeman, (1996) as academic and professional knowledge, and by De Jong & Ferguson-Hessler (1996), as applied knowledge. Teachers were asked to propose actions to promote the use of technological resources in a school and explain and justify their ideas and concepts behind their proposals. Participants completed the same questionnaire before accessing the course content and after finishing the group task. They were collected at the beginning and at the end of the course.

3.3. Data analysis

The unit of analysis used to analyze academic knowledge was text segments (Halliday and Hasan, 1976) (segments with similar vocabulary constitute an entire segment of a coherent theme). It was also used the model of text analysis applied by Jeong and Chi (2007) to measure explicit knowledge presented in a written text, pointing to the same idea of 'pieces of individual knowledge' in terms of segments with similar content. The written text was divided into segments (sentences or paragraphs), which contained a different fact, concept or principle. Next, these segments were compared to a list of main facts, concepts or principles of the course content provided by the instructor. Textual references were contrasted. Each segment was counted. If a segment appeared repeatedly, it was only counted once. Examples of academic knowledge were: *"(1) when making a selection of the most appropriate means or resources it must be taken into account the target group, objectives pursued and the means or infrastructure available; which is preferably done by means of a previous analysis; (2) ICT must be adapted to the skills and level of students; (3) the organizational structure of the center to enable the introduction of ICT has to be considered*". Procedure knowledge refers to a variety of plans of action that contains sequences of solution activities as a component of the problem solving processes (De Jong & Ferguson-Hessler, 1996). So, it was analyzed (Van Aalst, 2009) by observing the processes and actions that participants propose to solve problems, based on their understanding of concepts, phenomena and situations. In this context, procedural knowledge was revealed when specific actions and processes to a particular context were expressed, with the aim of resolving a specific situation (Guile and Young, 2003; Kvale, 2008). Again, the written text was divided into segments (sentences or paragraphs), which contained a different action, proposal or process. Each segment was counted and if a segment appeared repeatedly, it was only counted once. Examples of procedural knowledge were: *"(1) To find resources related to the subject; (2) To design and prepare teaching materials (ICT) to facilitate the activities of teaching / learning; (3) To select the most appropriate resources at any given time according to objectives, content, context, students and style of teaching; (4) To train for a proper use of ICT in the educational context.* Finally, situational knowledge considered as knowledge of relevant factors and conditions on situations, which appear in a specific domain (De Jong & Ferguson-Hessler, 1996), was assessed concerning the degree of approximation and approach to the real context using text segments related to what they teach, where they teach and whom they teach. Examples of situational knowledge were:*"(1) It is proposed to involve students and teacher of school X in the design and development of the school web; (2) Directors x and y of the areas of Sciencies and Language should develop didactic resources for the area; (3) An application should be developed to present the curricular school project, for general knowledge of teachers, students, parents and community"*. After the course, two independent analysts rated 20% of the segments. The inter-rater agreements were 80% for declarative knowledge, 72% for procedural knowledge and 66% for situational knowledge.

4. Results

Significant differences in teachers' learning outcomes have appeared after applying Wilcoxon Signed-Rank Test (for data which do not follow normal distribution), as shown in Table 1. Teachers have improved in all three types of knowledge, academic, professional or applied.

In the exercise made at the beginning of the course, all teachers used a total of 59 core ideas of the content (M = 1.40, SD = 0.989; Max = 5; Min = 0) and 144 ideas in their final exercise (M = 3.43, SD = 2.109; Max = 10, Min = 1). The differences were significant in the dimension of academic knowledge [W = 5.136. p <0.000]. Concerning professional knowledge, in the initial exercise all teachers made explicit 196 actions to solve the exercise (M = 4.67; SD = 2.764; Max = 11; Min = 0) and 364 actions in the final exercise (M = 8.67, SD = 4.694; Max = 24; Min = 2). The differences were significant [W = 4.881 p <0.000]. Finally, also differences in applied knowledge were significant [W = 4.310 p <0.000]. In the initial exercise this type of knowledge was assessed in a range of 1-2 (M = 1.31, SD = 0.468; Max = 2, Min = 1) and in the final exercise, the range was from 1 to 5 (M = 2.00, SD = 0.855; Max = 5, Min = 1).

Table 1. Teachers' learning outcomes (n=40)

	Initial questionnaire		Final questionnaire		Wilcoxon test
	M	*SD*	*M*	*SD*	*W*
Academic knowledge	1.40	0.989	3.43	2.109	5.136[a]
Professional knowledge	4.67	2.764	8.67	4.694	4.88[a]
Applied knowledge	1.31	0.468	2.00	0.855	4.310[a]

*******Data is significant at the 0.01 level (2-tailed).*

5. Discussion and conclusions

Our findings are consistent with previous research that stressed the relevance of project-based tasks for significant learning. After the development of a project-based task in a virtual group during four weeks, teachers showed an improvement in their academic knowledge, as they were able to use more ideas and concepts to back their proposals on the questionnaire, concerning the subject studied. With respect to professional knowledge, they were also more capable of planning actions to solve the situation. Finally, with regard to applied knowledge, their proposals were also more contextualized, and less abstract or theoretical. In conclusion, the project-based task was successful to facilitate significant learning in teachers.

Learning tasks based on problems resolution can have very positive effects on student acquisition of critical thinking skills (Shepherd, 1998), as well as on research situations, in relation to the theoretical study of the content (Taradi, Taradi, Radić & Pokrajac, 2009). Students participate in a process of continuous collaboration for the development of their knowledge and understanding, due to their interactions within a learning situation or project that reflects the world around them. As a result of participating in these activities and work together, they internalize knowledge (Palincsar & Herrenkohl, 1999)

Students learn in more open models, as they are able to apply the knowledge in a wide range of contexts (Boaler, 1998). Project-based learning has the advantage of being able to adapt to different learning styles or "multiple intelligences" (Gardner, 1993). The analysis of a real situation allows an open dialogue about different ways to accomplish the tasks to carry it out, and generates processes of reflection on the most appropriate solution for each case. The interaction generated by the analysis and decision-making favors the internalization of knowledge and in particular the implementation of professional and contextual knowledge. However, additional research is needed to get more insight in the effects and consequences of project-based tasks in learning acquisition in small virtual groups.

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