Tutorial Gap Identification Towards Student Modeling Using Fuzzy Logic

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ABSTRACT

Tutorial requirements of student modeling are traditionally identified by human tutors through crisp mental calculations, and the accuracy of this identification enhances with the experience of the tutor. These identifications become challenging when the mode of delivery is through e-learning. Automatic identification of tutorial requirements must be included in e-learning through ITS where some intelligent computational paradigms can help in automatic identification of the said requirements. This article proposes some fuzzy logic-based techniques toward the said purpose of automatic tutorial gap identification where analysis of the learner’s responses to purposefully designed modular MCQ tests and verbal explanations are taken in to consideration as inputs for the purpose. Variation of the fuzzy logics was taken in to account to justify the usefulness of methods under consideration and to provide a realistic and adaptable approach. The experimental results show that the proposed methods are successful and efficient towards the said purpose.

KEYWORDS


1. INTRODUCTION

Outcome based education (OBE) (Spady & Marshall, 1991; Spady, 1994) has become a need of the hour and it has two components towards its achievements. One is increasing the students’ attainment level and other one is to fill the gap in acquired knowledge which can enhance the students attainments if it is identified and bridged properly. Human tutors traditionally perform these tasks of identification and bridging the knowledge gap (Das et al., 2017; Rolandsson et al., 2017). With the increase of number of students in the process, human tutors face many problems towards the above identification and knowledge filling. These also advocates some paradigm shift in the educational activities where learners themselves take very important roles and teachers acts as facilitators. Knowledge gap residing in any student should properly be identified and remedial measures regarding this have to be taken. Finding the knowledge gap requires finding the gap of knowledge delivered to the students through different tutorials on each subtopic of a course.

Thus, learner centric education is a regulatory requirement now a day’s all over the world. The paradigm shift of the educational distribution also observed a change through implementation of blended form of education where learners themselves are in the process of identifying their
own knowledge gaps. Normally, human tutors take the role of identifying student’s educational shortcomings through different tests and interactions. Many of the learners’ educational deficiencies are taken care through tutorial classes may be with focused group or clusters of students. But identification of requirements of such tutorials are analyzed by human tutors in face-to-face mode. But such student modeling becomes more complicated and problematic with the number of students and hence educators offer some ICT tools (Zealand, 2003) for the purpose along with the facilities for blended form of education. Intelligent Tutoring System (ITS) (Bag & Das, 2010) are one of those ICT tools which take care the role of students modeling with the use of different intelligent computational processes.

Student modeling in e-learning is a serious matter of concern which is generally formulated with the interactions of learners with the automatic learning systems. Students are given MCQ test sets to solve after going through a piece of content based on some topic or subtopics (Gokmen et al., 2010; Barlybayev et al. 2016). Those test responses are analyzed through some computational methods and learners’ tutorial need may be identified which is done be experienced human tutors very accurately with their enhanced experiences of students dealings. As the human tutors are experiencing teaching, he is more accurately identifying the student’s tutorial needs as he comes to decision regarding tutorial needs from fuzzy to crisp articulation capabilities running in his back of mind. Likewise, ITS should incorporate some fuzzy logic to identify learner’s tutorial needs through analysis of learner’s responses to MCQ tests may be.

Tutorial gap (Das et al., 2017) measurement is done by using traditional way of numeric calculations. In this traditional method, tutorial gap is calculated, from the score obtained by a student in the evaluation process, by using some mathematical formula. This traditional way of finding tutorial gap produces rigid numeric values, which often may be unrealistic. This is because only numerically calculated values do not reflect the actual scenario correctly always. This inappropriate measurement can be rectified and blended with the realistic and flexible approach provided by fuzzy logic (Zadeh, 1965; Bose & Das, 2015; Mitra & Das, 2015). This paper focuses on the application of fuzzy logic to find the tutorial gap by taking the advantages of fuzzy logic over conventional method.

With the implementation of fuzzy logic, appropriate and accurate identification will become possible. Even the methods should be capable of offering better identification with respect to efficiency compared to traditional crisp calculation-based approaches. Fuzzy logic has been chosen in this work with the expectation of its usefulness in transforming real life ideas and situations to a meaningful efficient inference from uncertainty to unified conclusion. It may be noted that fuzzy logic has been used in the ITS for automatic student modeling for last couple of years in the field. Besides identification of tutorial gaps and other students modeling issues, these proposed methods may be useful for competency assessment of students and their promotions to higher level in the concern subject. This may also fulfill the required student evaluation part and student attainment to set desired level in OBE.

Rest of the paper is organized as follows. The following section 2 presents a review of related literature in the problem and solution domain as well. Section 3 presents the proposed fuzzy logic-based method of the identifying students’ knowledge gaps through analysis of their responses after going through a content. Section 4 presents the results of the investigation with the proposed method. The paper is ended with the section 5 presenting the conclusion and future possibilities of the present approach.

2. BACKGROUND

OBE is a student centric learning philosophy that focuses on empirically measuring student performance (Mitra & Das, 2015; Phillips & Phillips, 2016), which is called outcomes. This leads to Outcome Based Curriculum (OBC), Outcome Based Learning (OBL) and Outcome Based Assessment Evaluation (OBAE). It is normally a cyclic process, which enables continuous improvement, towards excellence. It has already been taken as granted for the quality educational regulatory requirements
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