ANALYSIS OF STUDENTS INTERACTION IN A PROJECT-BASED LEARNING STRATEGY INTENDED TO DEVELOP TECHNOLOGICAL COMPETENCES IN COLOMBIA

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Abstract

This article presents the results of a research program that promotes technological competences on students from tenth to eleventh grade through the implementation of a teaching-learning strategy based on a constructivist approach. In particular, this document shows how is the students' interaction in five educational institutions (EI) of Cundinamarca that implements a project-based learning strategy. The data was collected through a teacher's planning analysis and an instrument of non-participant observation. Results show that during the implementation of the strategy, collaborative or cooperative interaction among students is promoted. According to the observations, the students' interaction was collaborative in 6,5% and cooperative in 44,5% of the sessions observed. This data matches the teachers session planification, since activities to foster cooperative and collaborative interaction among students were identified in 77% of the sessions planned. In addition, results show that planning collaborative or cooperative activities is related to planning a coach attitude, a positive environment in the classroom and the use of technological resources. Despite these results, observed data don't show a significative relation between students interaction and other observed variables.

Keywords: Technology education, Project-Based Learning, Educational projects, collaborative interaction, cooperative interaction.

1 INTRODUCTION

Technology is an element that increasingly integrates several fields of society, ranging from recreational to academic and working areas. For this reason, it is necessary to promote processes that contribute to technological literacy in society. In Colombia, the concept of technology is restricted to the use of computers and basic software, a concept that seems to be made up of the approach given to technology in basic and media education. According to Colombian regulations, educational institutions (EI) can define the curriculum autonomously. Thus, each institution can manage the areas independently, introducing electives, or some areas to adapt to particular needs [1]. This autonomy makes the content and skills associated with some of the areas that are not included in the standards of basic skills, very different among educational institutions. This is the case of the technology area, in which the contents of the area, aside from being different between educational institutions, are often limited to using text editors, presentation software, and spreadsheets. Additionally, although the Ministry of National Education (MNE) has defined guidelines for the development of technological competences, their integration with teaching strategies seems to be an elusive goal. These factors could prevent the proper progress of technological literacy in the country.

To tackle this educational issue, a teaching-learning strategy was designed and implemented in five EI of Colombia. The teaching-learning strategy designed and implemented is developed in an investigation program called "Design, implementation and evaluation of teaching-learning strategies for the development of technological competences in middle education through the educational use of Information and Communication Technologies (ICT), in Cundinamarca, Colombia"[1]. These strategies allow teachers to relate the specific context of the EI with the interests of the educational community and the technological competences to be improved in the instructional design of technology courses [2]. The strategies are based on a constructivist approach [3], particularly on a methodology of Project-Based Learning (PBL) due to its usefulness to gather into one educational project, the technological competencies proposed by the MNE [4] and the real context of students. Furthermore, PBL has been recognized for its ability to motivate students to learn, give meaning to the content of the subjects, involve teachers as an important element in achieving the objectives of the class, promote a

[1] The research program (Ctr No. 0826-2013) is financed by the Patrimonio Autónomo Fondo Nacional de Financiamiento para la Ciencia, la Tecnología y la Innovación, Francisco José de Caldas, provided by the National Ministry of Education.

collaborative and cooperative interaction between the students, among others advantages [2]. Thus, it is expected a teaching-learning strategy based on PBL to promote the development of technological competences in Colombian middle education students.

This paper describes how is the students' interaction in the implementation of a teaching-learning strategy under a constructivist approach for technology courses in five EI of Colombia and its relation to other variables such as teacher's role and the use of technological resources. The first part introduces a brief description of PBL and about cooperative and collaborative interaction among students. The second part presents the instruments used to collect the data during the implementation of the strategy. The last section shows the results and some conclusions of the students' interaction and the relation between other variables.

2 PROJECT-BASED LEARNING

The strategies designed in the research program are based on a project-based learning methodology. For the strategies design process, diverse elements was taken into account: the context of each EI, the educational institution project (PEI), the technological infrastructure, the learning styles of students and a set of competences that were prioritized and adapted from the document "Guide Series #30. Be competent in technology: a need for development" [4].

Strategies were proposed to be developed throughout five phases: problem identification, design and planning, execution or implementation, evaluation and improvement and last, socialization. The first phase, aims to motivate students on the PBL methodology characteristics. Students are led from the identification of a problem observed from their environment to the process of searching and selecting a solution considering requirements and key aspects given by the teacher and other students. On the second phase, students design the solution proposed for the identified problem, evaluating the resources and the knowledge they need to develop the solution at a specific time. On the third phase, students prepare the materials and resources needed for the implementation of the proposed solution. On the next phase, it is determined whether the proposed solution is adequate and properly conceived or need changes or improvements. Finally, on the last phase, students present the result of their work to the community using different mass media [2] [5].

2.1 Students interaction

Based on a constructivist approach, the students' interaction is considered as the process in which people relate and exchange information during a teaching-learning strategy [6]. According to [7], the students' interaction promotes the debate and can help them to agree on a specific subject. Considering the characteristics of the PBL, two types of interaction are expected: a cooperative or collaborative interaction in which students can change roles or functions to achieve a goal. Guitert and Jimenéz (cited in [8]) argue that "there is a cooperative work when there's a constant relation between a number of individuals who have the ability to differentiate and contrast their different points of view until they generate a process of knowledge. This is a process in which each person learns more than they could learn individually. The permanent accompanying of a facilitator and mediator enables a constructive dialogue and conflict resolution between group members". On the other hand, [9] argues that a collaborative interaction is a methodology of active learning that encourages students to build their knowledge from the interaction produced in the classroom. This type of interaction induces the mutual influence between team members allowing a gradual development of the concept of being responsible of the learning of others.

2.2 Other variables analyzed: teacher's role, classroom environment, thinking processes and use of technological resources

During the strategy implementation, other variables such as teacher's role, classroom environment, thinking processes and the use of technological resources, were observed. As in the case of the students' interaction, in the PBL context it is expected teachers to have a coach attitude, in which they lead and guide their students to an autonomous learning, promoting activities that ensure reflection and participation, and considering intellectual, physical, social and emotional elements that surround the context of the entire education community [7]. Classroom environment is another variable analyzed during the strategy implementation. This variable is associated with the relations that are established in the classroom among students, teachers and work groups. For this particular variable, it

is expected an integrative-promotive classroom environment in which participation is encouraged, along with constructive feedback and acknowledge meritorious deeds [10].

In addition, strategies were designed to develop activities which promote higher cognitive processes producing significant learning in students. Based on a Marzano and Bloom taxonomy [11], it is expected the proposed strategies foster critical, analytical and creative thinking. Finally, the use of technological resources also was considered as a variable of analysis during the implementation process. The analysis focuses on three types of uses: resources to communicate with others, resources to present information, and resources to create or design solutions.

3 METHODOLOGY

The implementation of the strategies of teaching and learning took place in the technology sessions in five IE from Cundinamarca, Colombia, in groups from tenth or eleventh grade, with an hourly intensity of about two hours per week during a semester. Throughout the implementation process a personal accompaniment was performed by members of the research team to support the teachers in adjusting the planning of the next class session and gathering the information necessary to identify the proposed variables (teacher's role, students interaction, etc.).

3.1 Instruments

The information related to students' interaction was collected through two different instruments. A teacher planning analysis was used to observe if interaction among students was fostered through specific planned activities, and an instrument of non-participant observation (IONoP[2]) was implemented to report the students' interaction during technology course sessions.

The teacher planning analysis attempts to characterize if the designed activities intend to promote a coaching attitude, a collaborative or cooperative interaction, a climate of positive relationships and an appropriate use of resources. This instrument is based on a questionnaire with multiple choice questions, a checklist and space for observations. A member of the research group should fill the questionnaire based on the teacher planning.

Moreover, the IONoP aimed to characterize the presence of the variables described above in three moments; initiation, development, and closure. The instrument consists on a checklist questionnaire where the non-participant observer might select between exclusive options of the variable. For the student interaction, the observer should choose between four options: coexistence, in which students develop activities individually; solidarity, where they develop activities individually but it is allowed or encouraged students to help each other; cooperative, in which activities are organized in groups, where they pursue the same objective and members occasionally change roles; collaborative, where activities are also organized in groups, but they can have different objectives and members constantly change roles.

4 RESULTS

Overall, there were 66 records for the teacher planning analysis and 67 of the IONoP. Considering that the IONoP had three moments (initiation, development, and closure) in which variables were observed, the number of observations related to the different variables registered on the IONoP increases to 201. Table 1 shows the values of the variables planned and observed through the instruments. According to these results, 77,3% of the activities planned by the teachers were defined to promote a cooperative or collaborative interaction, variables that were evidenced on the 51% of the observations (44,5% for a cooperative interaction and 6,5% for a collaborative interaction). In the same way, in a high percentage of the plannings (about the 86,4%) it is evident that teachers plan to foster a coach attitude, however, only the 20,5% of teachers promote it during the sessions. Additionally, activities that imply higher cognitive processes are identified in 81,8% of the teachers planning, and in 56% of the observed data (31,5% for creative thinking, and 24,5% for critical thinking). Finally, even though a integrative-promotive classroom environment is only planned in 9,1% of the sessions, is observed on 34% of them.

[2] Defined by these acronyms due to its meaning in Spanish.

Table 1. Percentages of the presence of each variable through the implementation

Variable	**Planned**	**Observed**
Cooperative students interaction	77,3%	44,5%
Collaborative students interaction		6,5%
Coach attitude	86,4%	20,5%
Creative thinking	81,8%	31,5%
Critical thinking		24,5%
Integrative-promotive classroom environment	9,1%	34%
N	66	201

Results presented on Table 1 show the cooperative and collaborative students' interaction and higher thinking processes, as the more frequently planned and observed variables. This could suggest that teachers recognize the importance of developing activities that promote this type of interaction along with creative and critical thinking processes during the implementation of a PBL strategy. Results also show a considerable difference between collaborative and cooperative interaction in the observed data, which could suggest that given the characteristics of the strategy, teachers tend to organize the activities in groups to promote a cooperative interaction between the group members. Finally, in relation to the frequency of planned and observed variables, it is important to mention that the integrative-promotive classroom environment is identified in higher proportion during the implementation than in the planning moment. This could be explained due to the motivation that the activities generate on the students, considering that the activities permit a constant communication with others. On the contrary, a coach attitude showed a decrease between the planning and the observation. This result could suggest that despite there's an intention of having a coach attitude, is difficult to implement this role due to how the class is developed, the students behavior, the moment of the class (initiation, development or closure) and any other setback that could occur.

In order to determine relations between planned and observed variables, a contingency table was constructed and a chi-squared statistical analysis was conducted (Table 2). According to the results presented on Table 2, when teachers plan activities that involves a collaborative or cooperative interaction among students, this variable was identified on the 38% of the observations. About the teacher role, only the 18% is observed when it is planned. A chi-squared was used to determine if there is any dependency between the planned and observed variables. However, no significant relation was found, except on the integrative-promotive classroom environment variable. This result should be checked since there is a small frequency of the presence of planning a classroom environment, and this value is not sufficient to determine this dependency.

Table 2. Contingency Table between planned and observed variables

		Variable Observed	
Variable Planned		No	Yes
Coach attitude		82%	18%
	Chi=	1.948	
	Sig	.63	
Collaborative or cooperative interaction		61%	**38%**
	Chi=	2.303	
	Sig	.129	
Integrative-promotive classroom environment		93%	7%
	Chi=	.4.233	
	Sig	.040	
Creative or critical thinking processes		78%	22%
	Chi=	.682	
	Sig	.409	

In addition, Tau-b Kendall statistic was used to determine whether there is any relationship between planned and observed variables in order to show the importance to plan a session. Results of this analysis are presented on table 3. A direct relation between planning activities that promote a cooperative or collaborative interaction, and observe a coach attitude and an integrative-promotive classroom environment, was found. This could suggest that teachers try to accomplish a coach attitude by creating activities that involve the whole group such as presentations and a continual communication between the members of each team.

Table 3. Correlations between observed and planned variables using Tau-b Kendall

		Observed variables						
Planned Variables		Coach attitude	Collaborative or cooperative Interaction	Integrative-promotive Classroom Climate	Creative or critical thinking processes	Computer	Video beam	Board
Coach attitude	Kendall	.181	-.096	,230*	.111	.158	,277**	,230*
	Sig.	.166	.408	.048	.338	.173	.017	.048
Collaborative or cooperative interaction	Kendall	,218*	-.175	,238*	-.109	-.054	.167	,312**
	Sig.	.060	.132	.041	.347	.645	.152	.007
Integrative-promotive classroom environment	Kendall	-.218	.168	-.238*	.031	-.013	-.167	-.312
	Sig.	.060	.164	.041	.788	.908	.152	.007
Creative or critical thinking processes	Kendall	.190	-.212	-.052	-.095	-.178	.100	.029
	Sig.	.101	.068	.656	.412	.125	.390	.802
Use of technology	Kendall	-.055	.027	.082	.238*	,198	,203	-.108
	Sig.	.817	.310	.465	.034	.078	.070	.333

statistic

5 CONCLUSIONS

During the implementation of the strategy, collaborative or cooperative interaction among students is promoted. However, it should be considered the low frequency observed in a collaborative interaction. This could suggest that teachers make group activities that focus on the development of each team, in which people only do activities they have been assigned to, but not helping or relating to others members from different teams. However, based on Table 3 it is also observed a relation between the use of video beam and the board with planning a coach attitude, which could suggest that teachers understand a coach attitude as making activities that involves presenting or communicating ideas to the whole class. Another argument that could explain the difference between the frequency of cooperative and collaborative interaction is the teacher's experience using PBL. Since this strategy is new for technology classes in each EI, it's probable that teachers found easier to propose activities that promotes a cooperative rather than a collaborative interaction, due to the group organization they did on the implementation of the PBL [5].

Furthermore, it is observed that planning at least one variable leads to the observation of one of them, which highlights the importance of planning in order to observe any of the variables characteristic of a constructivist approach. For instance, when teachers planned activities that foster an interaction between students, an integrative environment and a coach attitude was observed in the classes (Table 3).

Finally, these results introduces a reflection whether the educational use of ICT promote collaborative interaction in the classes. During the implementation of the strategy it's observed that most of the teachers use ICT resources that helps to communicate and to present information. However, it isn't observed that teachers' foster collaborative resources to develop the project each team have made. To continue analyzing these uses allows teachers to improve the use of ICT in their classes.

Therefore, it is important to continue implementing strategies that promotes a constructivist approach, in which students are responsible and active of their learning, and teachers change from having a vertical role or being the owners of the knowledge to become a guide or counselor for their students learning [5]. Students benefit from a collaborative, interdisciplinary approach not only because of the connections they find among content ideas, but also because they thrive on the coherent development of their creative and independent learning skills.

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