

A FUZZY LEARNERS' KNOWLEDGE MODELLING SYSTEM FOR ONLINE LEARNING

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Highlights: Many past studies report on personalising learning via intelligent systems but only a handful report on assisting instructors in personalising learning by leveraging technology. Instructors are knowledgeable in teaching and learning but they seldom put much effort to personalise learning due to the complexity of this approach. This study presents a fuzzy learners' knowledge modelling system that addresses three issues related to the complexity of personalising learning. This study also demonstrates how this system can be applied in a real-world scenario. The case study shows that based on learners' performance in online assessments, this system is able to assist instructors to personalise learning by planning for appropriate interventions through the insights derived from the system.

Keywords: personalised learning, assessments, fuzzy logic, fuzzy inference system, learners' knowledge modelling system, performance reporting

Introduction

In the field of education, the emergence of technologies raises opportunities and challenges in personalising learning. However, due to the complexities of personalising learning, instructors who are knowledgeable in teaching and learning shy away from personalising learning (Curtin University, 2016). This study presents a fuzzy learners' knowledge modelling system that is able to minimise the complexity of personalising learning via technology leverage, in order to encourage and assist instructors in personalising learning. To fulfil this objective, design and development of the proposed system revolves around three issues related to personalise learning.

First issue is about how the proposed system is able to integrate with the present curriculum. According to NMC 2016 Horizon Report (Johnson et al., 2016), the use of technologies in personalising learning without such consideration can lead to increased needs of training sessions to ensure instructors can effectively personalise learning via technological assistance. Thus, the proposed system is designed to be able to decompose the instructors' knowledge based on the present curriculum. In addition, the proposed system is designed to record learners' knowledge as a subset of the instructor's knowledge. Via such design, the proposed system is able to report the learners' knowledge level of the present curriculum.

Second issue is about how to determine learners' knowledge that is lexically imprecise. Instructors tend to determine learners' knowledge based on their assessment results. However, determining what the learners had learned is not as direct as measuring the number of correct answers that the learners performed in the assessments (Jeremić, Jovanović, & Gašević, 2012). The reasoning of the learners' knowledge can also be influenced by imprecise factors. For example, DEPTHs (Jeremić et al., 2012) involves the difficulty of answering the assessment questions as a factor in knowledge reasoning. Hence, a fuzzy inference system is embedded into the proposed system to provide reasoning of learners' knowledge. This is because fuzzy inference system can mathematically deal with uncertainties (Asopa, Asopa, Joshi, & Mathur, 2016). This fuzzy inference system is designed to be able to capture learners' knowledge based on their assessment results and other imprecise factors, such as the difficulty level of answering the assessment questions that might influence the knowledge reasoning.

Third issue is about how to examine each and every learner's knowledge, especially in a large class. This is due to the need to understand each individual learner's knowledge for planning appropriate interventions to personalise their learning (Volarić, Vasić, & Brajković, 2017). However, such a process is difficult and burdening to the instructors without technological assistance, particularly with a huge group of learners. Learning analytics is gaining its prominence in supporting the feasibility of personalising learning among a huge group of learners (Johnson et al., 2016; Ruipérez-Valiente, Muñoz-Merino, Leony, & Delgado Kloos, 2015; Spector, 2018). Learning analytics is an emerging technology for capturing, analysing, and reporting any data about the learners and the learning environment (Adams Becker et al., 2017; Suthers & Verbert, 2013). Hence, the learning analytics approach is utilised in the proposed system, so that it is able to report the knowledge of a group of learners as well as an individual learner.

Methods

In order to demonstrate the applicability of the proposed system, a real-world case study was conducted in cooperation with an undergraduate instructor. During the semester where this case study was conducted, the instructor conducted weekly lectures. After several lectures, the instructors tested the learners' knowledge via online assessments. A benefit of conducting online assessments is that learners' assessment results are computed by the