

Assessment of learning activities in discussion forums online

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Abstract. - This is a report intended to describe a research about assessment of learning activities done in a virtual forum. Student's messages in the forum as a whole were considered as analysis unit. It was employed a content analysis technique to identify characteristics involved in the messages. Categories and indicators for analysis were defined from the Community of Inquire Model, adapted specifically for mathematics courses. Examples selected as a guide for learning activities assessment are shown, in terms of number and type of participation, as well as result from linear correlation analysis between numbers of participations to each category.

Keywords.- Inquiry community, social, didactic and cognitive categories.

I. INTRODUCTION

Interaction in virtual forums has been studied by several researchers. They have analysed different aspects of interaction [1, 2, 3, 8, 10, 12, 14]. To consider knowledge construction caused by students interacting in forums is a methodology for making inferences by systematically and objectively identifying defined characteristics in the messages. Van Dijk analysis [12] includes considering the quality of language employed, beliefs that a rise in social interaction. Everyone's contribution bears an own meaning and must be considered individually.

A remarkable method is the codification method proposed by Henri [8]. Accordingly, there must be distinction between participation and interaction categories, because number of participations is not a valid indicator to verify quality of interaction. Anderson, Garrison and Rourke [1, 5, 11] have developed the Community of Inquire Model to analyze interactions and learning processes in virtual forums, which is consistent with the constructivist proposal for learning.

II. COMMUNITY OF INQUIRE MODEL

For this model it is supposed that the learning process is integrated by three central components: Social, didactic and cognitive dimensions.

Social dimension is defined as student's skill to communicate social and emotionally into the learning community by means of messages; with those messages

students build personal relationships, settles affective communication and develops social ties, and so there is an environment necessary for the group to feel safe for open communication and behold around common goals.

Didactic dimension deals with designing, facilitating and guiding social and cognitive processes, intended to achieve meaningful learning [1].

This dimension can be seen in the forum as messages between teacher and students to accomplish the course goals, which means to decide about resources, programs, study guides, methodology, contents, discourse, activities and deadlines. As course designer, the teacher inherits a key role, but it must be taking into account that in a course with constructivist approach responsibility is not exclusive for her/him.

According to Anderson [1], contributions to this category may surge from anyone collaborating to implement the didactic role.

Cognitive dimension. Garrison [7] defines cognitive dimension as the level to which students are able to construct and confirm meanings through reflection and dialogue within an inquiry community.

This dimension is based on critical thinking which could be understood as a process, as well as a result. As a product it refers to acquiring deep and meaningful understanding, which is perceptible in the different assignments elaborated by students. As a process it is considered that critical thinking acquisition may be enhanced by understanding how it is accomplished.

It is important that in this research the term "category" instead of "dimension" or "presence", as used by Marclo [10] and Anderson [1], correspondingly.

III. METHODOLOGY

The need for original indicators was perceptible when first trying to categorize the messages put into the forum, according to the definitions made by those authors and found several situations not included in. Therefore it was generated a first set of original indicators, to try a new scale to categorize messages submitted to the forum.

Considering this new scale, indicators were redefined, in a way that the new set of indicators was suitable for two consecutive categorizations that produced same results. For each indicator, significant samples of text were collected.

The content of each message submitted to the forum was analyzed according to the previously defined indicators. When there were found one or more indicators, then it was considered that the message contained a collaboration of the type of the indicator and so it was counted. A message might include only one category indicators or two or three categories simultaneously.

IV. RESULTS

An important part of the study was adapting the Community of Inquire Model to the specific characteristics of the selected course. In Tables 1, 2 and 3 defined indicators for each category are shown, as well as significant samples of text, taken as guiding examples in the categorization (Note: Phrases in tables 1, 2, 3 are taken literally from messages submitted by students to the virtual forum. S.A., V.C., C.T. and J.C. are the initials of students' names).

TABLE I. INDICATORS TO CATEGORIZE, AND EXAMPLES OF SOCIAL CATEGORY

Social Indicators	Examples
Expressions about emotions, feelings and moods.	"Welcome fellows, I'm happy to work with you" "... I feel stressed because S.A. does assignments pertaining to future and gets parts that do not belong to him"
Jokes, irony, sarcasm or mockery expressions.	"You can't stand against women. I agree with you!!! (Just kidding!!!!)"
Comments about aspects not related to the course, as everyday life, personal communications.	"My computer is in trouble and I'm working in a public facility" "Do you know when are we having the i.d.'s to obtain books from the UDG library?"
Support, appreciation, recognition, grateful, displeasure and apology expressions.	"If is there any question from the assignment that you consider that I may help you, I'll do it with pleasure" "I'm sorry, I faced problems with my computer"
Comments not related to course contents.	"If you don't notice until now, we are the only team that has send assignments to the folder in the platform." "You may purchase online the Pita Ruiz book at Santa Fe book store"
References to other classmates' messages or assignments.	"... that is why V.C. says: We first rewrite..." "The J.C.'s answer may help to solve the problem." "...on exercise 1 I agree with J.C..."
Using classmates' first name to address them.	"C.T., I already have checked the exercises you send."
References to the Group, using expressions as we, ours, our Group, classmates.	"...we have to put together our parts to conform just one document for the assignment..." "My fellows, my proposal is..."
Etiquette of Communications, greetings, welcomes, farewells, etc.	"Hi everyone" "Please install..." "Greetings"

TABLE II. CATEGORIZATION INDICATORS AND EXAMPLES OF DIDACTIC CATEGORY

Didactic Indicators	Examples
References to program, work methodology, assessment criteria and deadlines to submit assignments.	"To sustain your messages and answers you must define and interpret the concepts involved..." "Write formulas with the equation editor" "The limit to deliver assignments 1 and 2 is the 19.02.07."
References to platform, or available resources.	"Please install the Skype program..." "...how do you put the vertical line in the augmented matrix when in the program...?" "Please consult the study guide ..."
Agreement or disagreement expressions about assignment of activities.	"Hi, I agree." "I don't agree with that ...I told you I was to do exercise 1"
Expressions to direct dialogs and activities to achieve course objectives and learning construction.	"Hi Partners: What is the strongest argument to solve an equation system?" "It's necessary further work for assignments 1 and 2 because there are several failures..." "In problems ... matrices are second degree and in ...third degree, therefore it would be convenient distribute them so that you every one receive a problem from each first and second parts"
References to contents, tutoring and questioning.	"In general, the number of transpositions depends of ..." "What's the use of permutations parity and product of substitutions?" "The concepts permutation and substitution are basic for learning the concept of determinant."
Requests and judgment expressions about own or other's work.	"Excellent answers." "Your explanation is quite complicated". "...in order to clarify your conclusion it would be good to indicate that parameters ann and b are different of 0."
References to additional information sources.	"The teacher put in the home page some tips ... so we can put in just one format the assignment" "see examples in the adjunct file" "... it was consulted in the editorial Alianza book, and the researcher familiar matrices..."
Comments about development and completion of assignments.	"I'm sending you what I have done about assignment 2..." "yesterday I didn't send the assignment, but for sure I'll send it today." "...I suggest putting in the platform the drafts of your shares for the assignments..."

TABLE III. CATEGORIZATION INDICATORS AND EXAMPLES OF COGNITIVE CATEGORY

Cognitive Indicators	Examples
References to the problem, indicating what is known and asking about unknowns.	<p>"I solved 5.1 and found the X substitution, from knowing that the substitution product is associative for any finite number of substitutions. I'd like to know if you found another method..."</p> <p>"I have calculated the range of matrix 2.1 from the maximum order of its minors different from 0. Is it valid? Or it has to be done by calculating the number of no-null rows of the scaled matrix from the given matrix"</p>
Expressions about difficulties to problem understanding, and confusion.	<p>"Regarding problems from exercise 2, I don't know how to verify the solutions..."</p> <p>"I can't finish exercise 1.3..." "I don't understand exercise 3.3."</p>
Comments to share and explain problem solving strategies.	<p>"...watch how I did exercise 2.3. I'll try to explain to you with words. You begin with the first number of the row..."</p> <p>"A general comment is that your solutions are correct and well founded by deduction, but there are some alternative solutions..."</p>
Agreement or disagreement expressions about assignments.	<p>"...I considered that is a correct answer, but the deduction is not"</p> <p>"Juan Carlos told me that ... Is it true? I think ..."</p> <p>"Are you sure that is the correct answer? How can you probe it?"</p>
References to information gathering and/or teacher and students suggestions	<p>"...thanks for the observation, with that I finish exercise 1.3,"</p> <p>"Considering the exercise 1.1 that our partner C.T. has solved, I noticed that I have missed to locate..."</p> <p>"It was useful for me to see the way you deduce the requested equation, in fact it's easier than the one I used."</p>

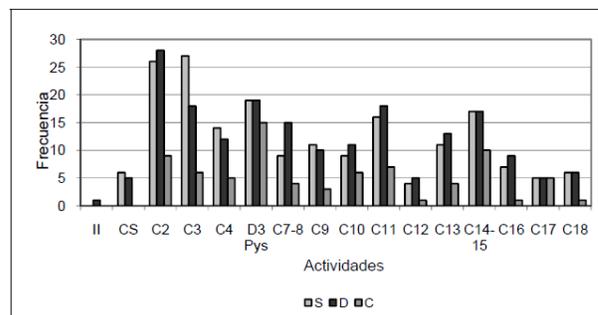
At the virtual forum participated eight students and a teacher, all of whom submitted 321 messages; when using Content Analysis with defined categories and indicators, there appeared 617 collaborations distributed as shown in Table 4. There is noted that the number of collaborations is close to two times the number of messages; this relationship shows how most messages include more than one category (Note: Teacher collaborations are included in distribution by categories).

TABLE IV. DISTRIBUTION OF CONTRIBUTIONS TO VIRTUAL FORUM IN CATEGORIES

Description	Frequency	%
Contributions to forum	617	100.00
Teacher contributions	174	28.20
Students contributions	443	71.80
Contributions to social category	252	40.84
Contributions to didactic category	269	43.60
Contributions to didactic category	96	15.56

Data of Table 4 show that the number of collaborations of each category is different. The number of collaborations of social category (S) and didactic (D) are similar (252 and 269 respectively), while the cognitive category (C) just had 96 contributions. This distribution seems reasonable for it corresponds to collaborations submitted to virtual forums where students and tutors direct their learning process through debating course contents [1].

It was observed that the amount of participations corresponding to each category was different for each learning activity, this suggests a variation for each category along the development of the course (Fig. 1).



Notice: II (Initial instructions), CS, (Communication via Skype), C2 (Class 2), (C3) Class 3, C4 (Class 4), D3 Pys (Discussion 3. Permutations and substitutions), C7-8 (Class 7-8), C9 (Class 9), C10 (Class 10), C11 (Class 11), C12 (Class 12), C13 (Class 13), C14-15 (Class 14-15), C16 (Class 16), C17 (Class 17), C18 (Class 18).

Figure 1. Histogram to show the number of each type of participations in the activities indicated along the course.

Figure 1 shows also a trend towards a reduction in the number of participations as the course progress. Such trend is noticeable for each three categories. The reasons for this decrease are not the same, but it could be said that for this particular course, students communicated directly among themselves using skype as synchronous media, skipping the possibility for registering those communications.

In Figure 2 the corresponding rates of participations in the activities are presented graphically. It can be seen as the rate between the types of collaborations remained relatively constant in spite that, as previously stated, the number of participations decreased along the course.

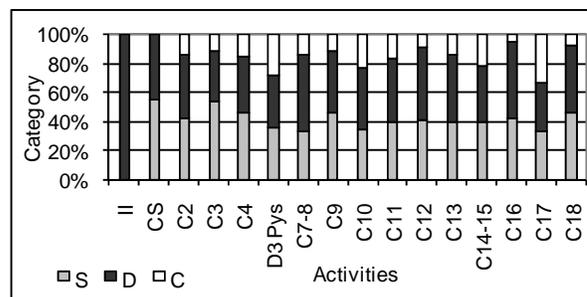


Figure 2. Rate between number of collaborations from each category in learning activities.

To describe the relationship between the social and didactic collaborations a frequency polygon is presented. In Figure 3 it can be appreciated that social category prevails slightly over the didactic one in the first third of the course, and then it reverts for the rest of the course.

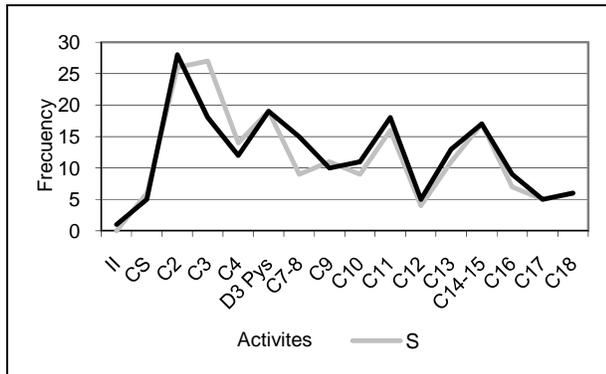


Figure 3. Rate between the number of collaborations from each category within the learning activities.

That slightly larger number of collaborations from social category with respect to the didactic one, may be devoted to the initial need for creating a community sense in order that students feel confident to participate. Once this environment is established there may be a slight decrease in the number of affective social collaborations and open comments, because social reinforcement is not needed as previously [13].

Regarding cognitive collaborations it can be seen in figure 4 that they appear until third activity (Class 2), this occurs as the first and second activities (Initial Instructions and communication via Skype) were directed to describe the methodology to use and communication media.

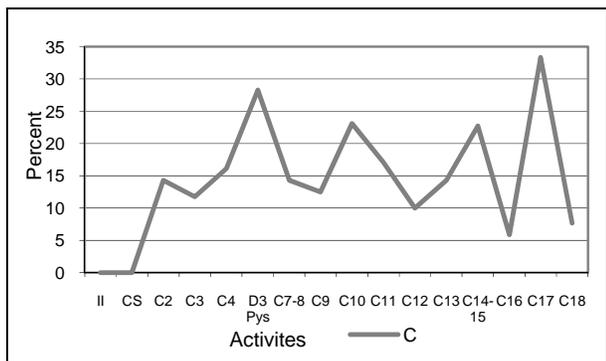


Figure 4. Percent of cognitive collaborations in course activities.

It can be seen in Figure 4 that the percent of cognitive collaborations along the course change from 3 to 33 %. It increased from 23 to 33 % when it was indicated in the forum to check and comment homework products, accordingly to provided indicators.

During sessions (Discussion 3, Permutations and substitutions, Class 10, Classes 14, 15 and 17) students had

to assess their own product and those from their classmates, in order to indicate amendments.

This behaviour is congruent with that described by Garrison [7] regarding how questions or tasks proposed in the virtual forum influence the type and level of cognitive activity of students.

The variation in the rate of cognitive collaborations in the forums agrees with Garrison [7]. He stated that cognitive activity is done in “research cycles” when students progress purposely from understanding the problem towards superior cognitive levels such as exploring, integrating and application.

From these descriptions, data make believe about a plausible correlation between the number of each type of collaboration. For further analysis it was considered the frequency students collaborate to each category. Using this data it was investigated linear correlation between the number of collaborations of each couple of categories social-didactic, social-cognitive and didactic-cognitive.

Pearson coefficients for each case are shown in Table 5. It can be seen that for all the cases there was a high positive linear correlation.

TABLE V. LINEAR CORRELATION BETWEEN THE NUMBER OF COLLABORATIONS TO THE CATEGORIES

Categories	Pearson's correlation coefficient r_{XY}	t_{table}	t_{cal}
Social-didactic 0.	9926	1.9432	20.0787
Social-cognitive 0.	8916	1.9432	4.8236
Didactic-cognitive 0.	9239	1.9432	5.9162

When using the t probe for each correlation coefficient with $\alpha = 0.05$ and 6 freedom degrees, null hypothesis H_0 were rejected, as they reflect that there is no evidence of linear correlation for the number of collaborations from both categories considered ($H_0 : r = 0$ and $H_i : r > 0$).

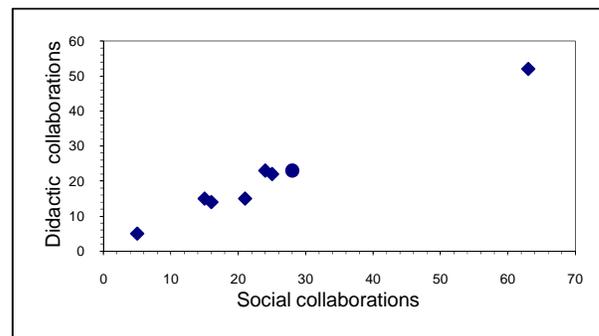


Figure 5. Linear correlation between social and didactic collaborations ($r=0.9926$).

Therefore it was stated that there is evidence of a linear relationship, meaningful statistically between the number of social and didactic collaborations (Fig. 5), social and cognitive (Fig. 6), as well as for didactic and cognitive collaborations (Fig. 7).

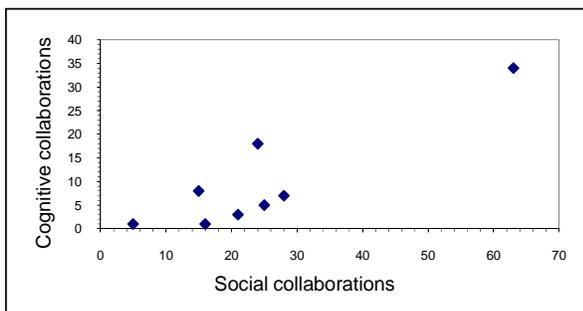


Figure 6. Linear correlation between social and cognitive collaborations ($r=0.8916$).

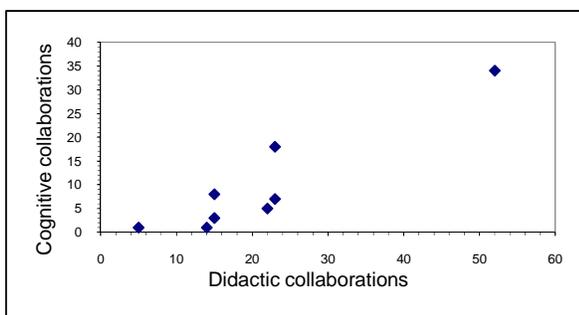


Figure 7. Linear correlation between didactic and cognitive collaborations ($r=0.9239$).

These results agree with those of Garrison [7] about how those three categories are highly related; how social and cognitive categories influence the didactic one, and how cognitive category in a virtual forum can be created and supported [4]. Garrison, Anderson and Archer [4] suggest categories intertwined; they are not isolated from one another.

According to Garrison [7] a high positive correlation between the number of social and didactic collaborations may be explained for most social interchange are related to learning, common purposes and research.

Linear correlation between social and cognitive collaborations was previously recorded by Garrison, Anderson and Archer [6], they explain how ideas interchange, proposing solutions and comfort feeling to participate in discussions, expunge simultaneously social and cognitive sides.

High correlation between didactic and cognitive collaboration frequencies confirms a previously stated about how tutor questioning and tasks requested play an important role to develop the cognitive category.

Finally it can be said that result from using the statistic probe *t Student* indicate that social, didactic and cognitive categories are strongly related as described by Garrison [7].

V. CONCLUSION

From results it can be said that using this model is useful for studying the development of learning activities in the virtual forums. It could be convenient for designing future courses in similar contexts.

Data collected employing indicators defined for this research can be useful as an assessment instrument for student performance in the forum, besides, they are useful to assess the effect of learning activities designed to impulse knowledge building (cognitive category).

Frequency measurement of collaborations to each category was used to find and understand collaboration patterns, however this is not a quantitative research purposed for statistical inferences. But it was a first approach to understand and explain the complex development of online learning activities. From this perspective goals were accomplished.

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