Virtual Conversations

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Abstract: - The formation of engineers involve enabling students in their own specialty knowledge, and, in skills related with critical thinking, reflection, argument development with verifiable and sustainable evidence, discussion management, negotiation and consensus solutions, and convincing, allowing them to improve the decision-making. This research contributes to the study of argumentative discourse, introducing a pilot scheme which is to characterize how students gathered in groups to argue their positions during a speech to their peers, via the Internet, to solve a mathematical problem. The study focuses on the connection between the academic performance of the students and the activities of building knowledge. Besides that, epistemological, argumentative aspects and pattern of dialogue are considered. The research is classified as exploratory, descriptive and experimental design. The methodology is a combination of proposals by Weinberger, Chang, and the author. A Case Study was used, specifically the Problem Solving to design tasks. A Virtual Classroom was built under Moodle platform, where there were exercises materials, interactive program to study, and self-assessment links to related books, etc, available to the students. In this place, discussion forums were developed without a teacher's presence in order to save the students messages that come from the discussion to do the task. In order to analyze the results of the investigation, it is taken as an analysis unit the full message posted by each student: all messages were coded by two different researchers, and then the Kappa coefficient was 82%. Among the results obtained is a large proportion of interactions that reflects a correct handling of the relationship between the given problem and the theoretical foundations to applications in specific situations, showing a good level of knowledge construction. However, the new approaches and ways of solving problems were few. Often, the students ignored the messages of other members of the group, leading to a repetition of the issues that were previously raised and, therefore, most of the discussions were not focused on the task. No evidence different to the result of the mathematical calculation was presented. Although the social interactions were out of this research, it was clear that the members of the group did not get rapport between them and, consequently, the engagement to participate in the forum activities was not strengthened. For all these reasons, there is not a enough evidence to ensure that the academic performance of the students make be better using these strategies. Finally, to optimize the successful implementation of this type of methodological strategies, the presence of the teacher in the discussion forums should be considered so that he performs the necessary interventions to guide students towards constructing knowledge

Key-Words: - argumentation, discourse analysis, dialogue patterns, academic performance.

1 Introduction

This research contributes to the study of the argumentative discourse introducing a pilot experience on the dialogs patterns developed by engineering students when they worked in virtual discussion forums without teacher's participation, in order to make the planned interventions that lead to genuine knowledge construction and then to make better the academic performance of the students. Research results will provide light on how to explain, ask questions and communicate the students to solve a task. These data will help other teachers wishing to implement similar activities, to understand the different ways to motivate students to discuss a particular point.

The research focuses on reviewing the activities of collaborative learning through the computer to analyze the speech of students according to two dimensions: epistemological and argumentative, and to look what happen with academic performance of the students.

2 Problem Formulation

The formation of engineers involve enabling students in their own specialty knowledge, and, in skills

related with critical thinking, reflection, argument development with verifiable and sustainable evidence, discussion management, negotiation and consensus solutions, and convincing, allowing them to improve the decision-making. The process of teaching and learning of mathematics for engineers must adapt to new times, so that students who are forming as such professionals, acquiring skills to develop a fluent speech and with arguments that support their positions front of a mathematical problem. [1][2] [3]

According to [4] some difficulties or barriers that arise when using the technique of argumentation in mathematics; for teachers, this involves a rethinking of the goals of instruction. Many times, despite efforts to start with certain tools that support the argumentative dialogue, the teacher falls back on traditional patterns of speech, which only emphasizes the right answer and that usually depends on knowledge of the teacher. Second, for this type of activity to be successful, requires the commitment of students to participate in them. Due to the novelty of the strategy, it is necessary that teachers are models and guide students as to intervene in the talks.

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3 Research Objectives.

The development of this research aims:

To characterize how students gathered in groups argue their positions during a speech to their peers to solve a problem related to mathematics.

To describe the patterns of dialogue followed by engineering students in collaborative activities carried out by Internet.

To analyze whether the presence of cognitive conflict or epistemological relationships within a study group influences academic performance of students

4 Literature Review

Collaborative learning refers to learning environments in which small groups of people work together to achieve a common goal. Thus, collaborative learning involves interactions among a group of individuals. When the interactions are carried out through computer tools in order to do the collaboration online, this practice is commonly described as the field of Computer Supported Collaborative Learning (CSCL). In CSCL-environments, online asynchronous discussion groups take a central place. These are known as Computer Mediated Conferencing (CMC), Computer Mediated Discussion (CMD), Computer Conferencing (CC), Networked Learning (NL), or Asynchronous Learning Networks (ALN). [5] [6]. This branch of the CSCL is called CSCA also (computer supported argumentation Collaborative) [7]. In spite of this conceptual variety, most environments have in common that students exchange messages through computers with one another.

The activities of CSCL developed in written asynchronous environments, promote collaboration among students and reduce the inhibition in the communication. It also allow promote the security language, where students have the opportunity and time to edit and make corrections in the text.[8]. The collaborative discourse on the Internet, help students synthesize information they have obtained to show it as evidence in the discussion. Enable to create groups of students who have developed various principles or concepts of the topic in question and facilitate the online discussion in order to each group defends its position, where the critics of the principles of another group, favors the work for a consensus solution through the scientific arguments based on evidence.[9]

Others authors [10] argue that it has been shown that understanding can be improved and learning can be triggered by both collaborative and argumentative processes in which interaction and discussion between students plays an essential role. When students discuss by writing chat o forum messages during a collaborative argumentation game, they may profit from the structure of the argumentative genre as a rhetorical goal of writing. This means that here there is interaction between rhetorical goals and problems of content. Through this interaction, students can improve their understanding of the texts they read earlier when preparing themselves for their debate. Besides that, these authors say when students are concentrating on the content of the preparatory texts to formulate their arguments during chat o forum, when they are in fact learning by arguing, their retrieval processes are directed toward the memory unite of written texts. The recalled propositions are, in turn, translated into written chat messages. Here the primary function of writing in general is to mediate recall and reflection, and the resulting texts, forum messages in this case, must be functional with respect to the joint activity in which the writer is involved. Due to the complex combination of the processes of reading, recalling, and formulating written arguments, we can say that written discourse is more effective in terms of learning than oral discourse.

According to [11], the constructive discussions involve exchange of information to build knowledge through the addition, explanation, evaluation, processing and synthesis. It is believed that learning

is effective when the students in collaborative situations, come into cognitive conflicts and resolve them through argumentation and negotiation, producing a consensus solution. In others words, all information should be critiqued, and evaluated on their degree of certainty (true or false) and its significance level (importance level).

The terms of argument and argumentation reflect two meanings where the term argument is used as an product and as a process. For example, an individual builds an argument to support a claim. For its part, the argumentation is the activity that takes place when two or more persons undertake to discuss opposing postulates. However, within the "argument" as product is the progress of claim, presentation of evidence, present against claims, and integration of arguments, which is the feature of argumentative discourse. [12]

Determining whether knowledge is constructed in a electronic discussion is not a easy task. It is necessary that the students commit to participate in the activity, that they know what is expected from them, how they will be assessed (number of messages, as messages, evidence of learning by example). Often, they think that the discussion is focused on "showing what you know ", especially to the teacher, as opposed to "explore a topic". The online discussions are rich environments to create knowledge, whether the student is committed to dialogue. Learning is a process, as evidenced by the conversation, in which learners reflect what they already know and negotiate new meanings through tools of argumentation to arrive at the construction of knowledge by consensus. [13].

A common approach to fostering scientific understanding is to encourage students to make their ideas explicit and to compare their ideas to those of their peers [14]. Engaging students in scientific discourse helps them to examine their own perspectives, evaluate alternative conceptions, and identify conflict that might then lead to reformulation of beliefs. Peer collaboration is beneficial to learning as it involves the process of articulation, conflict, and co-construction. The idea that cognitive conflict might promote collaborative scientific understanding has been well examined in science education. The cognitive conflict involves, in first place, identifying students' prior conceptions and confronting their beliefs with discrepant information of the task which contradicts their existing beliefs. This confrontation is employed to deal disequilibrium and induce students to reflect on their conceptions so as to resolve the conflict. The cognitive conflict, occur also, whether grouping students with different conceptions about to develop the task. In this way, as students are exposed to the conflicting ideas of the peers, they have to justify and clarify their position; and so it would help them to review their understanding, in others words, maximizing socio-cognitive conflict would promote individual understanding.

4.1 Conversations Written Analysis

Multiple approaches have been developed for analyzing the speech in different fields: linguistics, philosophy, anthropology and, off course, in education. All of these approaches consider different dimensions of the process, as indicators of the construction of knowledge.

To make judgments about the quality of the argument, in recent years, researchers have developed different methods to identify the essential features of the argument. Different essential features of the argument are considered by different researches. However, all of them, in one form or another, come to the model of Toulmin's argumentative structure, which emphasizes the identification of the structural characteristics of the arguments (They are ideas, data, evidence, grounds and qualifiers) and the segmentation processes, especially in terms of how students provide evidence for their approach. The most of researches are agree the structural analysis of the arguments of students contributes to an understanding of how they assimilate the practices of argumentation and provides information about the type of reasoning that students use when they construct arguments based on their daily experiences.

These researches, seek to identify the absence or presence of the components of the argument, established by themselves, and use this information to evaluate the quality of argument. Some of these researches are:

Gunawardena, Lowe and Anderson [15] propose a model to analyze the construction of knowledge that can occur during virtual conversations, from the coding of each unit of analysis according to the phases shown in Table 1.

Table 1. Gunawardena Model

Phases		Examples
I	Comparison Information	Raise comments, opinions, corroborating examples, ask questions or give answers
II	Dissonance and inconsistency	Identify areas of disagreement, questions and responses that support an argument or argument counter.

III	Negotiation - Co-construction	Identifying areas of agreement, integration of ideas and concepts
IV	Evaluation - changing ideas	Samples, evidence of the conceptual field, personal experiences, others to build consensus
V	Implementation of the new meanings	Summary and synthesis of the concepts studied. Application of concepts in new tasks.

If it appears that messages from members of a group flow from the first to the upper stages, it can says that knowledge is being built.

Veerman [11] provide a methodology to analyze the construction of knowledge from the perspective of epistemological content, argumentative content and type of approach. The messages should be encoded according to the specified in Table 2, and then to add by code and to get the relative frequencies of each dimension.

Table 2. Veerman Methodology

Dimension	Subdimension
Content epistemological	To Add
	To explain
	To evaluate
	To summarize
Content argumentative	To raise
	To Verify
	To Challenge
	To qualify
	To accept
	To Conclude
Type of approach	Making links to content
	Do not make links to content

Weinberger and Fischer [6] present a scheme for analyzing multiple dimensions of the process of knowledge construction in CSCL, which are

Dimension 1. Participation: provides two important types of information: students are involved in all process of the task and their participation is equivalent? To get this type of information, the amount of participation and diversity of participation are considered.

The amount of participation could indicate that the learners, theoretically, have been in position to be able to acquire knowledge within the virtual environment. In text-based CSCL environments, the amount of participation is generally higher, because students can develop their contributions without interruptions and think these better.

The heterogeneity of participation is important and may depend on the size of the group, social aspects and of riding freedom. If the group is very large, only a few of them participate, and others are left behind.

Dimension 2. Epistemic: refers to the content of the contributions of the students. It must be analyzed first, whether students are engaged in the activities to solve the task or rather, are being concentrated external aspects of the task.

Second, epistemic activities to develop the task, should be differentiated. Researchers said that the discourse on the task occurs when it helps to solve it. Discourse outside of the task is the opposite. The amount of discourse on the task, is related positively to the acquisition of individual knowledge. Students can apply different strategies to solve the task, different tasks require different epistemic activities. Depending on the task, specific epistemic activities can foster the acquisition of individual knowledge. Activities where it is wished the argumentative knowledge construction require that students work with case studies, theoretical analysis, including at least three different epistemic activities:

The space of the problem: it is referred to communicate about the data or information which can be extracted from the raised problem.

The conceptual space: occurs when students talk about the theoretical aspects without referring to the space problem. Includes summary, paraphrase and discussion of theoretical aspects related to the problem

Building relationships between space problem and space conceptual: it consists in applying the theory to the problem. Identified as students approach the problem and apply knowledge based on the revised concepts. Students who apply concepts to problems collaboratively may be able to transfer this knowledge to future problems and apply concepts in individual way.

Application of new approaches: inputs are presented about new ways to solve the problem.

Dimension 3. Argumentation: in the construction of knowledge using argumentation, learners need to solve complex problems. Students are therefore, continually, qualifying and offsetting solutions of the problem until converging to a solution. A micro-level analysis can be done, in order to classify the input as simple claim, qualified claim, claim with evidence, claim with evidence and guarantees, or simply questions, . As well as macro-level analysis allows to classify the inputs as an arguments, arguments counter, integration of arguments, or there are no arguments.

Dimension 4. Social mode of co-construction: the way how students solve the problem and construct

arguments can be expressed in different degrees in different members of the group. These include:
Externalization: is when students contribute to the discourse without reference to other contributions
Elicitation: students ask questions related to the topic to their peers, to seek the answer to the problem. This technique is valid only if the student gets the answer of his question, and applies himself, this knowledge to solve the problem
Construction of the consensus oriented by integration. Collaborative students may establish and maintain shared conceptions about a subject. Students approach and integrate the perspectives of their colleagues, synthesize their ideas to try to make sense of the task. Integration occurs when students work on the reasoning of their peers; an example of this is when the participants express their willingness to revise or change their views because of the persuasive arguments. Students may waive or modify their initial beliefs and correct them as response to the contributions of their peers.
Construction of the consensus oriented by conflict. This tool is considered very important from the socio-cognitive perspective in collaborative learning. Facing criticism, students feel pressured to try multiple perspectives and find better arguments to justify their positions. To make this kind of consensus happen is necessary that students determine key aspects of the contributions of peers and modify them or present alternatives. Therefore, it is necessary, a good close encounter between the whole group.
The summary of the pattern suggested by the authors is shown in Table 3.

Table 3. Weinberger Scheme

Dimensions	Subdimension
Participation	amount of participation
	Heterogeneity of the participation
Epistemic	problem space
	Conceptual space
	Building relationships
	New approaches
Argumentation	Macro: To argue, argue against, Integrate arguments, no arguments Micro: simple claim, qualified claim, claim with based, claim with bases and evidence, or questions
Social Mode of co-construction	Externalization
	Elicitation
	Construction of consensus oriented by integration
	Construction of consensus oriented by conflict

With regard to patterns of speech, Chang [11] proposes two models of discourse: the superficial and focus on the problem. The first occurs when the student ignores the comments of their peers, which can be statements, doubts, questions, etc. There is no mention of information that can complement, enhance or justify the right or wrong of the partner's position. Rejects, without foundation or justification of approaches made by others, to avoid confrontation, are categorized in this type of discourse, also.
Is talked about speech focused on the problem, when make key questions indicating knowledge, give explanations, answer questions, acknowledge the problem, perform synthesis, etc.

5 Methodology

In accordance with the established objectives, the study was framed by two types of research. Exploratory: the theme of analysis of argumentative discourse, approached from the perspective of building knowledge through the Internet, has been studied slightly. Therefore, this research may contribute to the state of the art in this area. Descriptive: besides, the patterns of dialogue that students maintaining when participate in virtual discussions, may be determined through of this research.
Additionally, in this study, it was planned develop a research which was the combination of documentary and field research, because the mechanism used to obtain the information came from articles printed or electronic and of the results of the experiment.
According to [8] an experimental research design was used, due to interventions in the context of education with the aim of proposing new theories about ways to analyze the discourse.
The methodology was a combination of proposals by Weinberger, Chang and author. From Weinberger (et al), the epistemic and argumentation dimensions were taken; the type of approach's discourse was analyzed according the claims of Chang (et al). Case studies, specifically problem solving to design the tasks was used. The research questions formulated were: How to measure the valid contributions made by students to solve problems? What are the most common barriers that prevent the success of argumentative discussions which allow the construction of knowledge? How the cognitive conflicts affect academic performance?

5.1 Context. Course and Participants.

The experiment was developed using the Virtual Classroom of the Faculty of Engineering at the

University of Carabobo. This virtual site is supported by the platform Moodle, a virtual environment that facilitates the process of teaching – learning. This platform offers the ability to drop files onto the network, provide forums for discussion, consultation, assessments and many other helpful strategies. Its use in this investigation allowed to place material support for students take them as formative assessments, in order to strengthen their knowledge and improve their preparation for summative assessments. MOODLE is a course management system freely accessible on the Internet,

The Differential Equations subject, belonging to the basic cycle of the Faculty of Engineering (a 3rd semester university course), was selected to carry out the learning experience with new strategies. The current population enrolled in this course is approximately 900 students. It was worked with a section of the course, which involved about 70 students, who were aged between 19 and 20 years old for that moment. The pilot phase was conducted during a semester.

5.2 Research Variables and Hypotheses

The student performance was considered as dependent variable and the building knowledge as independent variable. The hypotheses formulated were:

H_0: The academic performance of the students no depends on the intensive discussion activity nor epistemological relationships that present in the group that they belong to. (Null hypothesis).

H_1: The academic performance of the students depends on the intensive discussion activity and epistemological relationships that present in the group that they belong to.

5.3 Data Collection

The full message was selected as the unit of analysis. There were two doctorate students who worked to segment and classify the content of the conference transcripts. Using multiple coders permitted the determination of reliability, which reflects the assumptions of the data analysis procedure is objective (not interpretive).

5.4 Experience

In the Virtual Classroom, there were exercises materials, interactive program to study, links to related books, etc, available to the students. In this place, discussion forums were developed without a teacher's presence in order to save the students messages that come from the discussion to do the task. The research focuses on the analysis of interventions in the forums. To participate in the forums, students met in groups of three or four members. The forums were set up so that each student could participate only in the forum for his group, but all students could check the forums of the other groups. The length of each forum was ten days, and each one had a value of 2% on the final grade.

Forum Nº1. Each students group had to consider a generic problem for deriving the differential equation representing the family of curves given by the teacher during class attendance. The Curves that had each team were different. The rules of the forum and the importance of writing everything they were thinking during the task were communicated to the students. Attach material with calculations and charts, either as an attachment file or a scanned paper work, were allowed

Forum Nº2. A problem that was facing a company is presented. Four alternatives for resolving the problem were offered. It was asked to each students group to advise the company in making decisions regarding this case and recommend a proposed alternative. Some key parameters of the problem were modified in order to students analyze the sensitivity of the recommended decision for them. The rules of this forum were the same as the first.

6 Analysis of results

To analyze the results of the investigation, homogenous groups in number of participants, were considered. Therefore, the individual participations were ignored. The full message written by each participant was taken as the unit of analysis. All messages were coded by two different researchers, to remove subjective positions and increase reliability (Kappa coefficient 82%). Messages posted by students in the two discussion forums were analyzed according to three aspects: epistemological content, argumentative process and patterns of dialogue. Then, absolute frequencies for each code were calculated.

In the other hand, a analysis about the academic performance and the type of discourse in the interactions was realized.

6.1 Analysis of results by the epistemological content

Messages from all group participants considered were coded according to the scheme shown in Table 4.

Table 4. Epistemological Content

Code	Meaning
EP	Problem Space
EC	Conceptual Space
CR	Building relationships
NE	New approaches
FE	Off study

From this viewpoint, relations of the concepts theory with the specific problem were set up in many of the participations, in order to get the solution. However, few interventions reflected a different design to solve the problem, that raised by a member of the group. Repetitions of the same approaches proposed by several members of the group do not add value to the construction of knowledge to solve the problem, so they were considered "off study". (Fig 1)

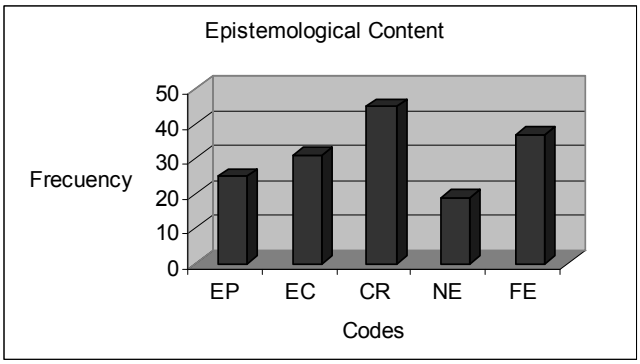

Fig 1- Epistemological Content.

6.2 Analysis of results by the argumentative process

This analysis was conducted in two different ways, which are complementary:

6.2.1 Macro Analysis

In order to qualify the contributions of students in a productive discussion that would deepen the topic in question, the scheme of codes shown in Table 5 was used.

Table 5. Macro Analysis

Code	Meaning
AR	Argument
CR	Argument against
IA	Integration Arguments
NA	Not agree

Under this approach, it could detect that students did not strive very much on discussing adverse positions, or extend the explanations for the solution of the problem and then, integrate different arguments. Repeated approaches were considered as "no argument". (Fig 2)

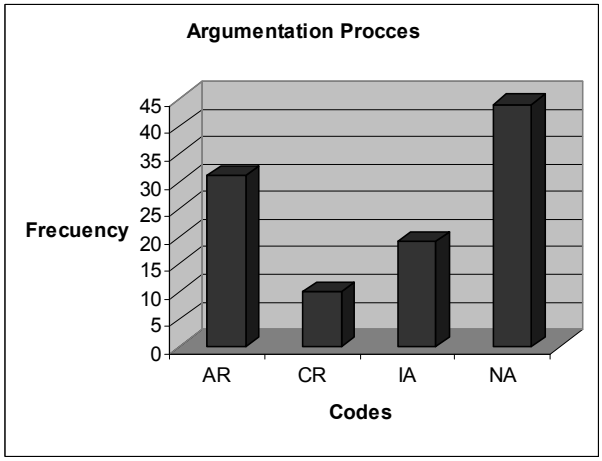

Fig 2. Analysis Macro. Argumentation Process.

6.2.3 Micro Analysis

Process argumentative is also studied from the standpoint of the tools used by students to support their ideas. The codes used in this phase are shown in Table 6.

Table 6. Micro Analysis - Type of Argumentation

Code	Meaning
PS	Simple claim
PB	Claim with bases
PE	Claim with evidences
OT	Others

Most of the learners supported their answers with mathematical calculations (evidence), but not always maintained a solid theoretical basis. Some approaches, arranged as evidence, were not considered as such because they were not correct. There was silence on the matter. Some questions asked by peers were ignored, missing the opportunity to respond with evidence or theoretical justification. Some students, made theoretical comments that were not linked to the problem directly, but these were related to previous knowledge. Many approaches with repeated evidence were posted, therefore, it was considered as evidence for the first group and the rest were classified as "other." (Fig 3)

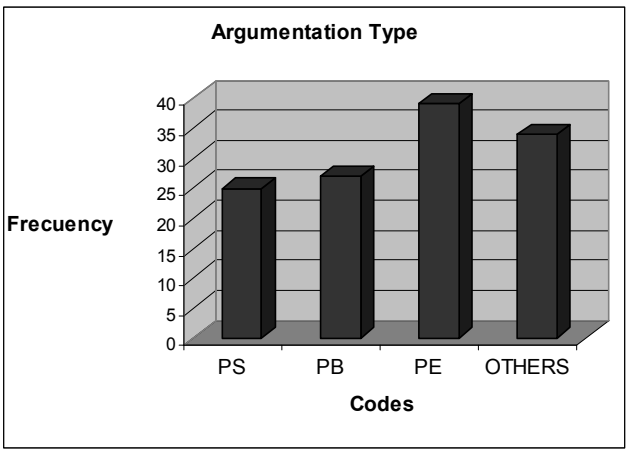

Fig 3. Analysis Micro. Argumentation type.

6.3 Analysis of results by patterns of dialogue

The coding showed in Table 7 was used to qualify all students' messages.

Table 7. Dialogue Patterns

Code	Meaning
SP	Superficial
CT	Focused on the task

In reviewing the messages posted by students, could be seen that over 50% of these, represented comments surface, due that most of them were repeated messages for the peers. Many questions were ignored, which were left unanswered in the air. There is no conversation, as such, among team members, rather it can be inferred that each person works on one's own without appreciating the participation of peers. (Fig 4).

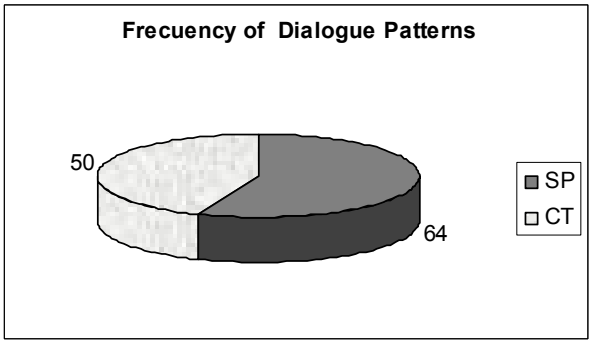

Fig 4. Dialogue Patterns

6.4 Cognitive Conflict in Virtual Discourse

According to the presence of cognitive conflict in virtual conversations, it was found that only 6 groups of 22, showed debate activities. (Fig 5).

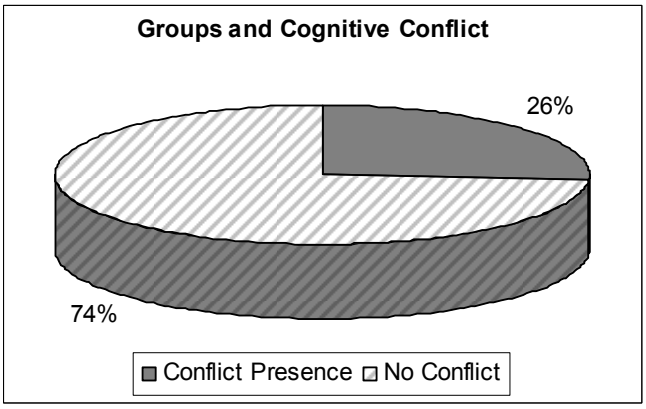

Fig 5. Groups with Cognitive Conflict Presence

However, it was determined that, from the total number of students approved of the course, almost half came from these groups which had cognitive conflict. (Fig 6).

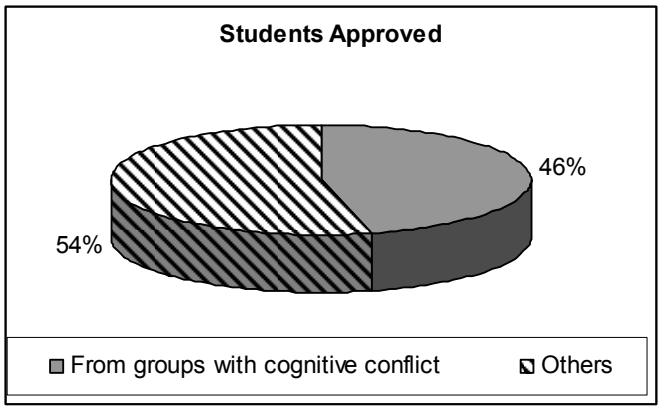

Fig 6. Origin Groups of students approved- CC

Furthermore, considering the groups where there were relationships between the theoretical concepts with the task signed, one finds that 85% of students approved coming from these groups.(Figure 7).

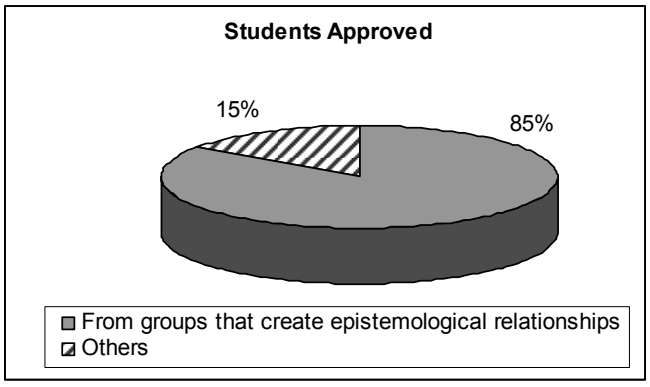

Fig 7. Origin Groups of students approved

In order to test the research hypothesis it was made a chi-square test, setting a confidence level of 95% and a degree of freedom. Remembering these hypotheses:
H_0: The academic performance of the students no depends on the intensive discussion activity nor epistemological relationships that present in the group that they belong to.
H_1: The academic performance of the students depends on the intensive discussion activity and epistemological relationships that present in the group that they belong to.

The observed frequencies are shown in Table 7.

Table 7. Observed Frequencies

	Belong to groups without cognitive conflict nor epistemological relationship neither	Belong to groups with cognitive conflict or epistemological relationship	Total
Approved Students	2	11	13
No approved Students	4	23	27
Total	6	34	40

From these data, it can be calculated:

$$\text{Proportion of students approved}=\frac{13}{40}=0,33$$

$$\text{Proportion of students no approved}=\frac{27}{40}=0,67$$

Then, the expected frequencies are generated and showed in Table 8.

Table 8. Expected Frequencies

	Belong to groups without cognitive conflict nor epistemological relationship neither	Belong to groups with cognitive conflict or epistemological relationship	Total
Approved Students	1,98	11,22	13
No approved Students	4,02	22,78	27
Total	6	34	40

After that the chi square value was calculated, and it was $x^2 = 0,006739$. Comparing $x^2 = 0,006739$ with the value $x^2_{0,95} = 3,84$ corresponding to 1 degree of freedom, is much lower, implying that there is not enough evidence to reject the null hypothesis

7 Conclusion

The lack of participation of the teacher in the virtual forums carried out in this research, did not favor the construction of knowledge between students. It reaffirms the statements of Paz and Kunh, in terms of that instructor require participation in virtual forum to ensure that the process of construction of knowledge occurs and to avoid students fall down in self expression or monologs.
However, it was found, that the most of the approved students come from groups that had activities that strengthened the construction of knowledge. This fact confirms the Weinberger and Fischer's expositions respect to that the successful learners often build relations between conceptual and problem space, so that, they internalize this relations in order to apply to new problems.
There were a large proportion of interactions that reflected a correctly handled of the relationship between the given problem and the theoretical foundations to applications in specific situations, demonstrating a good level of knowledge construction. Nevertheless, new approaches and ways of solving problems were few.
Most students worked on the forums by the way "to show all I know of the task studied" and not of " explore task ", as it was right to achieve a productive discourse.
No evidence different to the result of mathematical calculation, was presented. It leads to think that students did not understand what is evidence, or simply not prepared to look for it.
Most of discussions did not focus on the task, because students did not participate actively in discussion among themselves, but worked independently
Although the social interactions were out of this research, it was clear that the members of the group did not get rapport between them and, consequently, the engagement to participate in the forum activities was not strengthened.

8 Recommendations

To establish activities of virtual forum with presence of the teacher, who conducts assessments on the construction of knowledge during the experiment, in order to make interventions when it will be necessary, and help to create a learning community.

Induce students to coding their contributions that are posted in the forums by themselves. In this way, participants will be more aware of their contribution to solving the problem.

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