Incorporating teacher-student dialogue into digital course material: Usage patterns and first experiences

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***Abstract*—This work-in-progress research investigates teacher-student communication via Learning Management Systems (LMS) in highly populated courses. An LMS called TIM (The Interactive Material) includes a specific commenting technology that attempts to make teacher-student dialog effortless. The research goal is to explore students' willingness to use the technology and identify patterns of usage. To these ends, a survey with both Likert and open-ended questions was issued to CS1 and CS2 students. A favorable student evaluation was observed while several critical viewpoints that inform technology development were revealed. We noticed that besides appreciating the possibility of making comments, many students found benefit from peripheral participation without being active in commenting themselves. Informal communication appared to be preferred, and the commenting technology was considered second to best channel in this regard, following face-to-face interaction. The results are discussed in the light of Transactional Distance Theory and related literature to inform basic research.**

***Index Terms*—learning management systems, educational technology, distance learning**

I. Introduction

In highly populated courses, the personal connection between the teacher and the students can be lost and the situational awareness of the teacher may grow weak. The teacher in this position must rely on the students to bring up any issues in teaching, learning, and the viability of the exercises and course materials. Often, the bar for voicing issues is too high for the student to act and the difficulties that would be obvious with smaller cohorts get buried. The present study seeks to understand efficient teacher-student dialog through a Learning Management System into which a particular commenting technology serving this purpose was implemented. We describe this technology and the results of an initial evaluation.

A survey exploring the usage of the technology was issued to students taking CS1 and CS2 programming courses; these courses represent the setting with large yearly student cohorts. The survey focused on the volume of comment writing, students' willingness to provide comments, and how students perceived this technology in relation to other available communication channels. A preliminary analysis of the contents of the comments is also included. The research approach is descriptive, with the important goal being the identification of critical viewpoints that should be addressed to improve students' study conditions concerning communication and to inform further research. Transactional Distance Theory [1, Ch. 2] is introduced as a framework applicable to this study.

II. TIM system, The Interactive Material

TIM is a document-based LMS that endeavors to incorporate all technological aids that any teacher would need in daily practice. TIM allows its users to create and manage interactive learning materials. The key concept of TIM is *document*; creating and editing means manipulating a document through a browser using an online editor. A single document can incorporate all contents and activities needed in a particular course, for instance. Theory and exercises can be unified as a single page. Automatic assessment (AA) can be added for several exercise types, and users can implement their own AA tools. Teachers can use a document prepared for online delivery during a lecture by transforming it into a slide presentation, adding clicker questions, or setting up a real time discussion. Student can use a TIM document for self-regulated e-learning by marking the sections studied and adding comments into it. The document can also be exported to a printable PDF. An included LaTeX engine for mathematical expressions and discipline-specific plugins serve particularly well computing, engineering, and science education. Altogether, TIM supports both distance learning and in-class work, and has been used for a wide range of pedagogic and organizational functions (gamification, exams, contests, etc.). See more details in [2].

A. The commenting technology

TIM includes several communication facilities, of which the present study focuses on 'the commenting technology.' This technology facilitates dialog between teachers and students: a student can add a comment to any part of the TIM document (whether a theory section, instructions, an exercise, etc.), and a teacher can reply to it. Both the student's comment and the teacher's reply reside in the place where the comment was added to. In case of exercises, comments are linked directly to the students present answer attempt. The following attributes characterize the commenting technology: *textual*; *asynchronous*; *embedded* in the materials; *communal*, in that they are visible to other students when viewing the same material; *anonymous* towards peers (but not the teacher); *low*

latency, in the sense that teacher can opt in to be alerted on new comments via email. The email link provided opens the comment in the materials in the context where it was added to.

III. Theoretical framework and related work

Transactional Distance Theory [1] states that the distance between a student and a teacher is best seen as a pedagogical and not a geographical concept. The term Transactional Distance characterises the subjective psychological distance between students and teachers and is seen as a factor in rise of learning difficulties. The theory is primarily about distance education, though it is seen to exist in all forms of education [1]. Moreover, the current trend may be that this distance is increasing due to many students opting to watch recorded lectures and participate digitally instead of attending actual lectures. The transactional distance is regulated by factors such as amount of course structure, learner autonomy, and dialogue. Of these, dialogue stands out as both essential and manipulable by the selection of communication media. It is precisely dialogue that suffers from the adoption of web based technologies as substitute to face to face education. As such, the theory, as well as our observations, call out a study on different mechanisms to recover lost opportunities for dialogue. Transactional distance theory is not without critics [3], but we find that it provides a useful lens through which to study LMS development. Without a guiding theory, it would be difficult to discuss the tensions or complementaries of such systems.

Constant instructor-student feedback and interactions in online tools have been suggested to increase comfort levels with technology and encourage students to be proactive. The study by Pallof and Pratt [4] for instance stressed that a strong sense of community fostered connectedness, and therefore increased discussion and information sharing on subject matters. They concluded that online feedback and interactive tools reduced the feelings of isolation and burnout, and facilitated deep exchange of ideas among community members. As a free standing or integrated tool, online feedback mechanisms also allow students to reach a wider audience than just their course instructor [5]. They equally allow for critical thinking via the exposure of multitude of opinions within posts as readers are compelled to reflect on the posts and reactions of their peers and instructor [6]–[8]. Beaudoin [9] examined the characteristics of inactive students in an online undergraduate course. These students, in fact, spent a significant amount of time in learning-related tasks, including logging on, even when not visibly participating, and felt they are still learning and benefiting from this low-profile approach. The present study complements the research cited here.

IV. Study

The local introductory programming courses, CS1 and CS2, are offered to both CS and IS majors, as well as to students taking computing courses as their minor. A typical yearly number of participants is 700 in CS1 (two course instances) and around 300 in CS2. The staff for these courses consist of the lecturer and 5-8 teaching assistants who are senior students. TIM is used in both courses to manage all course materials and activities. For this study, we surveyed current CS1 and CS2 students, receiving responses from 414 out of 715 students who were reached out. Of these, 377 permitted use of their answers in this study. The survey questions are given in Table I and the scales for the questions appear in the figures of the results section. Textual answers to Q4 were utilized to explain about Likert answers, which adds mixed-methods characteristics to the study. In addition, we thematized 247 public comments in TIM. The aim is explorative; we describe usage patterns and identify key basic research questions.

TABLE I: Survey questions

Q1. How many comments did you make on the course page and the exercise pages? (see Figure 4)
Q2. What would suffice for you to make a comment? (See Figure 5)
Q3. Rate your agreement with the following statements:
Q3.1 I gained from making comments (E.g., did you get an answer that helped you progress in the course) (Figure 1)
Q3.2 I gained from reading comments of others and/or replies thereof (Figure 2)
Q3.3 I prefer TIM comments to emailing the lecturer (Figure 8)
Q3.4 I prefer TIM comments to emailing a public mailing list (Figure 8)
Q3.5 I prefer TIM comments to instant messaging services (E.g., slack, other IM) (Figure 8)
Q3.6 I prefer TIM comments to face to face discussions (E.g., during practise sessions) (Figure 8)
Q3.7 I felt that the technical implementation/user interface hampered me in leaving comments (Figure 3)
Q3.8 If I've made comments on some other course, I find it easier to make them on the current course, even though others have not made comments on this one yet (Figure 7)
Q4. Would you like to elaborate your answers? (open text)

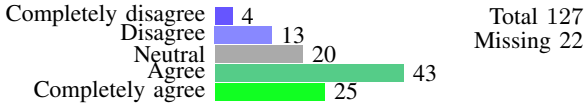

Fig. 1: *"I gained from making comments (E.g., did you get an answer that helped you progress in the course)"* (Q3.1)

V. Results

The results are summarized in the sections below.

A. A great system, especially if someone else uses it

In our survey, we queried student views on the technical acceptance (Figure 3) and the utility of the commenting technology. Although our system was seen as rather crude by some students, very few respodents felt hampered by our

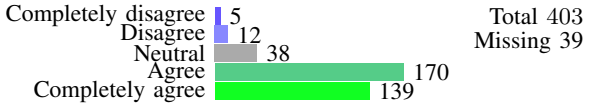

Fig. 2: *"I gained from reading comments of others and/or replies thereof"* (Q3.2)

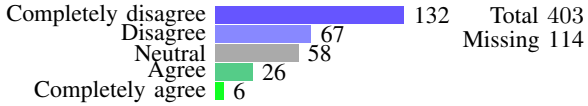

Fig. 3: *"I felt that the technical implementation/user interface hampered me in leaving comments" (Q3.7). The bars indicate relative frequency of answers while the numbers give the absolute frequency. The Total and Missing give the total number of respondents and those who did not answer, respectively.*

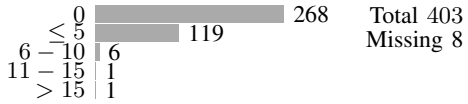

Fig. 4: *"How many comments did you make?" (Q1)*

implementation. It does not seem to be technically difficult to provide a useful technology of this nature.

Also, the respondents largely agreed that making comments benefited their studies (Figure 1). The core reason given was the way the comments enable off-hours study: the comments are especially useful, in the words of one respodent, *"when you end up pondering the exercises alone on weekends and there is no face to face support available"*. This is a considerable factor as nearly two-thirds of our students opt for predominantly remote study.

The respondents found peer comments to be very useful (Figure 2) even when they made comments themselves, and especially so if they did not. Students rarely made more than a handful of comments (Figure 4) whereas there were up to 1700 comments per course. Reading peer comments was mainly valued since they are helpful and concern the immediate difficulties by the student: *"I found that I discover answers to my own problems in exercises from them [comments by peers]. Or, there are questions about things that I wouldn't have thought of, and I acquire new information that way"*. Also, some students pointed out the communal support aspect of public comments: *"Occasionally, I felt relieved by reading others' comments and being reminded that there are others who also don't understand"*. This also indicates that public comments that reveal difficulties with the content can moderate self-efficacy challenges.

B. The bar of participation

A large majority of students ($\approx 67\%$) did not actively participate in making comments and those who did made comments sparsely (see Figure 4). The rate of non-participation seems somewhat concerning, but, as noted by one student, *"If I'd have a problem, then someone is bound to have asked about it already"*. The comments are communal and a single active student can solve problems for many others.

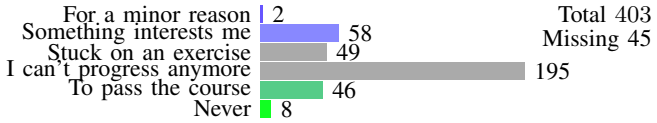

Fig. 5: *"What would suffice for you to make a comment?" (Q2)*

Fig. 6: *"Number of comments made by those who would only comment when passing the course depends on it, or more rarely."* (Q1/Q2)

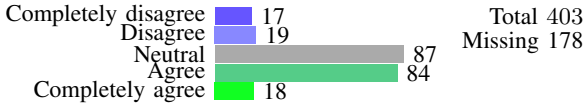

Fig. 7: *"If I've made comments on some other course, I find it easier to make them on the current course, even though others have not made comments on this one yet"* (Q3.8)

To assay the non-participation, we asked students to indicate a situation that constitutes the minimal reason for their participation (Figure 5). Majority of students indicated that they would participate only if their immediate progress depended on it. This is reflected in the open text answers such as *"It's quite embarrassing when you're really perplexed by some exercise and the system assumes that you make a sensible comment instead of just saying, I can't progress at all..."*. Contrasting the perceived difficulty of participation to number of comments made by student (Figure 6), we see that aversion for commenting was not a crucial factor in non-participation. That is, where 32% respondents made comments, of the highly averse students 25% did so.

Figure 7 maps answers to Q3.8, if using the comments in previous courses would increase the respondent's perceived likelihood of commenting in future courses. This was largely agreed upon, suggesting an effect of local norms. These "pro-sharing norms" are identified by [10] as a factor in contribution — perceiving commenting as good for the community gives a reason to do so, as evident in the passages such as *"I used comments more to note common course issues (like errors and places to improve) than to ask solutions for my own problems"* and *"I make comments primarily when I believe that my comment can help others or improve the service"*. On the other hand, without the community perspective, students may perceive no reason to comment at all: *"I haven't been in a situation where I'd have needed to comment something"*, even though they might have had something to contribute.

C. Position among other communication channels

In light of small numbers of active commenters, we asked respondents to contrast commenting technology to other communications media available to them on courses of our faculty.

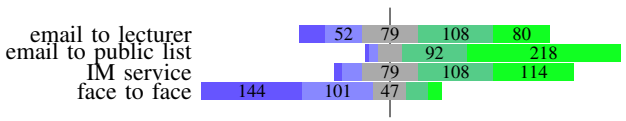

Fig. 8: *" I prefer TIM comments to ..." (Q3.3 - Q3.6)*. The stacked barchart colors follow Figure 7.

Results in Figure 8 show that the commenting technology does touch a local optimum; it is preferred to all other communication media, *except* face to face discussions with the teacher and teaching assistants.

In the open text answers, we see a preference towards informal/personal channels. For example, *"I find it easiest on myself if I send email to some specific person because it is more personal, and only the receiver sees my message"* and *"Commenting isn't as formal way of communicating as email. Having commenting available lowers the bar of participation"*. The preference for informal communication was also observed in [11] and [12], and to us it explains much of the results in Figure 8. The following illustration, in which a student prefers face to face discussions, clarifies that a formal and public communication channel may be considered a laborious and potentially disturbing measure: *"I rarely make comments, since I don't want to burden the teacher and the assistants any further. I prefer to ask in the practice sessions..."*

Usability of communication channels is also stated as a factor. The embedded nature of TIM comments is mentioned by many students, who are glad that the commenting option is embedded where they need it and the context for the questions is automatically provided: *"No need to look for emails or go to talk to anyone and the place where the comment is left immediately tells you what it is about."*.

D. What the students comment about

To analyze the contents of the comments, we selected three groups of documents: CS2 tools documentation (a total of 18 documents), a CS2 assignment (we selected 1 example out of 12 documents), and CS1 lecture notes (1 document, 300 pages). The numbers of public comments that students had written to these documents were 121, 20, and 106, respectively.

First, comments were observed to be highly context-specific. In the CS2 tools documents, most of the comments were questions about specific technical or installation issues, such as *"SceneBuilder won't install, here's the log file"*, or *"I pushed wrong files into a git repository, how can I delete them"*. Regarding the comments on the CS2 assignment document, most recurring themes were asking for clarification to the assignment text, questions on how to proceed when the student's solution is not outputting the correct result, and queries about why the code is not (automatically) assessed as per the expectations of the student.

Second, a clear majority of the comments were well thought out and potentially useful also for other readers. After posting a question concerning a specific technical issue, many students came back and reported on how they solved the problem, thus helping others in the same situation. About 12% of the comments were new ideas or concrete suggestions on how to amplify or further develop the textual material. Then again, 10% of the comments concerned some student-specific issues and were considered unhelpful for other students. This initial analysis suggests that documents are populated by helpful comments, which supports the interpretation of students finding the comments of other students useful (Section V-A).

VI. Conclusions

As a general conclusion, we have provided apparent value for our students by instituting the commenting system. The system increased dialogue in our courses and this dialogue, being public and embedded in the course materials, spilled over to other students being useful for them as well (Section V-A). Students appreciated that the context is automatically provided for their comments. In accord with this, a notably large number of comments sought to improve and clarify the course materials (Section V-D). Moreover, the preliminary content analysis indicated that the comments were of high quality and their topics were useful for other students.

Reflecting Transactional Distance Theory, the large courses studied are highly structured with fixed exercises and learning activities, and from this perspective resolving difficulties rests either on the students or the dialogue available (cf. proneness to distance). The comments provide a 'way out' for students who cannot resolve their difficulties themselves; students benefit from peer comments, prefer the commenting technology after face-to-face option, and even those students who are highly averse to using comments do so when they really need help. These observations suggest that the potential unwanted distance is being compensated by the commenting technology. We believe that the technology can significantly contribute to blended pedagogies (see [13]) and situations where students opt to learn remotely (Section V-C).

A large number of students did not actively use the commenting system and we observed a high bar of participation (Section V-B). This can be seen as a difficulty; unnecessarily distancing some students and taking the voice of some that may need help. The non-participation, and the resulting increase in the Transactional Distance can also pose a difficulty for the *teacher*. Without dialogue, the teacher may find it difficult to estimate course outcomes and to provide support where it is needed. However, we observed that peripheral participation with comments can be helpful and mitigate self-efficacy challenges (Section V-A); see also [10]. It is known that non-participating students can maintain a rich internal dialogue and perceive themselves as part of the course community [9], [14, pp. 87-90]. Keeping a low profile may thus be a personal preference. Moreover, from a pragmatist point of view, any large increase in the number of comments, especially one that would actually equalize students' participation in dialogue, could be unmaintainable. Instead of the current large number of replies per course by the teacher, there would now have to be an immense number. Also, at this point, the usefulness of peer comments would likely plummet as no student would be willing or able to read such number of comments.

Regardless of our pragmatic and optimistic views, we would find it interesting to further study which student attributes relate to the observed non-participation. For example, we have some anecdotal evidence that, gender, and possibly minority status in general, could relate to decision to participate and a desire for further anonymity.

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