Computers & Education 70 (2014) 128–137

Contents lists available at ScienceDirect

Computers & Education

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

Setting the stage for the metacognition during hypermedia learning: What motivation constructs matter?

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ARTICLE INFO

Article history:
Received 6 June 2013
Received in revised form
14 August 2013
Accepted 16 August 2013

Keywords:
Hypermedia
Self-regulated learning
Metacognition
Motivation
Think-aloud

ABSTRACT

Think-aloud and self-report data from 85 undergraduates were used to examine the relationship between motivation constructs and metacognition during hypermedia learning. Participants used hypermedia for 30 min to learn about the circulatory system. Think-aloud data were collected during this 30-min learning task to determine the extent to which participants used metacognitive processes related to monitoring: their understanding, the environment, and goals. Additionally, participants completed a self-report questionnaire, which measured various motivation constructs. Results from stepwise regressions indicated that self-efficacy significantly predicted the extent to which participants monitored emerging understanding and relevancy of content in the environment. Additionally, results indicated that extrinsic motivation significantly predicted the extent to which participants monitored their learning task goals with hypermedia. Lastly, results indicated a significant, positive relationship between self-efficacy and prior domain knowledge.

1. Introduction

Imagine a student who is provided with a multimedia rich, nonlinear technology environment and asked to learn about a complex topic such as the circulatory system. This environment offers the opportunity to use a number of learning tools, such as text and corresponding detailed images of the heart, as well as interactive videos explaining the path of blood through the circulatory system. Furthermore, the student can choose an instructional path that best meets his or her learning needs. The student may choose to engage the environment in a linear fashion, using the multimedia tools in a sequential order. Conversely, the student may choose to move between nodes of information and multimedia tools based on his or her evolving knowledge state of the circulatory system. Capitalizing on the affordances offered by this technology requires a student to engage in self-regulated learning. The student needs to be an active participant in his or her own learning. For example, technology environments that include multimedia necessitate the use strategies, such as coordinating multiple informational sources found in the environment. The student should also assess the extent to which the strategies are effectively facilitating progress towards the desired learning goal. Furthermore, regularly monitoring emerging understanding and relevancy of content promote adaptive adjustment in both the choice of learning strategies and the identification of optimal content. While these self-regulatory processes are critical in facilitating learning within multimedia rich, nonlinear technology environments, students of all developmental groups may not use them. Why is it that some students monitor their emerging understanding and relevancy of content, while others use these processes less frequently, if at all, with technology? In order to address this question, this study examined the extent to which various theoretically-grounded constructs of motivation predicted self-regulated learning and, in particular, metacognitive processes with hypermedia.

1.1. Metacognition within self-regulated learning

Views of the learning have evolved over the years, as evidenced by the movement to view learning as proactive and strategic as opposed to passive (Winne, 2005). To explain this proactive, strategic orientation, researchers have turned towards theoretical frameworks that are

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http://dx.doi.org/10.1016/j.compedu.2013.08.014

robust enough to capture motivational, cognitive, and metacognitive variables. The Self-Regulated Learning (SRL) theory offers such a framework, with assumptions that learning involves actively constructing knowledge through strategies and goals, motivation can be monitored and modified, and contextual factors mediate the ability to regulate aspects of learning (Pintrich, 2000; Schunk & Zimmerman, 2013; Zimmerman, 2006, 2008; Zimmerman & Schunk, 2001). The emergence of SRL as a theoretical lens to explain the process of learning has led to the development of various theoretical perspectives. While these different perspectives share some core assumptions about self-regulation, they also differ in some key theoretical points and these differences have resulted in theories that have been more prevalent within specific areas of research. The Information-Processing approach to SRL (see Winne & Hadwin, 1998), for example, has guided a significant body of research in the field of hypermedia learning. This conceptualization of SRL identifies four phases: (1) Understanding the task; (2) goal-setting and planning how to reach the goal(s); (3) enacting strategies; and (4) metacognitively adapting studying (Winne, 2001). In the first phase, the student constructs a perception of the task, which is derived from information retrieved from both long-term memory and specific task conditions. The student develops sub-goals and plans how to meet these sub-goals in the second phase, and then enacts strategies to meet these sub-goals in phase three. Lastly, phase four includes metacognitive monitoring activities and cognitive evaluations about discrepancies between goal(s) and current domain knowledge (Winne, 2001; Winne & Hadwin, 1998). As such, this theory emphasizes the role of metacognitive monitoring within the four phases of self-regulation.

The concept of metacognition emerged in the 1970s, highlighted by Flavell's theoretical perspective (Flavell, 1979). Originally conceptualized as "thinking about thinking" (see Miller, Kessel, & Flavell, 1970, p. 613), it has been further refined to include both the conscious awareness and regulation of one's own learning. Metacognition is a construct that focuses on processes related to the abstraction of existing or new cognitive structures (Dinsmore, Alexander, & Loughlin, 2008). For example, a student checking for understanding and regulating his or her learning based on this feedback loop would be engaged in metacognition. Within the context of Winne and Hadwin's IPT perspective of SRL, metacognitive monitoring is a process that results in the identification of discrepancies between satisfactory goals and the current profile of work on a task (Butler & Winne, 1995; Winne, 2001). This internally generated feedback provides the framework from which students adapt their self-regulated learning. Metacognition provides the foundation for effective regulation and allows students to regulate and govern task execution. These metacognitive processes affect use of cognitive activities, which support the acquisition and retention of knowledge (Ku & Ho, 2010).

1.2. Self-regulation and metacognition within hypermedia learning

The importance of metacognition has been theoretically articulated (Van der Stel & Veenman, 2010; Veenman, 2008, 2011) and has received considerable empirical attention, particularly in the field of reading comprehension. In order for students to maximize their comprehension of written text, they need to think about what they already know, monitor their emerging understanding, apply reading strategies, and then evaluate the effectiveness of these strategies (Baker, Gersten, & Scanlon, 2002; Pressley, Wharton-McDonald, & Allington, 2001; Zhang, 2008). Research has routinely demonstrated that differences between skilled and unskilled readers can be explained by metacognition; while skilled readers demonstrate an ability to accurately identify gaps in comprehension and strategies to improve comprehension, unskilled readers tend to comprehend text literally and have difficulty monitoring their comprehension and appropriately using strategies (Snow, Burns, & Griffin, 1998). A critical component to reading comprehension is the conscious awareness and regulation of one's own learning, otherwise termed metacognition.

Emerging technologies, such as hypermedia, offer new learning contexts to examine reading comprehension and metacognition. While the necessary components of comprehension still exist in this environment (i.e. the need to use comprehension monitoring and repair strategies when comprehension breaks down), the inherent nature of the environment magnifies the importance of metacognition in learning (Azevedo, 2009; Azevedo & Witherspoon, 2009; Greene & Azevedo, 2009; Moos & Azevedo, 2008). Hypermedia offers multiple representations that are hyperlinked, thus allowing the student to control the sequencing of information. This autonomy, coupled with access to multiple representations of information, magnifies the effect of metacognition on learning outcomes (Feyzi-Behnagh et al., 2013; Moos, 2011, 2013). Students generally demonstrate higher learning outcomes with these technology environments if they monitor their emerging understanding and progress towards the learning goal(s), as well as the relevancy of information in the inter-linked nodes of multiple representations (Azevedo, 2008, 2009; Graesser, McNamara, & VanLehn, 2005; Moos, 2011; Schraw, 2007; Winne & Nesbit, 2009; Zimmerman, 2008). While research provides ample empirical evidence demonstrating the impact of metacognition on learning within hypermedia, it has also revealed significant individual differences. Why is it that some students regularly monitor emerging understanding, while others rarely, if at all, engage in metacognitive processes? The field of academic motivation provides a theoretical framework to explain these individual differences.

1.3. Motivation and metacognition

The field of academic motivation, which is grounded in a rich history of robust theoretical and empirical work, has typically defined motivation as physiological processes involved in the direction, vigor, and persistence of behavior (Eccles & Wigfield, 2002). This operational definition is a broad umbrella for different intellectual traditions (Weinert, 1992), which have given rise to various motivation theories. In turn, these theories have identified a number of conceptually distinct motivation constructs that focus on beliefs, values, and goals (see Murphy & Alexander, 2000 for a review). The distinctness of motivation constructs is evident within the predominant theories of self-regulated learning, all of which account for motivation constructs and their role in active participation in learning. The Information Processing approach, for example, assumes that SRL is composed of four phases: (1) understanding the task, (2) goal-setting and planning how to reach the goal(s), (3) enacting strategies, and (4) metacognitively adapting studying (Winne & Hadwin, 1998). In the first phase, the student constructs a perception of the task from two sources: *Cognitive conditions* and *Task Conditions*. *Task conditions* provide information about the task, and include such conditions as experimenter-set learning goals. *Cognitive conditions*, on the other hand, provide information that the student retrieves from long-term memory. This information includes beliefs, dispositions, and other motivational orientation such as attributions that describe ability. This information, once in working memory, leads to the construction of the student's idiosyncratic definition of the task, which ultimately sets the stage for