ABSTRACT

With a rapid development of Internet, E-Learning is becoming a new learning mode. E-Learning is not limited by time and space. It also has a large number of on-line learning resource. However, it has many disadvantages for students, such as information overload, disorientation, low learning efficiency, low user satisfaction and so on. Our aim is to improve learning efficiency and user satisfaction by overcoming information overload and disorientation of E-Learning system. This paper proposes an algorithm by combining Spreading-Activation Theory and techniques of classifying and sorting knowledge. The algorithm can generate a near optimal navigation learning path (NLP) based on a student’s target knowledge unit (TKU) and knowledge map (KM) which it belongs to. NLP provides students an appropriate learning instruction to effectively eliminate disorientation during the process when they are learning interested knowledge units. The essential tasks of the algorithm is to filter redundant information and sort candidate knowledge units. So its realization process can be divided into three phrases: first, generating candidate complement map to overcome information overload. Because the candidate complement map only contains essential candidate knowledge units and learning dependencies among them to master TKU. Second, constructing learning features to discrete the candidate complement map to implement techniques of sorting knowledge conveniently. Final, sorting candidate knowledge units to get an appropriate NLP by using a Secondary Sort Strategy (SSS). The experimental results have shown that our method is sound for improving learning efficiency and users’ satisfaction.

Keywords: E-learning, Knowledge Map, Navigation Learning Path, Secondary Sort Strategy, Sorting Knowledge
1. INTRODUCTION

Recent years, E-Learning is widely used in the world as a new learning mode (Jaques, & Vicari, 2007) and plays an important role in many fields. It also brings large economic benefits to the whole society. For example, Stanford open curriculum and distance education are all its successful cases. E-Learning has mainly brought two changes compared to the traditional learning mode. First, it can effectively overcome the limitation of information storage and transmission. Information in traditional learning mode is mainly stored on paper, whose transmission is not as convenient as that of E-Learning. However, E-Learning mode provides information enough space to store and a convenient way to spread through Internet, so more and more information and learning resource emerge on the Internet (Trentin, 1997; Katz, 2000). Second, learning process has been changed from the mode that learning is dominated by teachers to the mode that by students. Traditional teaching is based on the mode that teachers decide which to learn. However, E-Learning is based on the mode that students learn freely. The above two changes bring students convenience as well as confusion. Given the first change, plenty of learning contents will lead students overloading. The second change also brings students bad effects. As lack of experience and teachers’ guidance, students may don’t know how to study a TKU with high efficiency. This may lead students misleading (Mobrand, & Spyridakis, 2007).

For the overloading problem, many scholars have provided mature solutions, such as various kinds of good Learning Recommendation Algorithms (Resnick, Iacovou, & Suchak, 1994; Francesco, Bracha, & Paul, 2010; Adomavicius, & Tuzhilin, 2005). This paper focuses on the second point, aimed at solving the problem of inefficient learning caused by misleading in E-Learning.

Many empirical evidences have proved that a proper learning path can guide students to master his/her TKU efficiently. Most recently, there are some methods which have been proposed to navigate learning. For example, Chu, Lee and Tsai (2011) proposed a method that regards the shortest path on the knowledge map as the learning navigation path (Chu, Lee, & Tsai, 2011). This method is easy to implement, but it can’t guarantee students master TKU because the shortest learning path leaves out many necessary knowledge units that a student must master before he learns TKU. Lee and Leu (2008) established adaptive scaffolding learning path to help students master TKU (Lee, Lee, & Leu, 2008). They mined many outstanding students’ learning log and found the frequent sequence from their log as the navigation learning path for others. But the lack of outstanding students’ log limits this method and it also leaves out the different abilities of different students. Chen and Duh (2008) proposed a learning path by using Item Response Theory (Chen, & Duh, 2008). They combine the difficulty of learning resource and students’ abilities which are measured by Item Response Theory. This method needs a lot of feedback from students. Students have to give feedback after finishing learning one knowledge unit, which brings students much inconvenience. Moreover, the designed questions are not good enough to reflect the real learning state of students, and the resource are also not well organized so that they lose their learning dependent relations among them. A navigation learning path disobeying learning dependent relations can’t be well understood.

Knowledge map is a semantic network which is composed of all knowledge units in a given domain and learning dependencies among them (Zheng, Qian, & Liu, 2010). Figure 1 and Figure 2 respectively show a knowledge map of “Geometry” and it’s a partial enlarged view, in which, “Theorem of acute angle sum of right triangle”, “definition of acute angle”, “definition of co-angle”, “Definition of right triangle” and “Makes triangle theorem” are all examples of knowledge unit, and directed edges between any two knowledge units are all examples of learning dependency. In this paper, we employ knowledge map as a tool to describe domain theory and propose a method of generating Navigation Learning Path (NLP)
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