INTERACTION IN AN ASYNCHRONOUS ONLINE COURSE: A SYNTHESIS OF QUANTITATIVE PREDICTORS

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ABSTRACT

The effectiveness and potential of asynchronous online courses hinge on sustained, purposeful interaction. And while many factors affecting interaction have been uncovered by prior literature, there are few accounts of the relative importance of these factors when studied in the same online course. In this paper, we develop a literature-informed model of six predictors on the likelihood that a note receives a reply. We corroborate earlier findings (such as the impact of the date that the note was posted), but also obtain one contradictory result (that reading ease does not appear to be a significant predictor). We offer hypotheses for our findings, suggest future directions for this type of research, and offer educational implications.

KEYWORDS

asynchronous learning, sustaining discourse, threads

I. INTRODUCTION

An increasingly popular form of distance education courses is the use of asynchronous computer-mediated communication (CMC) [1]. Typically, asynchronous forums group notes (messages) into threads—chains of notes connected by students replying to existing notes [2]. Many authors highlight the benefits of threaded asynchronous CMC compared to synchronous CMC and face-to-face courses, including time-independent access and opportunities for heightened levels of peer interaction [3]. Asynchronous courses naturally support and embody core tenets of constructivist-based education, including participatory learning, teacher-as-collaborator, and the production of meaningful artifacts [4, 5].

Yet, to realize such benefits, students must become engaged in the asynchronous environment, and, unfortunately, evidence abounds that such engagement is anything but automatic. For example, Hew and Cheung [6] collect several references to courses where large numbers of students do not post at all or post one or two messages per week. In such courses, the learning potential of asynchronous CMC courses is called into question: electronic discourse is to online learning what verbal discourse is to face-to-face learning [7].

Sustaining discourse in threaded asynchronous online courses has been deemed important by many researchers. Short threads may be indicative of question-answer exchanges, with little analysis and discussion [8-11]. Exchanging perspectives and exploring ill-structured knowledge domains is unlikely to be satisfying for students if such discussions occur in brief, independent threads [2]. Threads are central to the creation of online learning communities, since they facilitate idea exchange and social communication. Indeed, authors of many online learning theories, including Transactional Distance [12, 13] and Community of Inquiry [14], have used threads to further the understanding of collaboration, social presence, learning, and other important prerequisites for worthwhile online experiences.

Interaction and participation are two key constructs thought to enhance learning in asynchronous courses. Hammond [15] describes this assumption as arising from teachers' alignment with social constructivist and collaborative learning principles. To be clear, however, such interaction is a necessary but insufficient

criterion for higher-order learning to occur in asynchronous courses. Jorczak [16] explains that effective discussions typically involve conceptual conflict and divergence, requiring students to negotiate consensus and appreciate varying viewpoints. As well, Hewitt [2] reminds us that there is no inherent goodness in whether a thread grows or dies. The danger, though, is that short threads are unlikely to engender conceptual conflict as, by definition, they do not contain the perspectives of very many students. In addition, students are unlikely to summarize short threads, since they may not contain much information in the first place.

Much online learning research has therefore focused on how to sustain threads, and this has led to the investigation of many factors related to thread development. In the next section, we survey this literature. We then argue that while many factors have been independently proposed as contributing to thread growth, literature typically does not investigate multiple factors in combination. Our study seeks to synthesize several quantitative factors as an initial step in understanding the importance of these factors when examined in the same course context.

II. SUSTAINING DISCOURSE

From a social constructivist perspective, online learning is seen to be effective when it permits the exchange of views and allows students to learn through social communication [2, 17]. Lengthy discussions do not inherently suggest deep processing or collaborative meaning-making, but it is unlikely that such processes could occur in the absence of sustained discourse. Many authors, therefore, have offered hypotheses and implemented supports toward the growth of online discussion.

To begin, there is evidence that the discussion tool itself—and the ways in which students interact with the discussion tool—can dramatically affect discussion patterns. For example, Guzdial [18] found that the choice of discussion tool dramatically affected thread length, with newsgroups yielding shorter threads than a web-based asynchronous forum. Hewitt [19] has argued that threads often die prematurely, due to the universal practice of focusing in each session on notes that are "new since last time". Hewitt and Teplovs [20] found that thread growth depends on the time elapsed since the most recent note was posted in the thread, and the current size of the thread. Long threads with very recent notes are more likely to be further elaborated upon by students compared to small threads or threads whose constituent notes are older. These examples typify work that is concerned with thread development in the aggregate; that is, general patterns of thread growth across dozens of courses and thousands of notes.

Other literature links levels of interaction to specific student and course attributes. Vrasidas and McIsaac [21] argue that interaction is situated within and influenced by contextual variables such as course structure (e.g. required activities, workload), class size, feedback from instructor or peers, and prior online experience. Dennen [11] shows that amount of discussion is related to aspects of instructor presence, clarity of expectations, well-designed and integrated discussion activities, and instructor feedback. Others note that interaction levels tend to differ across students in the same course, based on factors such as individual learning style, self-esteem, and linguistic ability. Self-esteem and confidence appear to be particularly relevant, due to the public and permanent nature of asynchronous discussions.

In order to increase ownership and allow students to direct inquiry, students are often asked to moderate discussions in asynchronous courses. In one study, it was found that peer-moderated discussions contained more replies than non-moderated control discussions [22]. In addition, the moderated discussion contained more "substantive posts," defined as those notes that enriched and added to the conversation. Practices used by student moderators have been found to differ in their effectiveness in terms of inciting peer involvement. Students seem to appreciate, for example, moderators who divulge personal opinions or experiences in order to further the discussion, and those who show appreciation for others' contributions [6].

In addition to student moderators, the teacher-as-moderator remains critical for supporting interaction. For example, An, Shin, and Lim [23] condense a body of teacher-moderation literature down to two important factors: the extent of teacher involvement, and whether the teacher requires students to respond to their

peers. These authors compared three instructor facilitation approaches and measured resultant interaction. In the first condition, the teacher responded to every student's initial weekly message, and required that students respond to at least two of their peers' postings per week; the second had the teacher again respond to every initial message, but students were not required to respond to peers; and the third was like the first, except that the instructor did not respond to the initial postings. For our purposes, the most interesting finding is that voluntary student interaction in the second condition was far lower than in the other two conditions. Social network analysis showed that the instructor in the second condition was at the centre of the discourse, contributing over 90% of the notes. Students did not develop a community, and assumed that the teacher, rather than other students, was their target audience. In contrast, the highest level of student-student interaction occurred in the third group, suggesting that increased instructor interaction does not necessarily lead to enhanced student-student interaction.

In summary, choice of discussion tool, habitual reading and writing practices, course design, attributes of students, moderation style, and instructor involvement all have effects on the quantity and quality of interaction. In the current paper, we add to this body of knowledge through a study of note-level features related to interaction. Why do some notes get replies but others do not? We are interested in a binary (yes/no) classification model, the level of prediction accuracy we can reach with such a model, and the importance of individual predictors in determining whether a reply is predicted. When a note does not receive any replies, the discussion thread of which that note is a part also necessarily terminates. Therefore, though we examine constitutive notes rather than their threads, We believe that understanding which notes are likely to receive replies is a step toward understanding which lines of discussion are likely to be elaborated upon by students and which are likely to falter.

We searched the literature for measurable aspects of notes that might contribute to whether they would receive a reply. We arrived at six literature-informed hypotheses and used a logistic regression model to assess the significance of these possible predictors in an online graduate course. Our six independent variables are described in the following subsections.

III. MEASURED VARIABLES

A. Posting Date

In the course analyzed here, discussion was structured into weekly segments, each focused on several readings provided by the instructor. In these types of online courses, each week brings with it new literature and discussion topics, at which point earlier threads often die. For example, in one discussion that ostensibly lasted 20 days, Blanchette [24] found that 81% of notes were posted within the first four days, and that the discussion could be considered active for only seven days. We therefore expect a reply-advantage for "getting in early" in the week.

Several articles suggest that students respond to notes that have been written recently [18, 19]. Early in the week, there will be very few recent messages to which students can respond, compared to later in the week where a buildup of messages is likely. We therefore hypothesize that notes posted early (Monday or Tuesday) would be more likely to receive a reply than notes written mid-week (Wednesday-Friday), on the following weekend, or early in the following week's discussion (Monday or Tuesday). These four ranges were coded as 1, 2, 3, and 4, respectively, and contained 191, 505, 359, and 101 notes. The variable name in the model is date, suffixed with 2, 3, or 4 to indicate its value compared to the baseline of 1.

B. Written by Active or Inactive Participant

There is a widespread assumption that online courses are egalitarian spaces where everyone can freely contribute their ideas—that online courses cannot be dominated by a small number of people as can occur in face-to-face courses. Research suggests that, in terms of percentage of notes posted, no single student dominates the communication, and that most notes are produced by the collectively low-posting students [18]. In spite of this, we wondered if high-posting students may have a more indirect effect on

the discourse, in the sense that their messages might be more likely to receive replies. We therefore coded notes into two categories depending on whether they were written by a frequent poster (top half of the class in terms of post count and the baseline value of the variable) or infrequent poster. Frequent posters wrote 874 notes; infrequent posters wrote 282 notes. The variable name below is inactive, which contrasts inactive participants with highly-active students as baseline.

C. Reading Ease

Hewitt and Peters [25] investigated the relationship between reading ease (measured by Flesch Reading Ease score) and interactivity in 37 graduate courses. Each student's interactivity ratio was calculated as the number of reply notes they wrote divided by their total number of notes. Coursewide interactivity ratios were calculated by averaging student interactivity ratios for each course. They found that courses with high average reading ease also tended to have the highest interactivity ratios.

We have added Flesch Reading Ease to our model (variable name ease, mean 101.9, sd 14.4) in order to determine whether it is a robust predictor of replies, or whether it is measurable only as a broad, course-wide effect. Also, Hewitt and Peters found a significant negative correlation between Flesch Reading Ease and message word count, so the part correlation between reading ease and interactivity ratio is unclear. We therefore also include word count in our model, as described next.

D. Word Count

In a study of members' initial postings to Internet newsgroups, it was found that longer messages were more likely than shorter messages to receive a reply [26]. We understand this finding, however, in light of prior educational literature that suggests a tendency for students to quickly skim longer notes as compared to shorter notes. As notes reach 500 words, for example, half of their readings occur at a rate indicative of skim-reading [27]. We hypothesized that word count (variable wordcount below) would be a negative predictor of reply-likelihood, based on a guess that students would be less likely to reply to a note that they quickly skimmed. The mean word count was 180.8, with sd 142.3.

E. Written by Student or Instructor

Instructor presence can have drastic effects on the type, focus, and amount of dialogue [11]. If the instructor responds to almost every note, for example, the discussion can hinge on instructor perspectives rather than student-generated ideas. In the course analyzed here, the instructor quantitatively had only moderate presence: 61 notes were written by the instructor, compared to 1095 by students. We wondered whether instructor-authored notes, even in minority, would shape dialogue relatively more forcefully than the bulk of the notes written by students. This teacher-student variable is referred to as teacher, and is the third level of the previously-described frequent-infrequent factor. That is, each note is categorized as written by a frequent participant, infrequent participant, or teacher.

F. Contains a Question

We suspected that notes containing at least one question would garner more replies than notes containing no questions. Question-asking is a common and important discussion-facilitation technique [28, 6]. Lengthy threads often contain at least one note that asks students for clarifications or personal opinions on a matter, and it is hypothesized that notes with questions obligate students to reply [6]. In another study of student moderators' activities, it was found that the use of questioning was strongly associated with the continuation of threads [29]. Similarly, in the contexts of email [30] and Internet newsgroups [26], messages containing questions are more likely to garner replies than messages that do not contain questions. Below, the variable question is coded as "no" (no question in the note, the baseline value) or "yes," containing 660 and 496 notes, respectively.

To determine whether a note contained a question, we looked for sentences that ended in a question mark. In a linguistic categorization of question types, Blanchette [31] notes that in natural speech, it is common for questions to be asked indirectly through declarative sentences ("I assume we're meeting after class").

However, she found that such questions were rare in the online environment, where lack of intonation likely renders such "questions" ambiguous. Rather than attempt to infer whether declarative sentences were in fact questions, we decided to categorize as questions only those sentences that were syntactically interrogative. The only such questions that we removed were those that directly quoted from an earlier message. Some of the remaining questions, as also found by Blanchette [31] contained features reminiscent of rhetorical questions; that is, they were written one after another, often followed by an initial response. Notes containing such questions were classified as containing a question.

IV. DATA SOURCE AND METHOD

We extracted all notes from a fully online graduate education course that took place in winter 2011 at a large Canadian research university. The course was taught in an online learning environment that allows both asynchronous and synchronous communication using discussion forums and chat, respectively. The course concerned various topics related to the educational use of asynchronous CMC, including its history, the role of the teacher, student factors, and Web 2.0 technologies. There were eleven modules, each corresponding to one week, in which students discussed instructor-assigned readings. Students were usually divided into groups, though for some weeks all students worked together in one classwide group. Each week, two or three students acted as moderators. The moderators carried out roles in accord with those specified by the literature [32]: they collaborated in advance to develop guiding questions for the week, facilitated discussion throughout the week, and finally offered a summary of the week's issues. The instructor provided moderators with literature and best-practice strategies for focusing, maintaining, and extending discussions, as appropriate. Each student acted as moderator once during the course, and such moderation accounted for 20% of their course grade. Students' weekly participation in the forum was worth 30% of their grade; the instructor expected notes that advanced discourse, wrestled with half-formed ideas and difficult course concepts, and occasionally sought to summarize and suggest future directions for the discussion.

We removed from consideration all private notes, and all notes written in the cafe-type spaces, such as biographies and general discussion. We also removed notes written more than two days after the completion of their containing week, since such notes received very few reads and replies. Finally, the weekly "starter notes" written by moderators were removed. These notes contained the week's questions and were necessarily written early in the week. For the discussion to progress at all, such notes would naturally receive at least one reply. (On occasion, students did start new top-level threads that did not emanate from a moderator-posted starter, but such threads were rare.) Overall, we retained 1166 notes, written by 23 participants (22 students and the instructor). The mean number of notes written per student was 51; the instructor wrote a total of 63 notes; and the most active student wrote 172 notes.

For each note, we measured the above six variables. Since all variables were grounded in the literature, we used a forced-entry logistic regression model.

V. RESULTS

We begin by addressing the assumptions of logistic regression. The average VIF was 1.4, and the largest individual VIF was 2.29, suggesting that multicolinearity is not a problem; the dispersion parameter was 1.26, suggesting binomial dispersion of the dependent variable. Unfortunately, wordcount was not linearly related to the log of the response variable. Interactions between wordcount and other independent variables were considered, but none improved linearity. Therefore, wordcount was log-transformed. Examining Cook's distances, none were particularly large (all less than 0.009). However, the eight notes with the highest Cook's distance were unique in that they contained only a subject line but no words in the note itself. Since these notes were disproportionately influencing the model, and since a note with no words escapes our reading ease, word count, and contains-a-question classifications, we decided to remove these notes. In addition, two notes with highly negative reading ease scores, whose contents consisted mainly of long URLs, were removed.

The overall model was significant (chi-square = 120.86, df = 8, p = 0). The coefficients, standard errors of

the coefficients, Wald Z-statistics, p-values, and odds ratio associated with a one-unit increase in each predictor are given in table 1. (Recall the transformation performed on wordcount; we present a subsequent table that makes word-count data easier to interpret.)

The Wald statistic is analogous to the t-statistic in ordinary least-squares regression. The odds ratio in the Exp(B) column indicates the directionality of the predictor. A value less than 1 suggests that as the predictor increases, the probability of a reply decreases. Similarly, an odds ratio greater than 1 indicates that as the predictor increases, the probability of reply increases. For ordinal predictors, the odds ratio indicates what happens when the predictor steps from the baseline to the indicated level. The p column gives the probability, for each predictor, that the observed Wald statistic would be as large as it is if the predictor had no effect on the reply probability. For the following interpretations, we set $\alpha = 0.05$; therefore, a predictor is deemed significant if the value in its p column is less than 0.05.

Date2, date3, and date4 were significant negative predictors, suggesting that a note written on the weekend or early in the following week is less likely to receive a reply compared to notes written earlier in the week. wordcount and question were positive predictors: longer notes and notes containing at least one question receive more replies. Teacher and inactive were insignificant, suggesting that teacher-student and active-inactive distinctions do not affect reply probabilities. One other coefficient approached significance: ease weakly indicates that notes that are easier to read more often get replies. These results are discussed at length in the next section.

To simplify the model, we removed the insignificant predictors, and verified that the new model was as powerful as the original model using a nested chi-square test ($p = 0.12$) and a comparison of AICs (the AIC decreased slightly from 1463.5 to 1463.3).

Since odds ratios can be difficult to interpret, table 2 lists selected reply probabilities predicted from this reduced model. The word "mean" in a table cell refers to a variable being fixed at its mean value. For example, the first row of the table says that notes posted early have a 79% chance of eliciting a reply, assuming that word count is fixed at its mean, and that the note contains at least one question.

predictor	B	SE	Wald Z	p	Exp(B)
intercept	-3.01	0.86	-3.48	0	0.05
date2	-0.40	0.19	-2.06	.04	0.67
date3	-1.07	0.20	-5.37	0	0.34
date4	-0.98	0.27	-3.70	.0002	0.37
wordcount	0.47	0.08	5.51	0	1.60
teacher	-0.35	0.29	-1.22	0.22	0.70
ease	0.01	0.005	1.83	0.07	1.01
inactive	-0.02	0.15	-0.12	0.91	0.98
question	0.56	0.13	4.24	0	1.76

Table 1. Logistic regression model

date	wordcount	question	Probability
1	mean	yes	0.79
2	mean	yes	0.72
3	mean	yes	0.56
4	mean	yes	0.59
2	50	yes	0.52
2	150	yes	0.64
2	250	yes	0.68
2	mean	no	0.58

Table 2. Selected probabilities extracted from simplified logistic regression model

Of the notes that received at least one reply, the model predicted correctly 78.5% of the time. Of the notes that did not receive a reply, the model predicted "no-reply" 44.3% of the time. Overall, the model predicted correctly for 64.4% of notes, with Nagelkerke's pseudo R-squared = 0.128.

VI. DISCUSSION AND FUTURE WORK

The model developed in this paper synthesizes several strands of CMC literature, including work on thread-posting date, reading ease, importance of questioning for thread development, and distribution of student and teacher roles. Notes written early in the week corroborate the intuition that such notes receive more replies because they necessarily dominate early reading practices. Notes written late in the week and into the following week are correspondingly less privileged: we suspect this has to do with the fact that students have "moved on" to the next week or that there are many notes vying for student attention.

However, we acknowledge that there are many types of online discussions and that our course exemplifies but one of those types. In his review of online learning case studies, Hammond [15] describes three types of online learning forums: open (i.e. loosely-guided agenda), task-structured (e.g. where students comment on peers' work, or respond to weekly readings), and artifact-creation (e.g. where students complete a collaborative assignment). Our course included a collaborative case study in week 10, though the remaining weeks were task-structured and were our focus here. We wonder to what extent the "date effect" affects discussion in other types of forums. In a comparison of artifact-driven discussions and discussions where the discourse itself is the product, artifact-driven instructions generated fewer on-topic messages but more messages overall [16]. This increase in messages is likely due to a focus on incidental aspects of the required deliverable, rather than increased attention to collaborative knowledge-building [33]. It is plausible that such structural messages remain relevant for much of the lifetime of artifact production, and are not as easily ignored when they become a couple of days old.

In terms of reading ease, we have found only a marginal effect of a note's Flesch Reading Ease score on the likelihood of that note receiving a reply. As hypothesized by Hewitt and Peters [25], reading ease may be one external realization of the level of community reached in an online course. The argument is that notes that are easier to read are more "transparent" or "open," facilitating communication and increasing the connection between students. We suggest that it is the social nature of the course at large, rather than reading ease arising from that sociality, that impacts resultant interaction. The relevant construct from the literature here is social presence: "those communication behaviors that enhance closeness to and nonverbal interaction with another" [34]. Social presence is a necessary prerequisite for interaction, and heightened social presence has been associated with higher levels of interaction [35]. Perhaps a course high in social presence manifests, among other ways, in notes that are on average easier to read.

Moving on, we also found that notes containing at least one question receive more replies than notes containing no questions. In a qualitative study of thread development, Hewitt [2] asked students why they believe threads die. Frequently, students responded that they had nothing left to say in the thread or that the topic had been exhausted. Our finding meshes with these sentiments, in the sense that if a student runs

out of questions to answer in a thread, then they are less likely to reply to the thread's notes. The current study, however, does not consider the type of question being asked. Bradley, Thom, Hayes, and Hay [28] studied the impact of six different types of instructor-posed questions on response word count, completeness of the responses, and evidence of higher-order thinking. They found that all three of these dependent variables were influenced by question type. For example, "limited focal" questions—those that ask students to take a stand given several possible options—received responses of the highest word count and response completeness. Application questions—those that ask students to apply course content to a real-life scenario—received replies from the smallest proportion of students, and the responses that were received were brief and incomplete. Perhaps, then, some types of questions are easier or more appealing for students, and it is these types, rather than the blanket "contains-a-question" categorization, that more strongly influences reply probabilities. We also wonder to what extent various types of questions are used by student moderators, and whether the types of questions used are the ones best-suited to attract students and their differing perspectives. It is worth replicating the Bradley et al. findings in this way, since our interest is on questions generated by students, rather than questions generated by instructors.

We found that student-written notes were about as likely to earn a reply as teacher-written notes. The instructor of the course was reasonably but not excessively active, posting an average of 5.6 messages per weekly forum. (The instructor was also active in the cafe-type forums, but those notes have been excluded from analysis.) It appears that our instructor balanced the competing goals of teaching presence and student-directed discussion.

Recent research, however, suggests that echoes of teacher centrality may lurk beneath the presence or absence of direct replies, in the form of lexical links between notes. Lexical links are not based on "reply-to" links, but instead exist as word- and grammar-level features of notes that differentiate cohesive dialogue from a loosely-structured collection of topical messages [24]. Blanchette [24] describes an online forum where the teacher posted an opener note each week for eight weeks. These openers received a total of 27 replies, suggesting (as in our study) that the teacher did not dominate the discourse. Yet, a lexical analysis found that 302 notes (84%) linked to these opener notes. In our study, moderators posted the opener notes, but this does not discount the possibility that other instructor notes are disproportionately powerful in subtly shaping discourse.

Despite this possibility, we know that other teachers very obviously take centre stage in online courses [15] and that there is wide variation in teachers' presence in online courses. For example, teachers vary on the amount of direct instruction (including presenting content and diagnosing misconceptions) provided to students and the explicitness of course design and organization [36]. If a teacher sends many direct-instruction messages, would students be less likely to reply, since it is difficult to argue with "the answer" provided by the instructor? Or, would students be more likely to reply, in an effort to align views with the instructor? Such questions require the examination of several online courses, each with instructors that vary on the axes of teaching presence.

On word count, we hypothesized that it would be less likely for longer notes to receive replies because of student skimming practices related to lengthy notes. Instead, we found that longer notes were more likely to get replies than shorter notes. One hypothesis is that longer notes contain more ideas and, therefore, more opportunities to respond. Students might skim a large note, looking for something of interest, then respond only to that aspect of the note (rather than reading the entire note and offering a more synthesized reply).

Overall, the model was correct for 64.4% of notes. Therefore, though we have synthesized several literature-based findings, we are not able to predict with high accuracy using our model. We will continue to refine the model and consider qualitative aspects of notes in addition to quantitatively-measured variables. In fact, since our model currently does not measure content-based attributes of notes, it is rather comforting that we are not able to correctly predict, say, 90% of cases. We hope that students are looking at more than word count and posting date when deciding whether to engage with and subsequently reply to a note! A deeply-engrained assumption of online learning is that students will involve themselves in collaborative debate and dialogue in order to advance discourse and move toward integration and

resolution of ideas [37]. It would be rather depressing indeed if surface features of notes, such as those we have measured, were enough to mathematically plot an extremely accurate class trajectory.

VII. IMPLICATIONS FOR PRACTICE

Our study is limited to a single online environment, and so the generalizability of our findings is limited to similar courses. Still, the statistical importance of our content-free attributes suggests several educational implications.

First, we suggest that instructors encourage students to post early in the week, rather than waiting several days and then "catching-up." While this catch-up strategy is time-efficient, it likely leads to a privileging of ideas written early on. If individual students consistently contribute late in discussions, they may not receive the feedback required for negotiating perspectives and replying in turn to their peers' concerns. In addition, students might be encouraged to post their own new notes early on rather than waiting for other notes to which they can reply. Hewitt [2] describes the typical pattern followed by students upon log-in: they often read existing notes and only then write new notes. While this strategy seems educationally appropriate for the majority of the weekly discussion, it implies that students who post earliest may preferentially receive replies by virtue of this reading-writing pattern.

Second, it is tempting to suggest that students be told to carefully consider the length of their notes before posting. After all, notes should not warrant replies simply by virtue of being lengthy. However, previous work has found that imposing length requirements on students' postings can negatively affect higher-order thinking [38]. We therefore follow others [39] in communicating to students that a note should contain only one coherent topic or argument. It is hoped that by keeping notes focused, other students' replies will relate to the core of the idea being presented, rather than possibly focusing on more peripheral subtopics of the initial note.

Third, students should be supported in their efforts to ask questions as they seek emergent understanding of course concepts. Peters and Hewitt [40] note that some students worry about seeming foolish in the public space of an online environment. In our study, students who asked questions often received replies to those questions. Though we have not analyzed the quality or nature of these responses, we do know that questions are not met with silence, which in itself could be reassuring to hesitant students. In short, teachers or peer moderators should feel free to model questioning practices, particularly in order to seek help from other students during initial exploration and meaning-making.

We hasten to add that the educational contribution of this study is not in the ability for students to understand how to create "super-notes" that are very likely to receive replies. We have stressed in this section and in previous sections that whether a note receives a reply is not inherently good or bad. Instead, through an understanding of features that shape reply probabilities, this study more usefully alerts us to such features as a first step in fostering meaningful communication and helping all students confront disparate ideas. We have shown that notes can receive replies for reasons external to their content. It is our responsibility to make these findings work toward educational ends.

VIII. CONCLUSION

Taken together, our findings largely concur with the literature on which our model was based. Long notes, notes written early in the week, and notes containing at least one question all lead to higher probabilities that a note receives a reply. Reading ease of notes did not have a significant effect on the likelihood that a note would receive a reply. Overall, our binary classification model predicted 64.4% of the notes correctly. Our predictors are therefore significant but only moderately powerful. As mentioned above, this model must be understood within the specific course on which it was based. In particular, different instructor facilitation styles and varying types of forums are known to differentially affect participation. Future work involves cross-validating our model on such courses in order to investigate the power of our predictors under varying levels of these important mediating variables. In addition, we have discussed the importance of considering content-based attributes of notes, such as the type of question

being asked or the level of social presence exhibited in the notes. Despite such necessary extensions, this paper adds to the body of literature suggesting that robust predictors of interaction exist not only in the aggregate, but also on the level of individual notes.

IX. ABOUT THE AUTHORS

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