Bug Model Based Intelligent Recommender System with Exclusive Curriculum Sequencing for Learner-Centric Tutoring

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ABSTRACT

Face to face human tutoring in classroom environments amply facilitates human tutor-learner interactions wherein the tutor gets opportunity to exercise his cognitive intelligence to understand learner’s pre-knowledge level, learning pattern, specific learning difficulties, and be able to offer course content well-aligned to the learner’s requirements and tutor in a manner that best suits the learner. Reaching this level in an intelligent tutoring system is a challenge even today given the advanced developments in the field. This article focuses on ITS, mimicking a human tutor in terms of providing a curriculum sequence exclusive for the learner. Unsuitable courseware disorients the learner and thus degrades the overall performance. A bug model approach has been used for curriculum design and its re-alignment as per requirements and is demonstrated through a prototype tutoring recommender system, SeisTutor, developed for this purpose. The experimental results indicate an enhanced learning gain through a curriculum recommender approach of SeisTutor as opposed to its absence.

KEYWORDS

Adaptive, Bug Model, Curriculum Planner, Intelligent Tutoring System, Learning Style, Pre-Knowledge Level, Tutoring Strategy

INTRODUCTION

The field of Artificial intelligence has gained momentum in the recent past. This advanced field of research has significant applications in the field of edification mainly for making learning and teaching more effective. The realization of which has led to the creation of multiple educational computer artifacts that in turn developed in the field of intelligent tutoring. The introduction and development of Intelligent Tutoring Systems (ITS) were a major factor in driving growth in the field of intelligent tutoring representing a culmination of disciplines of educational research, computer science and cognitive psychology (Nwana, 1990). The resultant products, termed as cognitive tutors, behave like human tutors, that often learning to suit the learning preference of the learner and progress as per performance and behavior of the learner.

Web based systems are an abundant source of education with availability of study material, but when considering the learner’s needs of adaptation and personalization, the lack of these capabilities reveals. Additionally, the web is full of overloading and accessibility issues. This poses difficulty for a learner to attain her/his focused learning objectives. Highlighting the importance of adaptivity, in learning environment, following points are listed. First: Every learner differs in goals and objective, pattern of learning, abilities, preferences, and also prior-knowledge level. Prior-knowledge level is
a metric that discriminates learners with the same learning pattern but differing knowledge levels. Secondly: learner specific learning paths generated to help the learner navigate through a course designed by an adaptive system (Gutiérrez, 2007; Latha & Kirubakaran, 2013).

Intelligent tutoring systems over a period of time have become progressively effective, but are tough and costly to build. Same authoring tools have originated and have shown limited usage in ITS development in the past.

Existing ITS are broadly classified into two classes: class one highly emphasized on traditional curriculum and class two highly emphasize on simulating a learning instructional environment. Going by the same philosophy, the current similarly existing authoring tools have been classified into two broad categories: Performance-oriented and Pedagogy-oriented. These renders ITS, that fall under the same two groups, pedagogy and performance oriented ITS. Performance oriented systems, provide rich learning atmosphere in which learner, learns the skills by practice and receives related feedback. Pedagogy-oriented systems, teach and sequence canned courseware. These systems pay attention towards representation of their teaching content, tactics and strategies. The performance-based systems provide procedural guidance (step-wise) as and when needed while pedagogy-oriented systems, emphasis on planning and instructing at a more general level. Although the number of ITS is low in percentage, but the overall impact on learning is high. Intelligent Tutoring System (ITS) is computer aided instruction software that mimics the behavior and guidance of human tutor. One of the reasons, that distinguishes ITS from other computer aided instruction and e-Learning systems, is learnability adapted to complex learner behaviors. This system creates profile for each learner and determines the learner’s degree of understandability, learning preference and learning style. The intelligence exhibited by the system, involves change of tutoring style in real time, providing impressive interaction with learner, adjusting its knowledge base as per learner responses and comfort level. One of the misconceptions about ITS is that, it is aimed to replace human tutors rather it was designed to work individually and simultaneously with a large group of learners. Intelligent tutor contributes to reduce the anxiety of learner about not being able to get a concept and further to enhance learner’s degree of understandability. Intelligent tutoring system provides a refined teaching routine providing a teacher with real time tutoring material. Table 1 illustrates the few existing ITS, that shows a reasonable learning gain when tested over learners.

Curriculum sequencing or educational modules sequencing is vital in the classroom and in ITS, because of its precise approach, which is amicable to learning. Moreover, curriculum sequencing, maps properly to a course plan, to be covered. As in classroom teaching, an instructor is anticipated to offer learning for all learners regardless of learners learning preferences or grasping levels. Henceforth, a generalized course plan is built and put into practice. The significant downside of this mechanism is that the instructor is not familiar with the learner grasping and prior-knowledge level, thus instructor is able to bring only restricted variety in a teaching style. However, in ITS the goal is to overwhelm this shortcoming, to a great extent.

Until now, the emphasis in ITS research, has been mainly on tutoring a learner, according to his/her learning inclination, however, extremely restricted consideration, has been paid on curriculum sequencing, which is the design of a custom-tailored learning path for that specific learner (Weber, 2001; Gerdes, 2017). Every single learner before being admitted to a course holds some knowledge about the subject. Therefore, there is a requirement to pre-determine the prior-knowledge level of the learner and based on that, alignments the learning material for the learner, by selecting material from the pool of courseware. The research demonstrates that if the courses are tutored according to the learner preferences and prior-knowledge, the overall degree of engagement and learning gains of the learner with ITS, are ungraded. The present work is centered around furnishing a learner with custom-tailored course material sequenced according to learner preference and level.
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