Some Observations from the Analysis of an Online Discussion Board

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Abstract— **Many educators and educational institutions include an online discussion forum in the content management system supporting their courses, because they think such tool facilitates the instructional process. It could be true if we explicitly design the instructional process to take advantage of this tool, but to do so we have to better understand how users actually use online discussion boards. Trying to answer such a question this paper presents a study of discussions occurring in several undergraduate courses in computer science offered by the University of Chile. More specifically, the study was based on the semantic analysis of a representative set of messages registered in eight different courses occurring in a period of two years. The obtained results indicate that the users do not perceive the forum as a learning tool, but as a communication platform that allows them to socialize and address coordination and operative issues related with the courses.**

Keywords–online discussion board, semantic analysis of messages, communication, coordination, social interaction.

I. INTRODUCTION

Traditional teaching in higher education is nowadays typically supported by Web-based Courseware Systems (also known as Course Management Systems). These systems offer a variety of services, including repositories with teaching materials, messaging, activity planning and scheduling, and grade reporting. Another interesting component is the online discussion board, intended for discussion among instructors, teaching assistants and students.

Such a tool may be used to deliver educational contents, coordinate teaching/learning activities, and support asynchronous communication among the course-related community members. Several researchers have identified the advantages that an online discussion board can bring to a course, for example in terms of students' engagement [Wang05] and learning outcomes [Mart05]. However, these advantages are not automatically obtained just by making the tool available to students and instructors. Taking advantage of this tool requires instructors to explicitly design the instructional processes and learning activities to exploit the roles and functions supported by online discussion boards. Unfortunately, few instructors perform this design activity by their own initiative. Therefore, in most cases, the role of the discussion board emerges on-the-fly according to the immediate needs of students and instructors, just to be lost when the course finishes.

This paper reports our analysis of the online discussion board used by U-Cursos [UCU12], a course management system developed by the University of Chile. U-Cursos has been in operation since 2001 at the Engineering School of the University of Chile. No specific goals or guidelines have been established for this system: instructors and students use it as they consider appropriate, and up to date no reflection on its impact has been accomplished. Such openness is regarded as positive, allowing the educational community to learn the best ways to appropriate and tailor the service to their particular interests, which may be varied. However, this openness also results in speckled opinions, often based on personal stories and anecdotal evidence, overall lacking substantive observations based on hard data. After many years in operation, we felt it was time to attempt to develop a more substantive perspective about this service.

All courses at the Engineering School must use U-Cursos at least to report the students' final grades. In practice, most or all courses use the discussion board for many other purposes. We selected to deal only with Computer Science courses, since we could obtain additional data on these courses that could help better understand their impact on the educational community.

Next section presents and discusses the related work. Section III describes the methodology used to analyze the discussion board messages. Section IV presents and discusses the obtained results. Section V elaborates on general aspects of this study and indicates some patterns identified during the messages processing. Finally, Section VI presents our conclusions and future work.

II. PREVIOUS WORK

Since the early years of computer supported Learning Management Systems (LMS) the communication and interaction among students involved in a computer supported collaborative learning activity has attracted the attention of many researchers [Curtis02]. From all the various ways that Computer-mediated communication has been used to support

learning, the Asynchronous Online Discussion Board (AODB) has been the most popular [Ham05].

Interestingly, most experiences reported in the literature are about using such tools in higher education scenarios. The learning modes where AODB tools have been used are often referred as Adjunct Mode, Mixed Mode and Totally Online Mode [Hara00]. The difference between Adjunct Mode and Mixed Mode is the degree to which computer technology and networking have been used to implement the course delivery. Adjunct Mode is described as traditional learning courses which make use of a few computational resources to enhance course content delivery and coordination. Mixed Mode makes use of computational resources as significant and well-integrated components of the overall course. This mode has been also referred as Hybrid or Blended Learning [Garr08]. According to this classification, our study is performed in an Adjunct Mode scenario.

Researchers and educators often mention the hypothesis that online discussion boards enhance the learning experience by increasing the students' engagement in courses [Wang05] producing significant learning outcomes [Mart05].

However, according to the literature it has been difficult to establish a clear link between the use of asynchronous online discussion boards and successful learning. On one hand, in [Alt97] authors examine whether combining face-to-face with online discussion does improve the learning outcome over a population of 142 undergraduates; they report that this combination provides a superior learning environment compared with the traditional classroom alone. On the other hand, in [Thom02] authors report that although discussion forums promote high levels of cognitive engagement and critical thinking, they do not promote the coherent and interactive dialogue necessary for conversational modes of learning. They notice that the role of a moderator is important to overcome this problem. In [Wu04] authors explore the possibility of predicting learning outcome from participation in discussion forums. They conducted a study over 116 undergraduate and graduate students taking regular courses in the New Jersey Institute of technology. The discussion forum was provided by the WebCT LMS tool. Their study aims at establishing causality about the factors that relate participation and successful learning. They conclude that perceived learning value from online discussion is the most reliable variable, along with students' motivation and enjoyment from online discussions, and that the role of the instructor in order to promote and guide the discussions is fundamental.

Most existing studies about the relationship of students' participation in AODB forums and their learning outcome reporting positive results focus on students' self-reported perceptions of learning [Hilt00], [Rich03], [Wu04]. Studies using more objective performance measure, like participation in online forums and grades have found no concluding evidence relating both aspects [Davi05], [Picc02], [DeNe06]. In our opinion, this might also be related to the overall problem of measuring the influence of a single variable in learning, since it is very difficult to control all other variables which also influence learning and to keep them at the same level for the experimental and control groups.

Many authors share the idea that productive discussions do not happen automatically, they must be planned and curated [Chism00]. Best practices for curating discussions include the following elements:

- Require students to participate
- Grade students' effort
- Involve learning teams
- Structure discussions
- Require hand-in assignments (deliverables)
- Pose questions and scenarios that require learners to use their own experience
- Relate the discussions to course objectives

In [Ham05] the author makes an extensive survey of works about online discussion in teaching and learning in higher education. He cites four main issues which authors consider are important for implementing conditions for taking up asynchronous online discussions:

- **Curriculum design**: This is the most discussed issue in the literature. Authors argue that a structured curriculum leads to more cohesion. Therefore learning activities should be timetabled, roles and responsibilities made explicit. Opportunities for reflection should also be considered. The context in which the course takes place should also be considered: online discussion is less likely to be of value if face-to-face meetings are easy to organize
- **Instructor support**: Most authors think the presence of the instructor is important. Let to themselves, learners might be reluctant to disagree, challenge or response to others in a group. Instructors need to signal their presence and provide administrative, pedagogic and even affective support. They should encourage divergence, suggest roles, introduce starter and finalizing ("wrapping") activities.
- **Learners' behavior**: This issue has been relatively less touched. Besides the obvious need to be proficient in using ICT authors mentioned experience and understanding group work as the most important skill learners should have to participate in learning sessions using discussion boards.
- **Software**: The need for a permanent storage of threaded discussions has been mentioned by many authors. Also the need for reliable access to user friendly software and providing users with a clear visual representation of the messages and threads has been frequently mentioned.

However, we can find many Websites from traditional higher-educational organizations intended to complement the face-to-face teaching activities taking place on campus without too much planning. In this study we wanted to find out which was the real usage students and teachers gave for such a tool in an Adjunct Mode learning environment when no specific goal for offering such a discussion board has been declared.

III. METHODOLOGY

Our study analyzed messages posted in the U-Cursos forum for Computer Science undergraduate courses taught at the Engineering School of the University of Chile. The courses follow a traditional face-to-face setting: typically 3 hours of classes per week, in a semester lasting 16 weeks. Additionally, each course has a 1 ½ hr. exercises session per week conducted by teaching assistants. The evaluation of the courses typically includes two or more intermediate tests, a final exam, graded homework assignments, projects, and presentations. Most core courses only have tests, homework assignments and exams.

There are 10 undergraduate programs at the School. One of them is Computer Science (CS). Undergraduate students must follow a 5 ½ years program with core courses in the initial 2-years, which are common with other School programs. The Computer Programming I course is a core obligatory course and thus it has a relatively large enrollment compared to other CS courses: about 800 students per year (8 sections per year). This course was particularly relevant to our study because of this foundational role.

A. Corpus

The available data consisted of messages exchanged in CS courses (including the aforementioned Computer Programming I). For each message, the data set identifies the author, heading, message contents, date, course code, semester code, and year code. We examined messages in which the author field was replaced by a coded identifier, for privacy reasons.

B. Sampling

A total of 58 courses in CS are taught per semester on the average. We chose to analyze data from U-Cursos for two years: 2010 and 2011.

The forum for CS courses had a total of 27,426 messages in 2010, and 25,152 messages in 2011. Considering that the number of messages was very large to perform a semantic analysis of them, we selected a sample of 8 courses (3,436 messages). The sampling strategy consisted of selecting representative courses of the several levels in the CS curricula. Every selected course had an enrollment ranging from 20 to 102 students.

For each selected course, we examined a random sample of messages so that we could have a 95% confidence that the sample was representative of the population. The sample size was determined using the method proposed by Kish [Kish65]. A total of 1,493 messages were analyzed semantically through manual work.

C. Coding

We planned to have a descriptive analysis level, i.e. the codes should classify the phenomena with little interpretation. We did two tentative coding approaches before settling on the final coding. The tentative ones were considered to be too broad and to not completely capture the most interesting information. This was discovered by coding a few courses. When setting up the codes list, we tried to define categories with little or no intersection. The final codes list is shown below.

Coordination messages
 - about lectures
 - about assignments
 - about exams
 - about the course
 - others

Messages on operative issues
 - about lectures
 - about assignments
 - about exams
 - about the course
 - others

Messages on course contents
 - about lectures
 - about assignments
 - about exams
 - about the course
 - others

Social messages
 - about lectures
 - about assignments
 - about exams
 - about the course
 - others

Messages on evaluation
 - about lectures
 - about assignments
 - about exams
 - about the course
 - others

After the two previous attempts and using the lessons learned in such a process, we settled on five message categories: coordination, operative, course content, social and evaluation. Furthermore, every category can include messages related to the following course components: lectures, assignments, exams, the course, and others. Every message in the sample was semantically analyzed by the authors and classified in the corresponding category and course component. The raters were assigned to courses using a distribution table that balances raters/courses assignments according with the number of students involved (the courses were classified in small, medium and large courses).

By coordination messages we mean those used to coordinate formal activities of the course; e.g. notifying a change of classroom or discussing the possibility to move a scheduled activity. Messages regarding operative issues are used to deal with the course logistics; e.g. to indicate how to install or setup a software tool necessary to perform a certain activity. Messages concerning course contents are oriented to deliver, acquire or clarify knowledge that is part of the course curricula; e.g. "how can I calculate the complexity of a recursive algorithm?". Social messages are those supporting social interactions among people, e.g. "great!! thanks". Finally, messages concerning evaluation are those addressing a project,

task, test or exam, e.g. "Professor, what content is being considered for the next test?".

Despite the effort in specifying orthogonal categories, we knew that some messages could be coded in more than one category. Therefore, we felt the need to carefully agree on the criteria to choose categories in these cases. Thus three authors initially coded messages in a face-to-face session and then fine-tuned a set of criteria to consistently assign codes. After settling on these criteria, the messages were finally processed.

D. Analysis

The adopted analytical approach uses within case displays with a matrix accounting for the occurrence of message types in courses; and a matrix accounting for the occurrence of message types in groups of courses.

Besides the analysis of those matrices, we also triangulated the message types with other information we had concerning the courses' overall performance. In particular, we had records about: (1) the students' overall performance, measured by the average mark obtained in each course; and (2) the instructors' performance, measured by the average scores given by students in surveys independently conducted by the School. Unfortunately we did not find any correlation between performance and the message types identified in this study.

IV. RESULTS

Table 1 reports the occurrence of messages according to the previously defined categories and course components. Analyzing the results by message categories, we can see that the lowest items (with less participation) correspond to discussions about contents and evaluation (Fig. 1). This indicates that the discussion board is not recognized by the users as a tool that facilitates the learning process, since they do not use it with such a goal.

Table 1. Summary of messages classification

	Lectures	Assignments	Exams	Course	Others	Total
Coordination	6%	7%	7%	0%	0%	20%
Operative	1%	**20%**	6%	0%	0%	27%
Contents	1%	7%	1%	0%	0%	**9%**
Social	4%	**18%**	6%	3%	2%	33%
Evaluation	0%	2%	6%	3%	0%	**10%**
Total	12%	54%	26%	6%	2%	100%

The highest participation corresponds to operative, coordination and social categories, with a total of 80% of all messages. Analyzing messages in the operative category, we can see that most of them are related with the course homework assignments. Analyzing further, we observed that almost all of these messages were triggered by students, not instructors. This indicates that the discussion board is used mainly to support the students' needs and not the instructors' needs. In fact, considering all categories we can say that there is an almost negligible number of discussions that were triggered by instructors and teaching assistants. This indicates that the tool is not recognized by lecturers and teaching assistants as an instrument that directly supports the learning process.
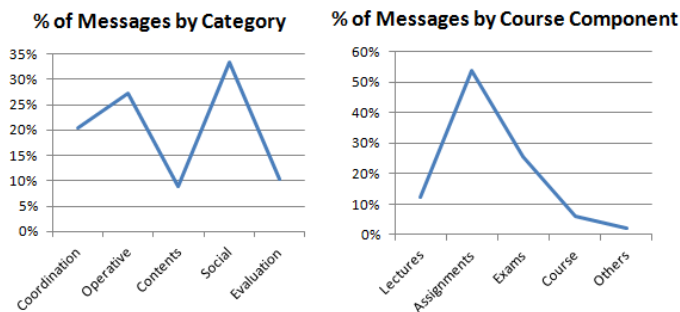

Figure 1. Summary of messages classification

Coordination messages are also focused on addressing the students' needs, and they are related to lectures, homework assignments and exams in a quite similar percentage. Messages on operative and coordination categories totalize 47% of the forum participation.

The results on social messages (33%) indicate that the participants assign to the forum a social role. Social messages were delivered by people independently of the topic they were discussing. This also indicates that the social aspect is relevant to the learning process, and the online discussion boards can help supporting social interactions among the course community members.

Concerning the course components that were the focus of the discussions, clearly the most important were the homework assignments. This is not surprising since most courses involve an important number of assignments, and each one of them typically must address an engineering challenge and the use of particular tools. This is a complex scenario that usually generates uncertainty and doubts in students. We observe that these doubts are externalized, discussed and clarified through the discussion board. We also observe that the students have been particularly supportive of their classmates.

Figure 1 shows graphically the usage trend of the online discussion forum, while Figure 2 presents the results obtained in each course, as a way to show that such a trend is representative of the analyzed set. Analyzing the messages by category, we can identify just two courses that do not follow the trend; they are the courses 4-2 and 5-1. The first one corresponds to fourth-year and the second one corresponds to fifth-year courses, according to the CS curriculum. In Figure 2, the first number in the course identification indicates the course level according to the CS curriculum, and the second one is just a serial number to identify courses belonging to the same level.
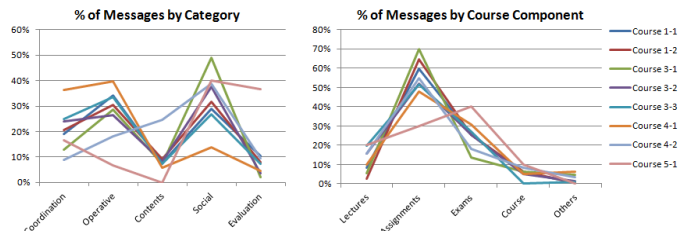

Figure 2. Summary of messages classification by course

Trying to understand the students' behaviors in the courses that do not adhere to the general trend, we analyzed their messaging discrepancies. In the case of course 4-2, we observed more messages related with contents than with operative issues. This situation can be explained because that course involved, as part of its instructional goals, the learning of a particular modeling tool. Since the tool was not intuitive enough, the students exchanged many messages trying to clarify how to use the tool. If we ignore the messages related with such clarifications, the forum usage aligns with the general trend.

Analyzing course 5-1, we observed few messages related with operative issues and no messages concerning the course content. A first explanation for this situation can be made indicating that the total number of messages in the course forum was just 30; therefore any particular glitches affecting the course may also affect the representativeness on the message categories. The low participation in this particular forum was because that course required students to work together developing a software product; therefore most interactions among them were done face-to-face. Anyway, the low percentage of operative messages would also be a consequence of the flexibility given by the instructors to the students, who could select any software development tool to build the software product. Since students typically choose the tools in which they have more experience, it is expected that few or no operative messages about these tools be exchanged in the discussion board.

Analyzing the course messages by components, we can see an important percentage related with the course assessment, and particularly about the exam. That can be explained simply as a consequence of the low number of messages in the course forum, since the total number of messages about the exam was 11 and 3 of them were social.

V. DISCUSSION

Despite the fact that the forum usage was completely open, several behavioral patterns could be observed. First, some etiquette rules were established by the instructors. For instance, in one course the teaching assistant ruled that no program code necessary to do homework could be posted in the forum, either with the purpose to get assistance with debugging or to show how to solve a particular problem; questions requiring code display should be asked by e-mail only.

A pattern that was also frequently found was the following. A request or question posted by a student was followed by several messages of support from other students, then a reply or answer from a teaching assistant, and then a thank you posting, closing the thread. The "support" messages were not socially altruistic but issued by interested students because the subject was also relevant for them.

We also found many messages expressing the students' deep appreciation for a suggestion provided by a teaching assistant. Perhaps the student has spent a long time trying to figure out himself/herself the explanation or solution before asking for help. Some of the appreciation messages showed some good humor, such as "You are great, Jack!" or "You have saved my life!".

We almost did not find messages concerning educational contents, which were originated because a student found a difficult concept needing an explanation while studying. Instead, most of these messages were done for practical reasons: the student was working on a homework assignment and needed a way to solve an impending difficulty. The same could be observed in relation to operational messages. These findings demonstrate the fundamental importance of homework and exercises for achieving real understanding of the course contents. One would imagine before this study that the students frequently review the notes and other educational material and then have many doubts, which are exposed in the forum. It simply does not happen that way.

We did not find an intentional use of the forum by the instructors to encourage students to do ungraded investigation on a certain topic or discussion of a subject related to the course. These missed opportunities may have several explanations. One of them may be that instructors perhaps do not want to give additional workload to students who may already have many assignments. However, we observe that perhaps instructors may be overlooking this possibility because they have not given much thought to exploiting the services supported by the forum. In particular, ungraded challenges may be a chance to motivate very good students in connection with the course contents. This may be a negative consequence of just making the forum available to instructors without any advertising of its possible uses.

The fact that the forum was somehow similar to a social network, of course, made some students adopt the same behaviors they have in social networks. Text written with abbreviations, typical of Twitter, appeared in many messages. Other messages used coarse language, their authors forgetting that some readers may be offended by such expressions.

VI. CONCLUSIONS AND FUTURE WORK

This paper presents a study that intended to identify the role assumed by students and instructors when using online discussion boards. The study involved semantic analysis of 3,436 messages corresponding to 8 representative courses in Computer Science.

Although we (and many other researchers) think the discussion forums can be used as facilitators of the learning process, by default these tools seem to be perceived more as communication platforms, allowing the course community

members to socialize and address coordination and operative issues.

An almost negligible number discussions were triggered by instructors or teaching assistants. This indicates that the service, by default, is not recognized by lecturers and teaching assistants as a facilitator of the learning process. Moreover, there were few messages concerning learning contents, which indicates that such a knowledge exchange is performed using other communication channels.

The support to teaching contents might be constrained by explicit/implicit rules related with evaluation. Also possible is that the students perceive contents discussions as detrimental to their own performance (i.e. they are not altruistic). It could also be that they feel they should be altruistic to a smaller group. Should we (instructors) encourage the students to be more altruistic? We are not sure. In any case we do not see content-focused discussions increasing without solving this altruistic/egotistical dilemma.

The instructors can learn how to redesign a certain educational process by doing a retrospective analysis of the courses' discussion board. For instance, if many messages related to evaluation are posted in the forum, the instructor could take care of that, improving evaluation rules and deadlines, and making this information easily available to students.

The number of messages processed in this study is not enough to get strong conclusions about the role played by the online discussion board in a course community. However, the trend is strong, which allows us to hypothesize that the identified patterns would also be present in other CS course communities. Therefore, the next steps in this initiative are to validate that hypothesis and determine how general are the behavioral patterns identified in this study.

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