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Design and evaluation of instructor-based and peer-oriented attention guidance functionalities in an open source anchored discussion system

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ABSTRACT

Social interactions to supplement learning and asynchronous tools to facilitate exchange of quality ideas have gained much attention in information systems education. While various systems exist, students have difficulty with deep processing of complex instructional materials (e.g., concepts of a theory and pedagogical support mechanisms derived from a theory). This research proposes a theoretical framework that leverages attention guidance in a social constructivist approach to facilitate processing of central domain concepts, principles, and their interrelations. Using an open source anchored discussion system, we designed a set of instructor-based and peer-oriented attention guidance functionalities involving dynamic manipulation of text font size similar to tag clouds. We conducted an experimental study with two small groups of first-year doctoral students in a blended-learning classroom format. Students in the control group had no access to attention guidance functions. Students in the treatment group used instructor-based attention guidance functionality and then switched to peer-oriented attention guidance functionality. The evaluation compared focus, content, and sequential organization of students' online discussion messages with heat maps, content analysis, sequential analysis, and statistical discourse analysis to examine different facets of the phenomenon in a holistic way. The results show that in areas where students struggle to understand challenging concepts, instructor-based attention guidance functionality facilitated elaboration and negotiation of ideas, which is fundamental to higher order thinking. In addition, after switching to peer-oriented attention guidance functionality, students in the treatment group took the lead in pinpointing challenging concepts they did not previously understand. These findings indicate that instructor-based and peer-oriented attention guidance functionalities offer students an indirect way of focusing their attention on deep processing of challenging concepts in an inherently open learning environment. Implications for theory, software design, and future research are discussed.

1. Introduction

Collaborative learning (CL) opens opportunities for an individual to actively construct new knowledge for a deep understanding of a subject matter. A key element in the effectiveness of this popular educational approach is social interaction (Phielix, Prins, Kirschner, Erkens, & Jaspers, 2011). Social interaction can provide a natural setting for demanding cognitive activities such as externalizing one's own perspective, questioning collaborators' perspectives, negotiating differences in perspectives, and internalizing a refined perspective (Dehler,

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Bodemer, Buder, & Hesse, 2011). These activities allow students to use one another as a resource for collaborative learning. Thus, the effectiveness of collaborative learning relies on the quality of social interaction.

Computer-supported collaborative learning (CSCL) systems can facilitate and stimulate the production of high quality social interactions with their functional characteristics (Suthers, 2006). An annotation-based asynchronous online discussion system is one valuable CSCL tool for collaborative processing of academic texts. This system is sometimes referred to as anchored discussion because students' shared annotations directly link discussion threads to relevant context, affording greater coherence (Brush, Bargeron, Grudin, Borning, & Gupta, 2002; Guzdial & Turns, 2000; Van der Pol, Admiraal, & Simons, 2006). There are two linking functions crucial to the design of an anchored discussion system: artifact-to-discussion linking and discussion-to-artifact linking. Suthers (2001) reported that these linking functions tightly couple instructional material (artifact) and its related discussion. Extensive prior research compared anchored discussion with conventional threaded discussion. For example, Guzdial and Turns (2000) showed that linking a discussion thread to an entire or a section of an instructional material stimulates more sustained and on-topic social interaction. Brush et al. (2002) obtained similar results and further demonstrated that linkage to finer-grained material (words or passages) promotes focused messages. Next, Mühlpford and Wessner (2005) found that these linking functions act as a catalyst for building common ground in social interaction. Along this line, Van der Pol et al. (2006) observed that an anchored discussion system increases communicative efficiency, encourages re-reading of relevant passages from an instructional material, and produces meaning-oriented discussion. Finally, Eryilmaz, Ryan, Van der Pol, Kasemvilas, and Mary (2013) isolated the combined effects of two linking functions from the presence of instructional material in an anchored discussion system and developed a theoretical model to explain the resulting quality and flow of social interactions.

Despite the positive results obtained by previous research, there are still many problems concerning the collaborative processing of academic texts with anchored discussion systems. A pressing problem, as stressed by Peters and Hewitt (2010), is that students have difficulty with deep processing of central domain concepts, principles, and their interrelations from complex instructional materials (e.g., concepts of a theory and pedagogical support mechanisms derived from a theory). The factors that give rise to this problem are twofold. First, students may opt for sharing existing opinions and experiences in online discussions due to a natural tendency to get things done with minimal effort (Sandberg & Barnard, 1997). In this line of reasoning, Hewitt (2005) found that students gravitate to familiar (comfortable) topics and avoid challenging topics from complex instructional materials in order to meet online discussion participation requirements. According to Bétrancourt, Dillenbourg, and Clavien (2008), students' above mentioned tendencies induce a "shallow processing of the subject matter instead of a deeper and more demanding processing" (p. 66). Along this line, Van der Pol et al. (2006) referred to shallow processing as "opinion-oriented discussion" and deep processing as "meaning-oriented discussion" within an anchored discussion system. Second, Kim and Hannafin (2011) found that when students have low levels of prior knowledge, naïve assumptions situated in prior experiences limit or fail to adequately inform their collaborative knowledge construction. Under such conditions, Kim and Hannafin (2011) remarked that "students develop robust and oversimplified misconceptions that prove highly resilient to change" (p. 412). Taken together, both factors underscore students' difficulties in productive use of instructional resources during anchored discussions, which can yield lower learning results (Jeong & Hmelo-Silver, 2010). Building on this line of reasoning, we concur with Lin and Atkinson (2011) that students with low levels of prior knowledge can benefit from attention guidance in collaborative processing of challenging concepts from complex instructional materials. However, a central challenge with attention guidance is that as students become more familiar with a subject matter, instructor's guidance may become redundant and in some cases it may even hinder collaborative knowledge construction because students may rely too much on an instructor's expertise and authority (Puntambekar & Hubscher, 2005). Therefore, the notion of successful scaffolding entails the fading of an instructor's guidance, which forces students to practice their own knowledge and develop the necessary skills for novel situations (Wecker & Fischer, 2007).

In order to address the problem at hand, we examined the design and evaluation of two different attention guidance functionalities in an open source anchored discussion system: instructor-based and peer-oriented attention guidance. Our central argument involved two components. First, instructor-based attention guidance functionality would help students with low prior domain knowledge to select and subsequently process a complex instructional material's challenging concepts with high quality social interaction patterns. Second, students would continue to carry out high quality social interaction patterns focusing on challenging concepts after switching from instructor-based to peer-oriented attention guidance functionality.

The article proceeds as follows. The next section leverages attention guidance in a social constructivist perspective to facilitate focused online learning conversations. Building on this theoretical framework, the subsequent section describes the design of instructor-based and peer-oriented attention guidance functionalities in an open source anchored discussion system. The sections following that detail the research hypotheses, methodological approach, and present results of the study. The article concludes with a discussion of the findings, contributions, limitations, as well as avenues for future research.

2. Theoretical framework

The theoretical lens that guides our study is an "interactional constructivist epistemology" (Suthers, 2006). This position emphasizes that the value of social interaction lies in "idea improvement" (Scardamalia & Bereiter, 2006, p. 99) within small learning groups. Two theoretical stances that were introduced by Mayer and colleagues (e.g., Robins & Mayer, 1993) serve as the underpinning of this position: active responding and active processing. The first stance, active responding, recognizes the value of making intellectual advances in areas where students struggle to understand, such as expressing ideas to clarify misconceptions; asking thought-provoking questions to pursue a new line of reasoning; elaborating on existing ideas to extend what is already known; and negotiating conceptual discrepancies to justify, defend, and revise ideas (Kobbe et al., 2007). The second stance, active processing, classifies these types of social interaction activities as constructive or truly mathemagenic (Rothkopf, 1970) only if their outputs contain ideas that go beyond the explicitly presented information in a complex instructional material (Chi, 2009). For example, asking students to compare-and-construct the abstract knowledge of two complex instructional materials in social interaction requires them to express the relevant similarities and differences in their own words when the instructional materials do not explicitly state this information. In summary, the term active characterizes the production of such activities in social interaction rather than passive acceptance of peers' inputs, and these actives become constructive when they produce new ideas that go beyond the information provided in a complex instructional material.