Personalized E-learning system with self-regulated learning assisted mechanisms for promoting learning performance

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ABSTRACT

With the rapid development of Internet technologies, the conventional computer-assisted learning (CAL) is gradually moving toward to web-based learning. Additionally, instructors typically base their teaching methods to simultaneously interact with all learners in a class based on their professional disciplines in the traditional classroom learning. However, the requirements of individual learners are frequently ignored in the traditional classroom learning. Compared to the conventional classroom learning, individual learners are the focus in web-based learning environments and many web-based learning systems provide personalized learning mechanisms for individual learners. One key problem is that learners have to frequently interact with web-based learning systems even though they lack instructors to monitor their learning attitudes and behavior during learning processes. Hence, a learner's ability to self-regulated learning is clearly an important factor affecting learning performance in a web-based learning environment. Self-regulated learning is a goal-oriented learning strategy that is very suited to self-managed learning to promote learning performance of individual learners in a web-based learning environment. However, how to assist learners in cultivating self-regulated learning abilities efficiently is an important research issue in the self-regulated learning field. This study presents a novel personalized e-learning system with self-regulated learning assisted mechanisms that help learners enhance their self-regulated learning abilities. The proposed self-regulated learning mechanisms assist learners in becoming lifelong learners who have autonomous self-regulated learning abilities. Additionally, four self-regulated learning types, based on a self-regulated learning competence index and self-regulated learning performance index, are also proposed. Experimental results demonstrate that the proposed self-regulated learning assisted mechanisms aid learners by speeding up their acquisition of self-regulated learning abilities in a personalized e-learning system, and help their learning performance.

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1. Introduction

In recent years, learning modes have experienced a revolution due to the rapid growth of Internet technologies. In conventional classroom learning, learners typically play a passive role as teachers are used to conveying knowledge and experiences to learners. Since learners rely highly on teacher instruction to acquire knowledge during learning processes, most learners could lose lifelong learning abilities due to their lack of autonomous learning and self-reflection abilities (Shih, Chang, Chen, & Wang, 2005). In modern education, learners have a primary role in learning; teachers teach knowledge and convey experiences to learners, and direct learners to construct knowledge based on learner self-analysis, self-examination, and autonomous exploration abilities. Notably, the Internet can overcome the limitations of time and space to establish a convenient learning environment; that is, learners use

a web-based learning environment to acquire knowledge at any time and any place via the Internet. Undoubtedly, web-based learning environments, which satisfy the requirement that learners are a central role in learning, are becoming increasingly popular. The most urgent issue in web-based learning is to identify the abilities learners should cultivate. Many studies have identified a significant positive correlation between academic achievement and self-regulated learning ability among students at different stages of academic development (Dabbagh & Kitsantas, 2005; Kumar et al., 2005; Narciss, Proske, & Koerndle, 2007; Schunk & Zimmerman, 1994). Many studies have indicated that students with poor self-regulating ability are not as academically successful as those with good abilities (Zimmerman & Schunk, 1989). In other words, good learners typically have good self-regulating learning abilities. Therefore, the most important task for instructional designers and teachers is to develop effective strategies that encourage and guide learners in actively processing learning actions. Particularly, learners must frequently encounter web-based learning systems alone, without a teacher to oversee their learning

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attitudes and behavior; consequently, the self-regulated learning ability of individual learners is an important factor affecting learning performance in web-based learning environments. This study focused primarily on developing self-regulated learning assisted mechanisms for web-based learning systems that assist learners in monitoring their own self-learning situations and direct their learning motivation toward to good self-regulated learning abilities, thereby enhancing the learning performance of individual learners.

Currently, self-regulated learning (SRL) has received considerable interest in the education and psychology fields. The SRL model developed by Zimmerman mainly examined learning characteristics in active learning from the perspectives of meta-cognition, motivation, and behavior (Zimmerman, Bonner, & Kovach, 1996; Zimmerman & Schunk, 2001). Self-regulated learning was defined by Zimmerman as the degree to which learners are metacognitively, motivationally and behaviorally active participants in their own learning (Zimmerman, 1986a,1986b). That is, self-regulated learning refers to a learning situation in which learners set their learning goals, plan, and then regulate and evaluate the learning process independently (Narciss et al., 2007). The goal of SRL for learners is to learn to be their own teachers (Schunk & Zimmerman, 1998; Torrano & González, 2004). That is, good achievement via SRL requires a strong will to learn and excellent learning skills (Torrano & González, 2004).

Recently, many studies have developed web-based learning systems with SRL mechanisms that promote learning effectiveness. For example, Shih et al. (2005) proposed a SRL system with a scaffold support that assists learners in developing a learning schedule and process management of learners, to promote learning performance for self-regulated m/e-learning. Joo, Bong, and Choi (2000) employed a self-efficacy scale in a motivated strategies for learning questionnaire (MSLQ) to investigate self-efficacy for SRL, academic self-efficacy, and Internet self-efficacy. Their survey results indicated that student self-efficacy for SRL positively correlated with academic self-efficacy, strategy use, and Internet self-efficacy. Moreover, Chang (2005) investigated the effect of SRL strategies on learner perceptions of motivation for web-based instruction. The self-regulated learning strategies were intended to assist students to self-observe and self-evaluate learning effectiveness. The research results obtained by Chang revealed that student learning within a web-based environment with self-regulated learning strategies was responsible for student learning. Additionally, Niemi, Nevgi, and Virtanen (2003) focused on guiding students to cultivate self-reflection and self-evaluation using the IQ Learn tool, thereby helping students develop self-regulatory skills in web-based learning environments.

Based on surveys mentioned-above, this study develops effective SRL-assisted mechanisms for a personalized e-learning system (PELS) to enhance learner self-regulated learning abilities and learning performance. In the proposed SRL strategies, four SRL competence indexes are proposed to assess SRL behavior of individual learners. Two learning performance indexes are proposed to assess the learning performance of individual learners in the PELS assisted by the SRL-assistive mechanisms. Additionally, we believe that a heteronomy mechanism comes from teacher assistance can transform learners with poor SRL abilities into autonomous self-regulated learners in a web-based learning environment. In summary, this study presents SRL-assisted mechanisms in the PELS that can cultivate learners' self-regulated learning abilities using the proposed SRL assessment mechanism with immediate feedback response to learners and a heteronomy mechanism comes from teacher's reminding. Experimental results indicated that the proposed self-regulated learning mechanisms change passive learners with poor SRL abilities into active learners with spontaneous learning abilities, thereby improving learning achievement in a web-based learning environment.

2. Self-regulated learning

This section first discusses the SRL theory developed by Zimmerman's and used in this study, and then the proposed SRL model is presented.

2.1. Zimmerman's self-regulated learning theory

Zimmerman et al. (1996) referred various aspects of SRL in different studies when developing their SRL model. Their model contains the following four interrelated learning processes: self-evaluation and monitoring; goal setting and strategic planning; strategy implementation and monitoring; and, strategy outcome monitoring (Zimmerman et al., 1996). Fig. 1 shows the cyclic mode of SRL.

(1) *Self-evaluation and monitoring:* learners assess their learning performance based on self-observations of learning achievement.
(2) *Goal setting and strategic planning:* learners set learning goals by analyzing their learning missions, and then generate appropriate learning strategies to set learning goals.
(3) *Strategy implementation and monitoring:* learners execute planning learning strategies and monitor the effectiveness of learning strategies via self-monitoring.
(4) *Strategy outcome monitoring:* learners assess learning effects of learning strategies by observing the relationship between learning achievement and learning strategies.

The SRL model efficiently helps learners to self-examine and self-evaluate their learning performance by monitoring learning goals set by the individual learners during learning processes. Once learners set their goals, they must be able to revise their learning strategies to achieve these goals. Furthermore, the meta-cognition of learners can also be enhanced by self-evaluation and monitoring. Importantly, learners can adjust their learning strategies and improve their learning behavior through self-examination, thus promoting learning performance.

2.2. The proposed self-regulated learning model

Teachers are traditionally in charge of learning outcomes, but many studies indicated that SRL ability of individual learner significantly affects his/her learning performance (Dabbagh & Kitsantas, 2005; Kumar et al., 2005; Narciss et al., 2007; Schunk & Zimmerman, 1994; Zimmerman & Schunk, 1989). Most learners are used to passive learning. Frequently, passive learners have low spontaneous learning abilities and do not know how to plan for autonomous learning; consequently, they cannot obtain satisfactory learning
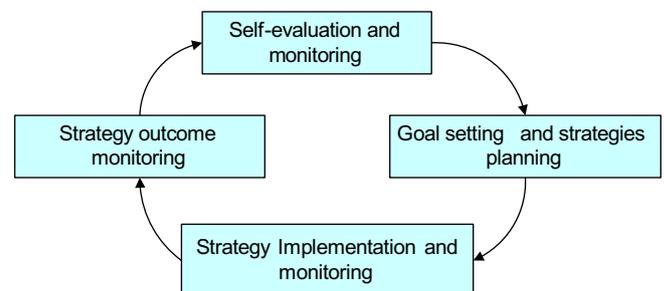

Fig. 1. The cyclic model of self-regulated learning proposed by Zimmerman.