



Project-based learning and student knowledge construction during asynchronous online discussion

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ABSTRACT

Project-based learning engages students in problem solving through artefact design. However, previous studies of online project-based learning have focused primarily on the dynamics of online collaboration; students' knowledge construction throughout this process has not been examined thoroughly. This case study analyzed the relationship between students' levels of knowledge construction during asynchronous online discussions with respect to engagement in project-based learning. Graduate students' online postings in a course that comprised both project-based and non-project learning activities were coded and counted for knowledge construction, teaching, and social interaction moves using computer-mediated discourse analysis. Chi-square analyses found that the instructor's teaching discourse remained fairly consistent during project-based and non-project learning. Despite this, students' online discussions during project-based learning were characterized by more advanced levels of knowledge construction, where ideas were rationalized and integrated into plausible solutions. In contrast, students' online postings outside project-based learning rarely moved beyond the lower levels of information sharing and idea exploration. Based on these results, guidelines for designing and facilitating online project-based learning are presented and discussed.

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1. Introduction

Asynchronous discussion forums, chat, and other computer-mediated tools facilitate social exchanges between instructors and students during online learning. Researchers such as Garrison, Anderson, and Archer (2001) and Gunawardena, Lowe, and Anderson (1997) have proposed that knowledge is constructed through these social exchanges when new and deeper understandings are found in students' online discourse. These authors also posit that advanced levels of knowledge construction occur when students demonstrate the ability to formulate, evaluate, and apply new ideas to resolve issues. However, empirical evidence suggests that such advanced levels of knowledge construction rarely occur during actual asynchronous online discussions (e.g., Kanuka & Anderson, 1998; Kanuka, Rourke, & Laflamme, 2007; Meyer, 2003).

Project-based learning is used in higher education to develop students' competencies for problem solving, group work, and self-management (Collis, 1997). It involves students in generating, evaluating, and implementing project ideas (Blumenfeld et al., 1991; Howard, 2002). Garrison (2007) posited that such learning activities could be influential in advancing students' knowledge construction level, and some empirical studies of online project-based learning lend

suggestive support to this idea (e.g., Aviv, Erlich, Ravid, & Geva, 2003; Thomas & McGregor, 2005). Following on this proposition, therefore, the present study examined if students' engagement in project-based learning was related to their demonstration of advanced knowledge construction during asynchronous online discussions. Graduate students' online postings in a course that comprised both project-based and non-project learning activities were coded and counted using computer-mediated discourse analysis (Herring, 2004). Chi-square analyses revealed that the instructor's teaching discourse remained fairly consistent during project-based and non-project learning. Despite this, students' online discussions during project-based learning were characterized by more advanced levels of knowledge construction where ideas were rationalized and integrated into plausible solutions. In contrast, their online postings outside project-based learning rarely moved beyond information sharing and idea exploration. The features of project-based learning that may have supported advanced levels of student knowledge construction in this case are discussed. In conclusion, we present and discuss guidelines for designing and facilitating online project-based learning.

2. Theoretical background

2.1. Models of online knowledge construction

The Interaction Analysis Model (IAM) of Gunawardena et al. (1997) was one of the earliest frameworks to characterize knowledge

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construction during online learning. The IAM was developed through qualitative analysis of an online debate involving 554 participants in a distance education conference. Debate leaders posted a motion and facilitated a week-long session during which the participants posted comments affirming or arguing against the motion. Analysis of the patterns and themes that emerged through these participants' online discourse led the researchers to posit that knowledge construction involves five phases: (1) Sharing and comparing of information, (2) exploration of dissonance, (3) negotiation of meaning, (4) testing and modification, and (5) application. Gunawardena et al. assumed that the purpose of social interaction in this educational context was to produce new knowledge and understanding. Learners co-construct knowledge by moving from "lower to higher mental functions" (p. 415); that is, they first share and compare information before negotiating, testing, and applying ideas collaboratively.

Garrison, Anderson, and Archer (2000) studied the use of computer-mediated communication in higher education contexts and proposed that the quality of learning is determined by students' ability to construct deep understanding through sustained critical discourse. Subsequently, Garrison et al. (2001) proposed that knowledge construction occurs in four stages, through which learners develop and confirm meaning: (1) Triggering event, (2) exploration of ideas, (3) integration of ideas, and (4) resolution of dilemma. According to this model, triggering events occur within the shared world of an online learning community, whereas the exploration, integration, and resolution of ideas may occur either privately or collaboratively. In Garrison et al.'s (2001) conception, students construct knowledge by toggling between private reflection and social reflection within the online learning community.

Gunawardena et al.'s (1997) model is more oriented toward collaborative knowledge construction within groups, while Garrison et al.'s (2001) model can be used to address both individual and collaborative knowledge construction. However, both models assume that the quality of students' knowledge construction becomes more advanced in the latter stages. This assumption also underlies studies by Scouller (1998) and Osman and Herring (2007) that claim that "deep learning" occurs when students demonstrate the ability to generate, evaluate, and apply ideas to solve problems, while their learning remains "surface" if they merely exchange information.

A number of studies of online discussion in higher education contexts have applied Gunawardena et al. (1997) or Garrison et al. (2001)'s models. Consistently, such studies have found that students' knowledge construction seldom progresses beyond the exchange of information. Several studies based on the five-phase protocol of Gunawardena et al. (1997) found that at most 6.5% of students' discussion posts were at Stage 5—Application (Kanuka & Anderson, 1998; Osman & Herring, 2007). Studies using Garrison et al.'s (2001) rubric have also concluded that the majority of students' online discussion posts involved the exploration of ideas, while at most 10% of these attained the highest level of Resolution (Garrison, 2007; Garrison et al., 2001; Kanuka et al., 2007; Meyer, 2003; Vaughan & Garrison, 2004). These somewhat discouraging findings lead naturally to the question: How can the quality of students' knowledge construction through online discussions be improved? Specifically, what can be done to facilitate student attainment of the higher levels of integration, resolution, and application?

2.2. Project-based learning and advanced levels of knowledge construction

Garrison (2007) claimed that online learning tasks that guide students to propose, explore, and synthesize solutions could positively impact the quality of students' knowledge construction. Project-based learning is a methodology that has the potential to support this proposition. Projects are non-routine activities undertaken within a specific time frame to meet defined objectives (Gray &

Larson, 2008). During project-based learning, students resolve issues or dilemmas by designing, critiquing, and evaluating concrete artefacts or products (Blumenfeld et al., 1991; Howard, 2002). This method embodies John Dewey's conception of "learning by doing" (Barron et al., 1998), as students are responsible for planning and implementing their ideas and solutions. It engages them to ask questions, search for information, brainstorm, design, and test alternative solutions (Blumenfeld et al.), which, as hypothesized by Garrison (2007), are activities that could help them better construct knowledge.

Two studies of online learning in higher education contexts suggest that project-based learning could be favourable for facilitating student knowledge construction. Aviv et al. (2003) found that close to 58% of students' discussion posts were associated with the testing of solutions related to their project work online. Thomas and McGregor (2005) found that close to 50% of student messages were associated with the exploration and implementation of ideas during the initial stages of a project; this increased to 92% by the end of the project. The results of these studies are promising, but they are in the minority; most other studies of online project-based learning have largely focused on the dynamics of online collaboration (e.g., Bernard & Lundgren-Cayrol, 2001; Lou, 2004; Paulus, 2005). Therefore, there is a need for focused investigation of how project-based learning is related to students' knowledge construction during online discussions.

3. Research question

Given the background presented above, the following research question was explored in this study:

RQ: What is the relationship, if any, between students' participation in project-based learning and their construction of knowledge at advanced levels during online discussions?

Following the definitions of Garrison et al. (2001) and Gunawardena et al. (1997), knowledge construction in this study is understood as the process whereby students undertake social exchange with their instructor or peers in order to create and apply new understandings that resolve dilemmas and/or issues they are facing. The closer the students are to resolving their issues, the more advanced their level of knowledge construction.

It is hypothesized that advanced levels of knowledge construction will characterize students' online discourse when they engage in project-based learning. The proportion of advanced knowledge construction discourse should also be larger when they engage in project-based learning as compared to non-project learning, because project-based learning, by its nature, engages students in the exploration and development of solutions to issues and dilemmas.

4. Methodology

4.1. Subjects

The subjects were the 17 students (13 females and 4 males) enrolled in an online graduate course conducted at a large Midwestern university in the USA over 12 weeks during the summer semester of 2007. The course was a graduate elective offered by the university's School of Education that taught the design of e-learning courseware using the computer applications Macromedia Flash and Dreamweaver. Instruction for this fully online course took place entirely through an asynchronous online discussion forum hosted on Google Groups. This course was purposively selected for the study, in that it comprised both project-based and non-project learning activities. Internal validity threats due to subject characteristics (Fraenkel & Wallen, 2003) could be controlled, as the same group of

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