Hewitt, J., & Brett, C. (2007). The relationship between class size and online activity patterns in asynchronous computer conferencing environments. *Computers & Education, 49*, 1258-1271.

The relationship between class size and online activity patterns in asynchronous computer conferencing environments

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Abstract

This study analyzes the relationship between class size and student online activity patterns in a series of 28 graduate level computer conferencing courses. Quantitative analyses of note production, average note size, note opening and note reading percentages found a significant positive correlation between class size and mean number of notes generated. Significant negative correlations were found between class size and average note size and between class size and percent of notes opened. Analyses of average reading speeds among large classes and small classes revealed that students in large classes are more likely to scan lengthy notes (i.e., notes that contain more than 350 words). Possible explanations for these results are discussed.

Keywords: computer-mediated communication; distance education and telelearning; adult learning

The Relationship between Class Size and Online Activity Patterns in Asynchronous Computer Conferencing Environments

Class size has long been recognized as a factor affecting achievement in face-to-face contexts. Students in smaller classes tend to learn more, according to Glass & Smith's (1979) landmark meta-analysis of 80 empirical studies. More recent investigations, such as the Tennessee Project STAR (Student Teacher Achievement Ratio) experiment, have largely corroborated these early findings (e.g., Ehrenberg, Brewer, Gamoran & Willms, 2001; Krueger 2003; Angrist & Lavy, 1999), and indeed, today there is considerable political pressure to reduce pupil-teacher ratios, especially at the elementary level. However, the effects of smaller class sizes in computer mediated learning environments are less clear. Although some researchers have argued that small class sizes are equally advantageous in both face-to-face and online contexts (e.g., Rovai, 2000), there is surprisingly little empirical evidence to support this hypothesis.

The relationship between online learning and class size is complex and there appear to be advantages and disadvantages for both large and small class sizes. In some ways, larger computer conferencing courses may offer educational benefits. For example, larger classes can expose individual students to a wider range of ideas and perspectives than they would experience otherwise. There are also more opportunities for peer collaboration. On the other hand, larger classes increase the amount of information that students have to process, and may also reduce the amount of time that an instructor can spend working with individual learners. Therefore, the question still remains, what class size is optimal and under what instructional circumstances?

In this paper we begin to investigate the relationship between class size and online activity. Our focus is on fundamental computer conferencing processes: reading and writing. What is the relationship between class size and student note writing in online courses? How is class size related to the reading practices of students?

Background

While class size is sometimes discussed in the online learning literature, there is relatively little empirical research on this issue. Broad guidelines exist, such as Hiltz's (1997) recommendation that class conferences be divided into subgroups when student numbers reach or exceed thirty. Interestingly, both Rovai (2000, 2002) and Aragon (2003) also propose thirty as an upper limit on class size. On the lower end of the scale, Turoff (1997) proposes a need for a critical mass in order to allow effective online engagement. Rovai (2002) suggests 8-10 students are required, minimally, for good interactions to develop. Thus, the ideal class size appears to be somewhere between 8 and 30 students, depending on the type of course. This range represents a tradeoff between having enough members to support lively discussion but not having so many participants that people feel overwhelmed (Rovai, 2000). However, these claims and recommendations appear to be based upon the researchers' own online teaching experiences. Little formal research has been conducted in this area.

In the few cases where formal studies have been conducted, researchers have been unable to identify any substantial influences of class size on online activity. For example, Jiang and Ting (2000), in their analysis of 19 web-based courses, compared class size against a range of variables, including: i) students' perception of learning achievement; ii) students' perception of their level of interaction with the instructor; iii) the number of notes written by the instructor; and iv) students' perception of their degree of interaction with fellow students. In each case, they were unable to detect a statistically significant correlation. However, many of their tests were based on student perceptions, rather than actual events, and student perceptions may lack the precision and consistency necessary to uncover genuine class size effects.

Class size may affect social presence, as Aragon (2003) hypothesizes. Social presence encompasses fostering a commitment to shared goals among students, building trust, and establishing productive norms of peer interaction (Rovai, 2000). It is commonly viewed as a core part of community-building (Gunawardena, 1995; Gunawardena & Zittle, 1997). Research suggests that improved levels of social presence promote higher levels of interactivity among participants (Tu & McIsaac, 2002). In relation to this, Aragon (2003) proposes that social presence may be more easily established in small rather than large classes. However, again, there is no firm evidence to support the notion that class size and social presence are related.

Class size almost certainly has an affect on information overload. Information overload is a phenomenon that is commonly reported by students in computer conferencing courses (Hiltz & Turoff, 1985; Berge, 1997; Paulo, 1999). In cases where classes are large, students can become overwhelmed with the amount of information shared online. Potentially, the perception of information overload could have a number of negative consequences, such as heightened student anxiety, which can interfere with the amount of attention that participants dedicate to online learning.

Overall, there is little empirical research to support or refute assumptions regarding the influence of class size on student participation in online environments. Although a number of researchers have recommended upper and lower limits on online class size, these are not based on empirical studies and so, for the most part, the influence of class size on student performance in online environments is unknown.

Methodology

To investigate how class size might impact student performance in online environments, a group of 28 online graduate courses taught at the University of Toronto were selected for the study. To be selected, a course had to meet four criteria. First, each course had to be a "pure" distance education course in the sense that all coursework took place online. Hybrid courses (i.e., courses that are partially face-to-face and partially online) were excluded from the analysis. Second, only recent courses (those offered in the previous two years) were included in the study. Third, for data extraction reasons, the course had to use the Web Knowledge Forum package as its discussion environment. Web Knowledge Forum is a threaded discourse computer conferencing program that keeps extensive logs of student activity. Finally, the selected courses were ones that had a "whole class discussion" format. These are courses in which the principal activity each week is a full class discussion of issues related to the course readings. The purpose of the latter criterion was to ensure that all courses shared a roughly similar design, so that the effects of class size would be easier to detect.

Each of the courses was worth a half-credit and typically took place over a 13-week period during the academic year. Class sizes (excluding the instructor) ranged from a low of 5 to a high of 19 (Table 1). The 28 courses were taught by a total of 14 different instructors. Using time-stamped log data collected from the 28 courses, analyses were conducted to explore the relationship between class size and i) student note production and ii) student reading behaviors.

Data Analysis: Note Production

The first set of analyses explored whether a relationship existed between class size and student note production. Note production was measured in three ways: i) Course averages of the mean number of notes written by students; ii) Course averages of the total number of words generated by students; iii) Course averages of mean notes sizes written by students. The results of these analyses are shown in Table 2 and sorted by class size. For example, the five students who participated in Course #33 wrote 51 notes, on average, and the average size of each note was 502.4 words. The students wrote an average of 25589.6 words over the duration of the course.

Notes Written

A comparison of class size and the mean number of notes written (Fig. 1) revealed a statistically significant positive correlation ($r=0.48$, $p<0.02$). This suggests that students tend to write more notes, on average, in larger classes.

Words written

A similar comparison of course size and the mean number of words written (Fig. 2) failed to find a significant correlation ($r=-0.07$). Thus, there is no evidence of a relationship between the size of the class and the amount of text that each student produces.

Size of note

A comparison of class size and size of notes (Fig. 3) revealed a negative correlation between size of class and the mean size of notes ($r=-0.59$, $p<0.01$). This suggests that students tended to write shorter notes as the class size increased. Removing the two outlier points on Figure 3 produced a slightly smaller, but still significant correlation ($r=-0.55$, $p<0.01$).

Summary of Note Production Analyses

The three analyses reveal several different relationships between class size and note productivity. Students in larger classes appear to write more notes than their peers in smaller classes, but the notes have smaller word counts. There is no evidence of a relationship between total words generated and class size.

Data Analysis: Note Reading

One of the benefits of computer mediated conferencing environments is that they provide students with access to their classmates' ideas and perspectives (Hammond, 1999). A course database is essentially a communal repository of knowledge that is collaboratively constructed by students and their teacher. Therefore, one key measure of student engagement is the degree to which students are accessing this repository and examining its contents, i.e., how closely do students read and engage with the work of their peers?

In this study, note reading practices were analyzed in two ways. In the first analysis, the average percentage of notes opened was compared to class size. The second analysis explored the relationship between class size and reading speeds.

Notes Opened

A note is considered to be "opened" by a student if the contents of the note appear on the student's screen. What percentage of the total course notes do students open? A test of correlation between class size and percentage notes opened (Fig. 4) revealed a significant negative relationship ($r=-0.77$, $p<0.01$). This indicates that students in larger classes open a smaller percentage of their peers' notes than do students in smaller classes.

Note Scanning

A Note Scanning analysis was conducted to determine how closely students are reading each other's notes. Are they reading their peers' notes in depth? Or do they quickly scan over them? The term "scan", in this case, refers to the practice of either skimming through a note at an unusually rapid pace or reading a note partially and then abandoning it. How often do students scan the notes of their peers? Do scanning rates change with class size?

According to Muter and Maurutto (1991), the average reading speed of University of Toronto students on a high-resolution cathode ray tube (CRT) monitor is 199-250 words per minute (or 3.3 - 4.2 words per second). In comparison, the average CRT "skimming" speed (resulting in poorer text comprehension according to Muter and Maurutto (1991)) is 501 words per minute, or 8.4 words per second. Accordingly, in this study, we define 4.0 wps or slower to be a standard reading speed, and 8.0 wps or faster to be "scanning".

While some research has suggested that up to 30% of skilled reader's activity can be described as skimming (Masson, 1982), little research exists on skimming as a process or comparing the differences between skimming online and skimming from paper (Muter & Maurutto, 1991). However, online skimming and scanning can also be seen as coping strategies that students adopt when faced with a large number of messages (Land, 2004). In such cases, skimming and scanning may lead to shallow, superficial learning.

In the version of Web Knowledge Forum used in this study, reading speeds can be calculated using the time-stamped tracking records maintained by the computer conferencing environment. Each time a new note is opened, it overwrites the existing contents of the browser window. Consequently, if a student opens a note at 6:00:32 PM and then opens another note at 6:00:42 PM, we know that the first note was visible on the screen for only 10 seconds. If this note contains 100 words, we can claim, with some certainty, that the student was "scanning", since the reading speed was 100 words / 10 seconds = 10 wps -- a speed that is clearly faster than 8.0 wps. Thus we can conclude that either the student skimmed through the note quickly, without reading in depth, or that the student only read a fraction of the note before abandoning it.

In some cases, students may choose to print a set of notes to read offline. This practice is supported by a special facility in Web Knowledge Forum and learner actions of this sort are detectable in the tracking data. Notes that were printed have been excluded from the analysis of Reading Speeds. Only notes that were read exclusively online were counted.

Students may also occasionally revisit notes, an activity which complicates the computation of scanning rates. For example, suppose a student, Zoe, carefully reads note #445 at a speed of three words per second. Later in the week, Zoe accidentally opens note #445 again, only to realize that she has already read it. She closes the note quickly, and an effective reading speed of twenty words per second is logged. Should Zoe's second visit to the note be counted as a scanning episode? After considering a number of such examples, it was decided that brief note opening events of this sort are not "scanning" in the true sense of the word. The purpose of the scanning metric is to develop a measure of how closely students are reading their peers' notes. Clearly, in the previous example, Zoe had already read note #445. So for the purpose of computing scanning statistics, we consider only the maximum amount of time that students spend with each note. Thus, Zoe's reading speed for note #445 would be recorded as 3 words per second and all other times that Zoe opened note #445 would be ignored. Table 3 illustrates how this approach is used to compute a scanning rate for each student.

To determine whether a relationship exists between scanning and class size, the 28 courses were divided into two groups: a Large Class condition consisting of the 10 largest classes and a Small Class condition consisting of the 10 smallest classes. Since mean values of reading times would be unpredictably inflated by circumstances in which a note is left on the screen for extended periods of time (e.g., a student opens a note on the screen and then leaves the room to answer the door, watch television, or prepare dinner), the study instead examined the percentage of scanning events for notes of various sizes. T-tests were then conducted to determine whether differences existed between small and large classes.

The graph in Figure 5 suggests that the differences in scanning rates between small and large classes are particularly pronounced with lengthy notes. An independent samples t-test found statistically significant differences ($p < 0.05$) between the mean scanning rates of students in small classes ($n=77$) and those in large classes ($n=168$) for notes containing more than 350 words. No significant differences in scanning rates were found between small classes and large classes for notes containing fewer than 350 words.

Summary of Note Reading

Clearly, class size is a factor that influences student note-reading behaviors. The larger a class becomes, the less likely students will open all their peers' notes. Additionally, students in Large Classes engage in the scanning of large notes more frequently than students in Small Classes.

Discussion

In some respects, the note productivity results are counterintuitive. Aragon (2003) claims that it is easier to establish social presence in small classes and Tu and McIsaac's (2002) study found that heightened levels of social presence encouraged greater interactivity. Therefore, one might expect individual students to write a greater number notes in smaller classes. The current analysis suggests this is not the case, which begs the question: Why do students write more notes, but smaller notes, in larger classes?

Although the precise nature of the relationship between note production and class size is unclear, we offer several hypotheses that may explain this phenomenon:

Hypothesis 1

The correlation between class size and note generation may be due to the increased number of opportunities for students in large classes to enter various discussions online. In essence, there is simply more going on in large classes than in small classes. Discussions tend to be more numerous and longer, students are exposed to a greater number of notes, and participants have access to a wider range of perspectives. Consequently, students in larger classes may find more discussion topics that interest them, leading to a higher level of note production. Of course, students in large classes are under the same time constraints as students in smaller classes, so they may have to compensate for the more numerous postings by writing shorter notes. Thus, variety and note volume may explain why learners write more notes (albeit slightly smaller notes) in larger classes.

Hypothesis 2

The relationship between class size and note productivity may also be the product of subtle social phenomena. It is proposed that students in larger classes may be more likely to feel uncertain about their place in the class, and how their performance compares to that of their peers. As the size of the class increases, it becomes increasingly difficult to judge whether one is having a measurable impact on the online discussions. This can be worrisome for some students, since many instructors award participation marks for online performance. Some researchers report that this situation produces a sense of competition among students (Peters, 2005; Conrad, 2002), in which online participants produce higher numbers of notes in an attempt to distinguish themselves within the class. However, even students who are not particularly competitive may still increase their rate of note writing due to the inherent difficulty of determining whether one is performing at the same level as everyone else - ("Am I writing as much I should be?"). Thus, it is proposed that increases in student note-writing may be tied to feelings of insecurity and competition that are more likely to surface in large rather than small classes.

Hypothesis 3

A third way to interpret the note production data is to suggest that both class enrollment and note productivity are tied to the skill of the instructor and/or the quality of the course. That is, perhaps well-designed, interesting courses, taught by skilled instructors, attract large numbers of students and also inspire higher levels of participation. If this is the case, then the correlation between class size and note writing is not due to a direct causal relationship between the two variables, but is rather an artifact of other influences (i.e., instructor competence and course quality). However, this hypothesis would also presumably predict that students in larger classes produce a greater number of total words, on average, and there is no evidence of such a relationship.

It is important to point out that the preceding hypotheses are not mutually exclusive. The relationship between class size and note production may be due to any one, or any combination of the rationales presented earlier. Additionally, there may be other explanations for the findings, beyond these three hypotheses. This is a rich area for future research and it should be fairly straightforward to test each hypothesis and determine whether it has merit or not.

The results from the Note Reading analyses were less surprising. The discovery that students in large classes read a smaller proportion of notes and scan more frequently is intuitively reasonable. One would expect students in larger classes to suffer a higher degree of information overload, and undoubtedly this encourages coping strategies such as scanning, and selectivity in note reading. However, these findings raise important questions about the educational impact of such strategies in larger classes. Is it acceptable for students to scan 30% to 40% of the notes in a course? What amount of scanning is acceptable? On one hand, it could be argued that students at the graduate level should be able to pick and choose the ideas they wish to focus on. Scanning may be an effective strategy for quickly finding those ideas. On the other hand, there is a danger that the practice of scanning, while a useful strategy for meeting basic course requirements, is not effective for fostering in-depth understanding. For example, students may develop the habit of scanning for points in discussions where they can most easily contribute, rather than challenging themselves to work on difficult questions that require more effort. From an educational standpoint, students should not focus on material that is familiar and easy to write about, but rather should expose themselves to new ideas and perspectives. Behaviors such as recounting personal stories or providing unsubstantiated opinions, allow students to easily meet course participation requirements, but without the intellectual effort required for genuine personal growth.

Conclusions

Previous computer conferencing research has not empirically investigated the effects of class size on student activity. The results from this study suggest that larger classes are associated with an increase in the number of notes written, decreases in average note size and the percentage of notes opened, and an increase in note scanning. Several hypotheses have been proposed to explain these results. Future research needs to investigate the social, pedagogical and psychological factors that may also be influential in explaining these findings and thus help inform more effective online course design in the future.

Acknowledgments

This research was supported by grants from the Social Sciences and Humanities Research Council of Canada. We would like to thank Jud Burtis for his extensive help with data extraction. We also would like to thank Ashifa Jiwani and Lynn Miller for their valuable feedback on earlier drafts of the paper.

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Figure Captions

Figure 1. Class size by average number of notes written, per student, in each course.

Figure 2. Class size by average number of words written, per student, in each course.

Figure 3. Class size by average size of note, in words, in each course.

Figure 4. Class size by average percentage of notes opened by students in each course.

Figure 5. Scan rates (8 wps or faster) for Small Classes and Large Classes for notes of different sizes.