**The Impact of a Notification System on Student Behaviours in a Collaborative Online Learning Environment**

**Abstract:** This study examines the use of a notification system that makes students aware of interactivity in their online learning community. There are many opportunities for learners to interact with each other in online discussions, but whether or not students are aware that these interactions have taken place is problematic. The system is studied in a hybrid graduate course. Social constructivism and social cognitive theory are used to frame our understanding of the way various interactions with student-produced content can lead to higher engagement. Correlation and ANOVA analyses are used to understand how student contribution behaviours are influenced by the notification system. Findings suggest that activation of the notification system positively influences student contribution behaviours. Suggestions for significance are provided.

**Objectives**

Student behaviour in online learning environments is associated with the design of the environment (Boettcher, 2007; Lulee, 2011). As such, attention needs to be paid to the types of tracked information and the ways information is presented to the learner when these learning environments are designed (Verpoorten, et al., 2009). A review of the literature finds little empirical evidence for the importance of using tracked information to guide learner’s self-regulated behavior because this type of information is typically available to instructors or system administrators. This study was intended to fill the gap by exploring how a personalized notification system (described in detail below) increases user awareness in a collaborative online learning environment, Pepper, where online discussions are a significant portion of students’ final grades. Additionally, we looked at the impact this system has on student behaviours within the environment. The following research questions guide the inquiry:

1) How do student expectations and professional orientation influence their use of the notification system?

2) How much more likely are students to exhibit activity based on the types of notifications that they receive?

The study examines these questions through correlation and ANOVA analyses. We hypothesize that use of the notification system will be influenced by student expectations of the course and their professional orientation. Additionally, we hypothesize that the notification system will increase student awareness of peer activity within the online learning environment, thus students will be more likely to contribute to the online discussion if they have the notification system activated.

**The Environment**

Pepper is a collaborative online learning environment that facilitates online discussions in a threaded format. The primary artifact students generate in the environment is a note. A note can contain text, attached files, embedded videos and images, hyperlinks to the World Wide Web, and links to other students’ notes within the environment. The environment has its own private messaging system where users can send messages to individual or groups of users at the same time. The personal notification system (Figures 1 & 2) within Pepper notifies students via email when the following action(s) initiated by another user occurs: replies to one of your notes, sends you a private message, posts a message to the class wall, edits a note that is co-authored by you, links to one of your notes, and adds a new note to one of the various folders in the course community that you have chosen to receive notifications about.
Figure 1. The Notification Center activation screen allows each user to customize the types of notifications they receive to any email address that they specify. If an email address is not provided, then the system is not activated.

Figure 2. An example of an email notification received for the instance of a private message being sent.

Theoretical Framework

Social Constructivism

Social constructivism suggests that learning is fundamentally social in nature and is shaped by context, conversation, and collaboration (Brown, Collins, & Duguid, 1989; Dewey, 1963; Vygotsky, 1978). Particular to online communities, there has been much focus on how the learning environment functions to support student interaction. Swan (2005) summarizes social constructivism’s importance for online learning practices: “learning is essentially a social activity, [and] that meaning is constructed through communication, collaborative activity, and interactions with others. It highlights the role of social interactions in meaning making ... [and] knowledge construction” (p. 5). As such, discussions connect individuals in an online learning environment and motivate them to take an active role in knowledge construction and collaborative processes (Oztok, 2013).
Social Cognitive Theory (SCT)

According to Bandura (1986, 1993), SCT is a comprehensive theory that informs self-efficacy, human motivation, behavior, and social interactions. Self-efficacy is one’s judgment of his or her capabilities to organize and execute a task (Bandura, 1986) and is regarded as a strong predictor of behavior, especially academic behavior (Maddus, et al., 1986; as cited in Fast, et al., 2010). From a social interaction perspective, the level of interaction relates to learners’ demographic backgrounds and their learning expectations. Research has shown that students with high levels of interaction in an online course tend to be different from those with low levels of interaction with respect to age, gender or previous qualifications (Yukselturk & Top, 2013). From a behavioral perspective, we focus primarily on choice behaviors (i.e., intention to activate notifications) on online learning. In Yin and Wang’s (2008) study suggests task value as a strong predictor of choice behaviors. Verplanken and Holland (2002) suggest that the attractiveness of outcomes often influences one’s choice (2002). In order to acquire knowledge, one needs to converge his/her environment with his/her personal characteristics and experience. SCT allows us to identify the most significant personal, behavioral and environmental factors that influence student decisions and provides us with a holistic view of the interactions between the aforementioned factors and students’ online contribution behaviors.

Data Sources and Methods

Data were drawn from the log files of a hybrid (face-to-face lectures and online discussion participation) graduate course using Pepper at a Canadian faculty of education. The 12-week course had a total of 73 students enrolled. Online participation in weekly discussions was valued at 50% of the students’ final grade. It was highly recommended that students activate their notification system to keep them aware of online discussion activity. 80% of students activated notifications in the course.

We conducted a grounded analysis of student-produced biographies to classify students’ course expectations and their professional orientation. We found three categories of expectations: 1) students that did not specify their expectations ($N = 16$), 2) students that expected to expand their knowledge and knowledge sharing capacity ($N = 28$), and 3) students that expected to apply their knowledge to research and/or their professional practice ($N = 22$). We found five categories of professional orientation: 1) behavioral therapist ($N = 11$), 2) teachers ($N = 25$), 3) students with education and behavioral therapy volunteer experience ($N = 17$), 4) behavioral therapists and teachers ($N = 4$), and 5) other professionals with no education experience ($N = 9$). Students that did not produce biographies remained unclassified ($N = 7$).

Anonymized student activity logs were extracted (cumulative student activity): notes written, replies given, replies received, likes given, likes received, private messages written, links created to others’ notes, links made to student’s note. Additionally, data were extracted for the types of notifications set by students (binary values of on/off): received reply to their note, received a private message, link was made to their note, a note that is being coauthored has been edited, message posted on the class wall, and others - associated with notes being posted in a particular folder of the course.

Correlation analysis informs the relationship between use of the notification system and student activity and demographic background. ANOVA analyses was used to explore two types of relationships: 1) the relationship between students’ demographic background and their online learning behavior, 2) the relationships between the use of five notification tools and students’ online activity behavior.

Results

Students in the course were most likely to activate the response ($N = 30$), the private message ($N = 49$), and the coauthor ($N = 58$) notification tools (see Table 1). Students with knowledge sharing and knowledge expanding expectations ($N = 71$) were more likely to use the notification tools compared to students without specified course expectations ($N = 37$).

Table 1. Descriptives: Notification tools and students’ demographic background

<table>
<thead>
<tr>
<th>Notification Type</th>
<th>No specified expectations</th>
<th>Knowledge expanding and knowledge sharing</th>
<th>Applying knowledge to research /professional practice</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response (On)</td>
<td>5 (8%)</td>
<td>13 (20%)</td>
<td>12 (19%)</td>
<td>30 (45%)</td>
</tr>
<tr>
<td>Message (On)</td>
<td>11 (17%)</td>
<td>20 (30%)</td>
<td>18 (27%)</td>
<td>49 (74%)</td>
</tr>
<tr>
<td>Link (On)</td>
<td>1 (2%)</td>
<td>4 (6%)</td>
<td>4(6%)</td>
<td>9(14%)</td>
</tr>
</tbody>
</table>
Students with a teaching background ($N = 71$) were more likely to use all of the notification tools. Teachers tended toward use of the private message ($N = 18$) and the co-author tools ($N = 16$), compared to other professionals ($N = 8$) and those who worked as behavioral therapists and teachers ($N = 1$). Teachers also tended to turn on the class wall notification tool ($N = 16$) (see Table 2).

<table>
<thead>
<tr>
<th>Notification Type</th>
<th>Behavioral therapist</th>
<th>Teachers</th>
<th>Recent graduates (post-secondary)</th>
<th>Both behavioral therapists &amp; teachers</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response (On)</td>
<td>5(8%)</td>
<td>11(17%)</td>
<td>8(12%)</td>
<td>2(2%)</td>
<td>4(6%)</td>
<td>30(45%)</td>
</tr>
<tr>
<td>Message (On)</td>
<td>9(14%)</td>
<td>18(27%)</td>
<td>11(17%)</td>
<td>3(5%)</td>
<td>8(12%)</td>
<td>49(74%)</td>
</tr>
<tr>
<td>Link (On)</td>
<td>3(5%)</td>
<td>4(6%)</td>
<td>1(2%)</td>
<td>1(2%)</td>
<td>0</td>
<td>9(14%)</td>
</tr>
<tr>
<td>Co-author (On)</td>
<td>10(15%)</td>
<td>22(33%)</td>
<td>14(21%)</td>
<td>3(5%)</td>
<td>9(14%)</td>
<td>58(88%)</td>
</tr>
<tr>
<td>Class wall (On)</td>
<td>7(11%)</td>
<td>16(24%)</td>
<td>10(15%)</td>
<td>3(5%)</td>
<td>6(9%)</td>
<td>42(64%)</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>71</td>
<td>44</td>
<td>12</td>
<td>27</td>
<td>188</td>
</tr>
</tbody>
</table>

Significant correlations exist between the use of notification tools and students’ online contribution/interactivity behaviors. Replies received were significantly associated with the number of notes written, the number of messages written and the number of “likes” given. It suggested that students who received more replies from peers or instructors tended to write more notes ($r = .88, p < .001$) and more messages ($r = .28, p < .05$). They also tended to give more “likes” to peers’ notes ($r = .35, p < .05$). The correlations between “likes” received, the number of note written and the number of “likes” given were significantly positive. That is to say, receiving “likes” motivates desirable behavior. Students who received more “likes” tended to write more notes ($r = .71, p < .001$) and give more “likes” to others ($r = .51, p < .001$). In addition, the number of notes written and the number of links created to other students’ notes were positively and significantly correlated, indicating students who wrote more notes tended to receive more links from others ($r = .43, p < .01$). Students who created more links to others’ notes also tended to be linked more by their peers ($r = .67, p < .001$).

ANOVA analyses showed statistical significance between students’ professional orientation and the number of notes written, $F(4, 65) = 3.87, p < .05$, along with the number of replies written, $F(4, 65) = 3.56, p < .05$. There is also a significant relationship between students’ course expectations and the number of link created, $F(2, 65) = 6.47, p < .05$. Important relationships were found with the effects of notification tools on learning behavior. The use of co-author notification tool was significantly associated with the number of note written, $F(1, 65) = 6.04, p < .05$, and the number of replies written, $F(1, 65) = 5.34, p < .05$. Use of the class wall notification tool was significantly associated with the number of notes written, $F(1,65) = 3.68, p = .05$. The relationship between the class wall notification tool and the number of replies written was also statistically significant, $F(1, 65) = 5.34, p < .05$.

**Conclusions and Implications**

Data analysis confirms our hypothesis of course expectations and professional orientation influencing use of the notification system. Students who are enrolled in the course with the intention of expanding their knowledge base and knowledge sharing capacities are most likely to activate the notification system. Considered from a behavioral perspective, these students can be conceptualized as intrinsically motivated. They are dedicated to acquiring knowledge through collective participation within the online discussions. The use of the notification system may help to inform their awareness of activities taking place in the environment. Teachers are the group with most notifications activated. Use of the notification system may be explained by students’ need to generate a sense of trust and affirmation in the community (Swan, 2005). This interpretation is supported by the fact that teachers in the course are receiving the most replies, likes and links made to their notes. Notes that receive likes and are linked to are more likely to be written at higher cognitive level than those that do not receive likes and are linked to.

Table 2. Descriptives: Notification tools and students’ demographic background
This may indicate that teachers are making more connections between course content and their practice. It is observed that students with education and behavioral therapy volunteer experience exhibit the most active participation within the learning community by producing the most notes. This demonstrates a need for this group to generate a working knowledge of the course content through knowledge sharing (Scardamalia & Bereiter, 2003). Additional analysis is required to inform our understanding of note content.

Data analysis supports our hypothesis of active notifications positively influencing student contribution behaviour. Of the five notification types, the private message notification is the most popular. Additionally, the class wall and co-authoring notifications are positively correlated to note production in the community. Combined, these three notification types represent an awareness of opportunities for students to engage in collaborative interactions in the environment. The use of these notifications may be an indicator of the developed sense of collective cognitive responsibility in the community (Scardamalia, 2002). Further analysis is needed to understand what types of notes are being produced after these notifications are received.

This study suggests that students are actively seeking awareness of community interactions. The positive correlations between notification use and student activity describes the need for students to generate a sense of affirmation and connectedness to their community. Use of the notification system may provide instructors with a sense of student participation in the community.

References
Author, et al. (in press). Examining the characteristics of student postings that are Liked and Linked in a computer-supported collaborative learning environment. British Journal of Educational Technology.


