Discovery of Learning Path Based on Bayesian Network Association Rule Algorithm

Huajie Shen, Taiyuan University of Technology, Taiyuan, China

Teng Liu, Taiyuan University of Technology, Taiyuan, China

Yueqin Zhang, Taiyuan University of Technology, Taiyuan, China

ABSTRACT

This study aims to create learning path navigation for target learners by discovering the correlation among micro-learning units. In this study, the learning path is defined as a sequence of learning units used to realize a learning goal, and a period used for realizing the learning goal is regarded as a learning cycle. Furthermore, the learning unit datasets are extracted according to the learning cycle. In order to discover the correlations of learning units, we proposed an algorithm named Bayesian Network Association Rule (BNAR), which is used to establish a dynamic learning path according to the learning history of reference learners group who achieved learning goals. Based on the successful learning history, the dynamic learning path navigation will help target learners to improve learning efficiency.

INTRODUCTION

With the development of society, we have entered a time of lifelong learning. The constant renewal of human cognition requires us to improve ourselves through continuous learning. On the other hand, our times is labeled as fragmented age, a lot of fragmented information floods our internet, and our schedule is divided into a large number of fragmented time by multitask. This makes it difficult to find a complete time to complete the learning. The micro-learning was born in the background. As a new online learning mode, micro-learning was firstly proposed in 2005 (Hug, Lindner, & Bruck, 2005). Compared with other online learning mode, the distinct feature of micro-learning is "micro", which focuses on the learning unit consisted of a short text (less than 140-character), a picture, or a media (played in 1 to 5 minutes) (Chen et al., 2015), and learners can learn it in a fragmented time.

Micro-learning-based contents consist of many tiny learning components, such as e-mail, news, text messages, micro-blog, etc. which are scattered throughout every corner of life, and no longer confined to traditional education based on textbooks, lectures, and classrooms. Learning is a gradual

process, which is from simplicity to difficulty. However, the learning units of traditional education are so big that learners cannot learn in a short period. Furthermore, it is difficult to flexibly organize individualized learning path for learners. Because of the mentioned reasons, how to extract a suitable individual learning path for learners which becomes a focus of research. The mode of micro-learning is a key solution for the problem, in which, the micro-learning units can help us to create learning path flexibly. According to domain knowledge and learning history of learners, we can find close "invisible association" among micro-learning units. In this study, we propose the Bayesian Network Association Rules Algorithm to extract the correlation among micro-learning units.

In order to support the personalized learning, we propose an approach to extract the individualized learning path based on the correlation mined form the micro-learning units. In the study, learners are divided into reference groups and verification groups. The reference group learners' log data sets are used to extract the correlation of micro-learning units, and then to create a personalized micro-learning unit path. The verification group is used to verify the accuracy and effectiveness of the micro-learning unit path obtained from the reference group.

The workflow of this study is described as follows. At the first step, log data sets of the reference group and the verification group is collected, and the data sets of the reference group are divided into different data sets according to the definition of the learning cycle. At the second step, based on the data set divided by the learning cycle, the probability of the first micro-learning unit in the data set is calculated, and the learning unit with the highest probability is regarded as the first one in the micro-learning process. At the third step, based on the first micro-learning unit, the posterior probability of the next micro-learning units occurring after the first micro-learning unit is calculated. The micro-learning unit with the highest probability is regarded as the next micro-learning unit. Similarly, the third step is repeated, and the micro-learning path is extracted until the analyzed learning process is finished. In addition, the extracted micro-learning unit path is verified with the verification group. In this study, a learning management system (LMS) is established based on Moodle, which is used to collect the learning history and profiles of learners (such as age, gender, professional background, cognitive level, etc.). The proposed approach will provide learners the micro-learning path navigation that is extracted from optimized learning experience. The micro-learning path consists of a sequence of micro-learning units, and the sequence is calculated by the algorithm of BNAR. By sharing the successful learning experience, the proposed approach will help target learners to improv their learning efficiency.

RELATED WORKS

1. Micro-learning

With the development of "Internet + education", micro-learning has attracted attention from more and more researchers. The current research of micro-learning mainly presents the trend of "theoretical exploration is one step ahead, and application research is follow up". The theoretical research of micro-learning has gradually transitioned from definition and feature description stage to theory design and framework development. The practical application of micro-learning is enriched in multiple levels and fields of education. The accumulation and sharing of application cases are the current hotspots. In the field of theoretical research, Norm (Friesen, 2001) proposed a theory of micro-teaching. Gugerbauer (Gugerbauer, 2006) proposed a construction of micro-learning environment and a content framework of mobile learning. Rodriguez et al. (Rodríguez, Lundqvist, Williams, & Baker, 2006) studied the construction of micro-learning virtual community, micro-learning structure based on semantic service and micro-content target classification based on ontology. In application research field, Eva et al. (Unterrainer & Welte, 2008) proposed a micro-learning system based on Topic Maps technology. Walder et al. (Walder & Wolfgang, 2008) studied the design and development of mobile

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