

# Chapter 26

## Ontology-Based Adaptive Dynamic E-Learning Map Planning Method for Conceptual Knowledge Learning

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### ABSTRACT

*E-learning improves the shareability and reusability of knowledge, and surpasses the constraints of time and space to achieve remote asynchronous learning. Since the depth of learning content often varies, it is thus often difficult to adjust materials based on the individual levels of learners. Therefore, this study develops an ontology-based adaptive dynamic knowledge concept e-learning mechanism that generates learning maps based on learner characteristics and guides learners effectively. To achieve this goal, this study proposes an adaptive dynamic concept e-learning navigation procedure, designs learning models based on the adaptive learning needs of learners, and develops knowledge map model and learning map model. Finally, this study designs adaptive dynamic concept learning map-planning algorithms based on the particle swarm optimization (PSO) algorithm. The learning maps generated by these algorithms meet the dynamic needs of learners by continually adjusting and modifying the learning map throughout the learning process. Adapting the adaptive learning content according to the dynamic needs of learners allows learners to receive more instruction in a limited period.*

### 1. INTRODUCTION

E-learning, which integrates network and information technologies, surpasses the traditional constraints of time and space, and allows remote asynchronous learning (Urdan & Weggen, 2000). The digitalization of teaching content can enhance the reusability and shareability of materials, increase the variety of teaching materials and models available, and provide learners with greater flexibility in the learning

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process (Urdan & Weggen, 2000; Rosenberg, 2001). However, to maintain focus on the learning process and not on technological applications, e-learning must integrate learning theories into developing adaptive learning models and dynamic course content.

The knowledge construction process, which proceeds from ignorance to mastery, progresses from the learning of individual concepts and an understanding of the relationships between different concepts to more in-depth or advanced knowledge (Kwon & Cifuentes, 2007). Ausubel (1998) mentioned that knowledge concepts have a hierarchical structure, and thus advocated the systematic learning of general and all-encompassing concepts before probing into details. Effective learning can only be achieved when the educator is experienced and instruction is tailored to the level of the students.

While current e-learning platforms provide in-depth teaching content, they generally overlook conceptual knowledge. This leads to learning problems related to the lack of conceptual knowledge. Additionally, e-learning platforms provide the same type of instruction to all learners, leading to poor learning outcomes (Tseng *et al.*, 2008). Knowledge consists of abstract concepts that are difficult to describe or define clearly, and different knowledge areas include vast amounts of conceptual knowledge. Failing to explain the connections between conceptual knowledge will likely disorient learners. Modern education emphasizes adaptive learning, which provides each learner with the opportunity to receive adaptive education (Wong & Looi, 2009). However, most e-learning systems and intelligent computer aided learning systems lack individual support capabilities. Therefore, it is imperative to investigate learner demands and characteristics to provide learners with dynamic and adaptive learning content (Wong & Looi, 2009).

Few existing e-learning platforms address the issue of adult learning (Rosmalen *et al.*, 2006). This study aims to improve the efficiency of e-learning outcomes in adults by employing adaptive strategies and proposing an adaptive dynamic concept e-learning navigation procedure. This study designs a learning model based on the adaptive learning needs of learners, and develops knowledge and learning map models based on the analysis of knowledge types. To meet the dynamic needs of learners, these algorithm-generated learning maps are reevaluated and modified throughout the learning process. This study designs adaptive dynamic concept learning map-planning algorithms based on particle swarm optimization (PSO). Finally, this study develops an adaptive dynamic concept e-learning mechanism that can be applied to the customized instruction provided by special education teachers when teaching mathematics. This development may help special education teachers improve the efficiency of mathematical conceptual knowledge instruction and reduce the problems of learner cognitive overload and learning disorientation.

## **2. LITERATURE REVIEW**

E-learning involves the transmission of teaching content through the Internet, and is therefore unrestricted by the constraints of time or space (Liaw *et al.*, 2007; Wong & Looi, 2009). Concepts of knowledge are the core elements that comprise knowledge, and serve as the basis for how human beings understand the world around them. In general, the acquisition of domain knowledge begins with its core concepts; knowledge concept networks are formed through the analysis, extension, classification, and association of these core concepts. Therefore, a comprehensive e-learning system must include a multimedia resource repository, bookmarking functions, and a navigation model (Britain & Liber, 1999).

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