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Effects of success v failure cases on learner-learner interaction

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ABSTRACT

Studies have found that students struggle to challenge their peers and engage in co-construction of knowledge when in asynchronous problem-based learning (PBL) contexts. In other settings, case libraries have been shown to support problem solving competencies, such as argumentation and problem representation. However, research has yet to study how the design and types of cases impact learner-learner interaction. To accommodate that gap, this study used content analysis and sequential analysis to ascertain how learner interaction differed when participants had access to success- and failure-based case libraries. Results found the failure-based condition had higher overall number of postings and differed in terms of the number of elicitations and planning (meta) interactions. Finally, results of the sequential analysis indicated participants in the success-based condition were more likely to begin planning their final assignment earlier, while the failure condition was more likely to continue engaged in collaborative problem-solving with their peers. Given these differences, the findings suggest failure-based cases may serve as a catalyst for learner-learner interaction when compared with success-based cases. Implications for practice, case-based reasoning, and failure-driven memory theory are discussed.

1. Introduction

Research finds that practitioners are often required to solve complex, ill-structured problems in a variety of domains (Gartmeier, Bauer, Gruber, & Heid, 2010; Hara & Schwen, 2006). Contextualized examples include physicians prescribing proper medicine to avoid post-surgery infection, engineers selecting optimal materials during the construction of a bridge, and sales personnel growing a business amidst market challenges. Because these problems possess multiple possible solutions and perspectives, practitioners must interact with their peers to generate viable solutions given available evidence and contextual constraints (Hmelo-Silver, 2004; Jonassen, 1997, 2011b). Specifically, individuals and their peers proffer ideas, ask questions, and engage in consensus building during collaborative problem solving. Moreover, communities of practice frequently leverage prior experience during problem solving (Tawfik & Kolodner, 2016; Hara & Schwen, 2006; Kolodner, Owensby, & Guzdial, 2004). In many cases, individuals rely on causal reasoning and requisite evidence of past experiences to justify a solution for a given problem.

Given the research on how practitioners solve complex problems, theorists have argued learners should be taught in a similar manner (Herrington, Reeves, & Oliver, 2014; Jonassen, 1997; Kolodner et al., 2004). Similar to communities of practice, learners in

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problem-based learning (PBL) are tasked with solving problems that are representative of the duties practitioners often encounter. Reciprocal discourse between group members, also known as learner-learner interaction, plays an important part in PBL (Donnelly, 2010; Moore, 1989). Similar to practitioners, learners in PBL must interact with their peers to externalize ideas, ask questions, and negotiate meanings in pursuit of a solution (Hull & Saxon, 2009; Jeong & Hmelo-Silver, 2016; Lajoie et al., 2014). However, research indicates that novices employ domain-dependent strategies, such as means-end analysis, and fail to challenge the assertions of their peers during problem solving (Oh & Jonassen, 2007; Tawfik, Sánchez, & Saparova, 2014). This reticence to challenge peers is even more pronounced when learners collaborate in online asynchronous PBL contexts (Ertmer & Koehler, 2014). To address this problem, scaffolds such as question prompts (Vogel et al., 2016; Weinberger, Ertl, Fischer, & Mandl, 2005; Kauffman, Ge, Xie, & Chen, 2008) and wikis (Brooks & Jeong, 2006; Ioannou, Brown, & Artino, 2015) have been embedded in online learning environments to stimulate learner inquiry in the problem space and serve as a catalyst for deeper learner-learner interaction required for PBL.

Learning systems have also started embedding "cases as previous experience" (Jonassen, 2011a, p. 194) as scaffolds. Because learners often struggle to synthesize information and engage in causal reasoning, cases allow the learner to observe how practitioners solved similar problems and apply lessons learned toward the extant problem (Dabbagh & Dass, 2013). In contrast to other forms of scaffolding, PBL groups can use cases to generate ideas, ask questions, and negotiate how the previous experience depicted in the solution can be transferred to the new problem. Some have further argued scaffolds go beyond other forms of support by modeling behavior and depicting causal reasoning in narrative form (Tawfik & Kolodner, 2016; Gartmeier et al., 2015; Hoogerheide, Loyens, & van Gog, 2015).

While research has begun to validate the use of cases as a viable scaffolding strategy, qualitative reflections of case libraries comprise much of the evidence (Bennett, 2010; Boshuizen, Wiel, & Schmidt, 2012; Kim & Hannafin, 2009). It is thus less clear how learners employ scaffolds to enhance the learner-learner interaction that is critical for PBL. Moreover, research has yet to explore how different types of experiences depicted in a case, such as success or failure, might generate different types of learner-learner interactions within PBL groups. Based on this gap, we first examine relevant research associated with PBL and learner-learner interaction in online asynchronous learning contexts. We then discuss the theoretical merits of case-based reasoning (CBR) and failure-driven memory. Finally, we present results on the use of success- and failure-based cases on interaction in terms of content analysis and sequential analysis.

2. Literature review

2.1. Problem-based learning and online learning

In many educational settings, instruction is often administered with didactic and lecture-based approaches. Learners in those instructional settings memorize important information conveyed by the teacher or assigned in the learning materials (Herrington et al., 2014). The transfer of knowledge and interaction often occurs through exchanges between the instructor and student, while also often devoid of context (Ng, Bridges, Law, & Whitehill, 2014). Moreover, learners in traditional classroom contexts are often assessed using single answer, well-structured problems. Despite being efficient models of teaching, critics have suggested didactic-based approaches fail to represent the complexity required to solve complex, domain-specific problems (Barrows & Tamblyn, 1980; Hmelo-Silver, 2004; Jonassen & Hung, 2008).

Given how practitioners solve problems, theorists argued instruction should emphasize the skills needed to solve ill-structured problems (Hmelo-Silver, 2004; Hung, 2011). Thus, PBL is an instructional strategy used to overcome the pedagogical limitations of didactic teaching by allowing novice learners to solve representative domain problems with peers (Barrows & Tamblyn, 1980; Hmelo-Silver, 2004). An important part of the ill-structured problem-solving process required in PBL includes how peers collaborate (Lu, Lajoie, & Wiseman, 2010; Moore, 1989). Specifically, PBL interactions require learners to proffer ideas for solving the problem, identify disagreements, ask relevant questions, and come to consensus as they monitor their own understanding (Hmelo-Silver & Barrows, 2008; Jeong & Hmelo-Silver, 2016). Further, sociocultural theory posits that externalized knowledge becomes internalized over time as learners interact with each other (Vygotsky, 1978). This internalization of the learner-learner interaction results in developing cognitive skills, such as critical thinking, problem-solving, and creativity (Ioannou & Stylianou-Georgiou, 2012).

The contextualized nature of PBL aligns especially well with constructivist approaches to online learning (Tee & Lee, 2013) and the degree of interaction required in these contexts. Moore (1989) hypothesized three different, yet complementary, forms of interaction: learner-instructor, learner-content, and learner-learner. Learner-instructor interaction describes the discourse between the teacher and student. Alternatively, learner-content interaction emerges between the student and subject matter, with a particular emphasis on the materials (e.g., readings). Finally, learner-learner interaction entails the dialogical processes between peers. This dynamic process entails learners engaging with peers to share ideas, ask questions, and negotiate new knowledge (Storch, 2002; Weinberger et al., 2005; Hmelo-Silver & Barrows, 2008; Jeong & Hmelo-Silver, 2016). How peers interact with each other influences the degree to which they are able to learn and later internalize their discussions (Sato, 2017).

While Moore's (1989) original definitions were not specific to collaborations that happen online, they are particularly important in asynchronous learning contexts. In contrast to face-to-face learning environments that emphasize learner-instructor interaction, learners in online learning often collaborate using discussion boards to discuss the materials for a given week. In doing so, the dynamic shifts away from learner-instructor interaction towards learner-learner interaction. However, research finds that discussions are often topical and rarely result in sustained learner-learner interactions that engender critical thinking (Chiang & Fung, 2004; Richardson & Ice, 2010). Comparatively, PBL varies widely from the read/reflect/respond learner-learner interaction cycle often used in many online courses. When PBL is contrasted with other strategies used in online learning, research findings suggest that its