Facilitating Student Interaction through Liking and Linking Tools in a Computer-Supported Collaborative Learning Environment

Abstract A Like button and Linking tool were created to scaffold positive learner interactive behaviours in a CSCL environment, Pepper. A mixed-methods approach was used to examine the characteristics – including discussion activity, note attributes, and cognitive complexity – of student notes. Notes were sorted into four categories: notes that received likes, notes that contained links to others’ notes, notes that are liked and link to others’ notes, and notes that were not liked nor contained links to others’ notes. The findings suggest that the like and linking functions positively cultivated and sustained interactive behaviours amongst students, which also led to an increase in the cognitive complexity of student contributions to the online discussion. Suggestions for future iterations of this project are offered.

Objectives One of the most commonly cited problems in online education literature is the challenge of nurturing open and constructive discourse (e.g. Kreijns, Kirschner & Vermeulen, 2013). Some researchers argue that a sense of community and user engagement needs to be established for fruitful discussions to evolve (Swan, 2005). A sense of community engenders trust among students, which facilitates the collaborative processes of idea identification, exploration, integration and resolution of course content (Garrison et al., 2000). If students are not able to develop a sense of trust within their community, then these processes will be hindered. In an effort to encourage open and constructive discourse, we examine the use of a like button (Fig. 1) and a linking tool (Fig. 2) in an experimental computer-supported collaborative learning (CSCL) environment called Pepper. This paper examines the characteristics of notes that are liked and/or link to others’ notes as compared to notes that do not receive likes and did not link to others’ notes. The following questions motivate this study:

1. What are the characteristics of liked notes and notes that link to other student notes that cultivate and foster the development of positive activity in online discourse?
2. Are notes that receive likes and link to other student notes of higher cognitive complexity than those notes that do not?

We hypothesize that the Like button and Linking tool facilitate beneficial activities and behaviours associated with interactive discussion and therefore facilitate the collaborative learning process. Additionally we hypothesize that notes that receive likes and/or link to other notes are of higher cognitive complexity than those that do not because students are more willing to engage in discourse when a sense of affirmation and trust is cultivated in their learning community.
Figure 1. Example of a liked discussion note in Pepper; the person(s) who liked the note are listed. Each note that is produced by a student can be liked by others in the community, and this is represented with a “thumbs-up” icon.

Figure 2. Example of a linked note in Pepper. The linking tool allows a student composing a new note to embed links to other student notes when ideas are referenced that already exist in the threaded discussion. Links are represented with embedded hyperlinks in the text. Once the new note is saved, readers can easily refer to these notes that are linked to by clicking on them and reading the content.

Theoretical Framework

Social constructivism is used to understand the need for students to interact with text-based content in various ways that help them develop a sense of trust, affirmation and sense of community, all crucial for successful collaboration. 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). Hiltz
(1994) discusses how successful online interactions can result in more effective learning and that “the social process of developing shared understanding through interaction is the ‘natural’ way for people to learn” (p. 22). Kreijns, Kirschner and Vermeulen (2013) emphasize that one of the pitfalls here is that “simply enabling social interaction, therefore, is not enough, it must be stimulated” (p. 2). Research on deep learning and information retention provides empirical evidence that discussion facilitates these cognitive processes (Van der Linden & Renshaw, 2004) as learners interact with and construct new understandings of course content through discussion. Considering social patterns of interaction, social constructivism is conceptualized here as the way various interactions with student-produced content can lead to more cognitively complex discourse in CSCL environments.

**Methods and Data Sources**

Data was extracted from a graduate-level course taught in a leading Canadian faculty of education. The total enrollment was 15 students, with 1 course instructor. Student discussion participation is valued at 40%. The selected course is consistent with data from the Pepper log files of discussion-based courses that indicate that over 90% of students use these tools.

We conducted a series of quantitative analyses on the written content of the notes in the graduate course to investigate how notes that received likes, that link to other notes, and that are both liked and link to notes differ from other notes in terms of their quantifiable features. In this course, 1324 notes were generated over a 12-week period. Of these 1324 notes there were four categories of classification: 643 notes did not receive likes or were not linked to other notes (Other); 265 notes were liked one or more times (Liked Note); 182 notes linked to other notes one or more times (Linking Note); and 234 notes were liked and contained links to other notes one or more times (Liked & Linking Note). For each note in the dataset, several metrics were extracted for notes that were classified as part of each of these categories. Data extracted for discussion activity includes: the number of times the note was read; Scan Rate ratio – which represents how long a student is spending reading particular content – the lower the ratio, the less time is being spent – (Hewitt, Brett & Peters, 2007); the number of times the note was revised; and the number of replies the note received. This information quantifies how students are producing and replying to each other’s contributions in the CSCL environment; analysis allows us to understand how students interact with the discussion content. Data extracted for note attributes includes: word count; Academic Vocabulary Percentage – texts that are more academic have higher percentages – calculated based on the percent of words from the Academic Word List (AWL) which is a collection of the most frequently occurring words in academic texts (Coxhead, 2000); sentiment – the degree of positivity of the language used (Pang & Lee, 2008); Flesch Reading Ease score where higher values indicate that text is more readable; and, the Flesch-Kincaid Grade Level score where higher grade level indicates that text is written at a higher level (Flesch, 1951). These metrics objectively illustrate the academic orientation of their contributions and informs our understanding of what types of contributions are valued by students in online discussions.

Analysis of note content was conducted to examine cognitive complexity of the content for notes that fell into the four categories described above. Cognitive complexity is defined as the academic orientation of the note with respect to the types of contributions made to the discussion. The scheme was developed using grounded analysis of note content within graduate online discussions; this is described in more detail in a separate article (Authors, in review). A sample of 300 notes were selected for coding with a confidence level of 95%. Table 1 was used to code the notes. Researchers rated the anonymized notes with over 80% inter-rater reliability. Two-way ANOVAs were run using note-liked (no or yes) and note-linked (no or yes) as the independent variables and each of the above metrics as a dependent variable. Levene's test suggested that many of the analyses violated the assumption of homogeneity of variance, so a robust ANOVA with 20 percent trimmed mean was used (Wilcox, 2005).
Table 1. Coding scheme developed to rate notes for cognitive complexity; there are four types of contributions that students may make – statement, sharing, agreement/disagreement, and questioning/challenging – each of which are rated from 1 (lacks substance) to 5 (offers detailed rationale to advance discourse); the score for cognitive complexity is calculated by finding the mean rating between the categories that are present in the student contribution.

Results
Research Question 1: We hypothesized that the Like button and Linking tool would facilitate positive activities and behaviours associated with interactive discussion and therefore facilitate the collaborative learning process. Figure 3 provides the mean values associated with the discussion activity and note-level metrics for the combinations of liking and linking.
The effect of liking was not significant (p=.875); the effect of linking was significant (p=.001). However, the interaction of liking and linking was significant (p=.019), so we interpret this interaction. Whether a note is or is not liked, linking is associated with increased reads. This effect of linking is stronger for notes that are not liked compared to notes that are liked.

The effect of liking was significant (p=.001); the effect of linking was not significant (p=.049). However, the interaction of liking and linking was significant (p=.008), so we interpret this interaction. For notes that were not liked, linking was associated with a higher scan rate (i.e. less-careful reading). For notes that were liked, linking was associated with a lower scan rate (i.e. more-careful reading).

The effect of liking was not significant (p=.61); the effect of linking was significant (p=.001). There was no significant interaction (p=.67), so we interpret the main effects. Whether notes were or were not liked, linking was associated with increased revisions.

The effect of liking was significant (p=.003); the effect of linking was also significant (p=.001). Furthermore, there was a significant interaction (p=.002), so we interpret that interaction. Both for liked and not-liked notes, linking is associated with more replies, though the effect is stronger for notes that are not liked.

The positive relationships between liking and linking on the one hand and these activities on the other is encouraging for our goals of student interaction and learning. For the linking tool in particular, we note that the tool is often used to link back to notes from earlier weeks in the course. We suggest that the linking tool facilitates the synthesis of classroom arguments and the construction of shared knowledge.

Our second hypothesis was also confirmed: that notes that receive likes and that contain links are of higher cognitive complexity than those notes that were in the control group. Figure 4 and 5 provide the mean values associated with each of the note attribute metrics for the combinations of liking and linking.
Words
The effect of liking was significant (p=.001); the effect of linking was also significant (p=.001). The interaction tended toward significance (p=.059). Linking and liking are both associated with increased word count.

Reading Ease
Again, all three effects were significant: liking (p=.001), linking (p=.001), and the interaction (p=.001). Linking and liking are both associated with decreased reading ease (i.e. with text that is more difficult to read), though the effect of linking on liked notes is weaker than for not-liked notes.

AWL Percentage
The effect of liking was significant (p=.016); the effect of linking was also significant (p=.001). Finally, the interaction was also significant (p=.011), so we interpret the interaction. Linking and liking are both associated with increased AWL percentage, though the effect of linking on liked notes is weaker than for not-liked notes.
Sentiment

All three effects were significant: liking (p=.006), linking (p=.001), and the interaction (p=.046). Linking and liking are both associated with increased positive sentiment, though the effect of linking on liked notes is weaker than for not-liked notes.

Grade Level

Again, All three effects were significant: liking (p=.001), linking (p=.001), and the interaction (p=.001). As for reading ease, linking and liking are both associated with more difficult text, though the effect of linking on liked notes is weaker than for not-liked notes.

In summary, notes that are liked and/or that link to others' notes are typically longer, contain more academic words, are more positive in tone, are more difficult to read, and are written at a higher grade level.

![Figure 6. ANOVA results for Mean Rating for Cognitive Complexity Coding with corresponding mean values.](image)

For cognitive complexity, we see main effects of liking (p=.036) and linking (p=.001), but no significant interaction (p=.207). Figure 6 gives the mean cognitive complexity level for the combinations of linking and liking. We see that both linking and liking are individually associated with higher cognitive complexity. Notes that received likes and/or link to others’ notes were more likely to be taken up in discussion and were written at a higher level of cognitive complexity than those notes that did not.

Discussion and Significance

Having considered the growing emphasis on learning communities in current CSCL research, the concept of the collective cognitive responsibility (Scardamalia, 2002) is useful for discussing the findings of this case study. According to Scardamalia (2000), one of the most critical conditions in learning communities that facilitate collaborative knowledge building is nurturing a shared understanding and culture to distribute the cognitive responsibilities among their members. In order to increase the collective cognitive responsibility, it is important to acknowledge, recognize and incentivize individual members’ contributions (e.g. knowledge that individual members bring into the discourse) in their collective efforts of collaborative learning (Scardamalia & Bereiter, 2003).

Data analyses suggest that students’ discussion activities and behaviours related to liking and/or linking are highly interactive; at the same time, those notes in comparison with the notes in the group with no liking or linking activity have higher cognitive complexity and academic level of content. In the online discussion-based learning context, students tend to use the Like button and the Linking tool to acknowledge other members’ contributions to the collective process of knowledge construction when the particular notes are considered to include meaningful knowledge or shared perspectives. In this sense, it can be argued that the efforts to contribute to the collective cognitive development of the community by writing sophisticated and advanced notes are sufficient indicators that likes and linking to others’ notes are recognized and incentivized by the two tools. Therefore, the mechanism underlying the use of these scaffolding tools in our online learning environment supports their effectiveness for increasing collective cognitive responsibility. A follow-up study is necessary to explore exactly why these tools support learner engagement in discussion.
References

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