Computers & Education 78 (2014) 312–320

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Effects of interactivity and instructional scaffolding on learning: Self-regulation in online video-based environments

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ARTICLE INFO

Article history:
Received 12 November 2013
Received in revised form
27 June 2014
Accepted 29 June 2014
Available online 5 July 2014

Keywords:
Interactive learning environments
Multimedia/hypermedia systems
Intelligent tutoring systems
Human–computer interface
Media in education

ABSTRACT

Online learning often requires learners to be self-directed and engaged. The present study examined students' self-regulatory behaviors in online video-based learning environments. Using an experimental design, this study investigated the effects of a newly designed enhanced video learning environment, which was designed to support or scaffold students' self-regulated or self-directed learning on students' learning behaviors and outcomes. In addition, correspondence between students' self-regulation strategies in traditional learning environments and observed self-regulated learning behaviors in the enhanced video environment were examined. A cross-sectional experimental research design with systematic random assignment of participants to either the control condition (common video) or the experimental condition (enhanced video) was utilized. Undergraduate and graduate students participated in the study ($N = 80$). Study results indicate that the newly designed enhanced video learning environment was a superior instructional tool than the common video learning environment in terms students' learning performance. In addition, there was correspondence between graduate students' self-reported self-regulation and observed self-regulation, with those high on seeking/learning information and managing their environment/behavior more likely to engage more in interactive note-taking.

1. Introduction

Online learning often requires learners to be self-directed and engaged in their learning, particularly because there are often fewer sources of reinforcement and prompts from instructors or peers to keep learners on task with the learning objectives. Thus, learners are likely to optimize their learning and performance in online learning environments when design and development of online learning tools are informed by research on learners' self-regulation and motivation. Self-regulated learning (SRL) involves effective use of cognitions, behaviors, and emotions to achieve learning goals (Pintrich, 2000). Self-regulated learners know how and when to use meta-cognitive strategies such as self-monitoring and self-evaluation for optimal learning and successful performance (Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1990). Although the majority of previous studies on self-regulation and learning have been conducted in traditional learning environments such as traditional classrooms, there is reason to expect that self-regulated strategies can be transferred or generalized to the online learning environment. The purpose of the present study is to test whether self-regulation strategies in traditional learning environments are associated with self-regulated learning behaviors in an online learning environment. In addition, this study examines whether student's online learning is enhanced by interactive functions that support self-regulated learning. Because video is one of the most common method to deliver instructional content in online learning environments, this study focuses on the design and

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http://dx.doi.org/10.1016/j.compedu.2014.06.018
0360-1315/

testing of an enhanced video-based learning environment embedded with functions to keep students actively engaged with macro-level activities (e.g., note-taking, supplemental resources, and practice questions) during the learning process.

2. Background and related work

2.1. Video-based learning and interactivity

Video-based distance education could be traced back, as early as the 1940s, to the introduction of television as an instructional medium. Since then, there have been numerous improvements in video technology, resolution quality, and delivery speed (Maniar, Bennett, Hand, & Allan, 2008), multimedia and communication (Wieling & Hofman, 2010; Zhang, Zhou, Briggs, & Nunamaker, 2006), and online video streaming (Hartsell & Yuen, 2006). As a result, video-based learning has advanced from passive linear broadcasting to an engaging interactive video experience for learners (Merkt, Weigand, Heier, & Schwan, 2011; Shephard, 2003).

Using interactive instructional videos has evolved based on learners' needs and new technologies. At one time, having functions to play, pause, forward, or rewind the video was considered adequate for the technology-based tool to be interactive for users. However, continuing advances in technology and theory-driven techniques afford users opportunities to exert greater choice and control over how the instructional content is presented to them (Kumar, 2010; Petty & Rosen, 1987). Embedded functions in interactive videos that are derived from self-regulation theory support learners' attention and involvement or engagement (Hannafin, 1985; Hartsell & Yuen, 2006). The present study focuses on provision of macro-level interactive tools for generative note-taking, seeking of supplemental resources, and self-evaluation through use of practice questions. These interactive tools allow users choice and self-direction in their learning. Furthermore, tools for note-taking, seeking of supplemental resources, and self-evaluation through practice questions scaffold users' metacognitive and self-regulatory strategies that target cognitive rehearsal, elaboration, and organization (Pintrich, 2002). Use of metacognitive and self-regulatory strategies are expected to enhance processing, recall, and learning of information. Studies show that self-directed generative note-taking, use of supplemental resources, and use of practice questions allow learners to reorganize and connect their ideas for deep learning (Cennamo, Ross, & Rogers, 2002; Kauffman, 2004; Ponce & Mayer, 2014). In addition to enhancing cognitive learning strategies, these interactive tools are expected to enhance motivational beliefs in self-regulated learning. Specifically, use of note-taking, supplemental resources, and practice questions afford learners opportunities for preparation and rehearsal that may be needed in order to experience success and mastery or self-efficacy (Kauffman, 2004; Pintrich, 2000). In contrast, poorly designed technology-based tools that neglect learners' self-regulation and motivational needs do not afford opportunities for users to be self-directed in their learning. For instance, videos with functions to play, pause, and forward or rewind may be interactive but limit self-directed learning by restricting users from directly accessing (or jumping to) particular parts of the video (Zhang et al., 2006). Hence, embedded functions such as note taking can scaffold video-based instruction process. Moreover, practice questions support students' self-regulation while watching instructional videos. It should be noted that simply providing learners interactive functions such as the option to jump to any given segment at any time does not guarantee that learners will know how to use the functions or have better learning performance (Merkt et al., 2011), because users may need training on how to use and benefit from the respective features (Merkt & Schwan, 2014).

2.2. Instructional scaffolding and self-regulated learning

According to Vygotsky (1978), learners improve when they are assisted by more advanced or knowledgeable sources of instruction (e. g., teachers or peers). Vygotsky's (1978) concept of *zone of proximal development* refers to “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). This external guidance or support could be in various forms including prompts, clues, modeling, explanation, and encouragement (Miller, 2002). *Instructional scaffolding* is a term used to explain the relationship and interaction between learners and their guides, and is a process that enables a novice to achieve a goal or objective, which would otherwise be unattainable without assistance (Wood, Bruner, & Ross, 1976). Instructional scaffolding is not one-way, but interactive and reciprocal process between the learner and the source of instruction (Bull et al., 1999). During this process, the learner is not passively receiving assistance but actively engaged in the learning process to benefit from the scaffolding in order to attain a higher level of achievement (Rogoff, 1990).

In the context of online learning environments, Vyotsky's concept of zone of proximal development and instructional scaffolding can be applied to support and optimize students' learning and achievement. Computer tools have been effectively used as scaffolds for learners (Yelland & Masters, 2007) and as tools to support the process of scaffolding (Bull et al., 1999). Examples of instructional scaffolds include web links or hyperlinks to additional resources, visual cueing, and adaptive release of instructional material. However, there are unique differences between instructional scaffolding in the traditional and online learning environments. Because learners do not have teachers or peers physically present in the online learning environment to serve as reinforcement or to offer assistance, online environments may need embedded functions to scaffold learners' self-regulation skills so they could remain engaged without the physical presence of teachers or peers. For example, Hadwin and Winne (2001) suggested the use of electronic notebook to scaffold students by using several embedded functions (e.g., glossary and note-taking) that support self-regulation in reading.

Although self-regulation is critical for online learning success, limited research exists on instructional scaffolding and self-regulated learning in online learning environments because it is an emerging area of research. A growing body of research shows that students have problems regulating their learning and fail to achieve conceptual or deep understanding in computer-based learning of complex topics when instructional scaffolds are not in place (see Azevedo & Hadwin, 2005). Importantly, different types of interactive tools may have different effects or impacts on learners and learning outcomes. In an experimental study, Zhang et al. (2006) found that students in the interactive video-based learning environment enjoyed their learning more and performed better than students in non-interactive environments. In another study, Merkt et al. (2011) found that secondary school students learned just as much information from interactive videos (embedded with functions to support self-regulated learning) compared to traditional textbooks. With adult learners, Sariscsany and Pettigrew (1997) found that pre-service teachers who were trained in an interactive video environment recalled more information than