

Survey of the Effectiveness of the Application of Intelligent Tutoring Systems (ITS) in Classroom

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Abstract: *Most of the ITSs evaluation were in experimental stage. ITSs have not been tested in real class room situation or in school level. This research, in order to fill the gap on this regard, conducted a survey questionnaire study on the application and effectiveness of ITS in schools. In this sense, the present paper evaluated the effectiveness of ITS in Tianjin University of Technology and Education School of Information Technology and Engineering. 261 participants filled the survey questionnaire consisted of 8 question items with Likert 5-point scale. The questionnaire assessed students' subjective view in related to their experience and practice on the ITS; interest on the subject of study using the tutor; easiness and interest towards the tutor; quality features of the tutor; drawback or weakness of the tutor; satisfaction with the marking and result of the tutor; overall quality of the tutor; suggestion and recommendation of the tutor to be used by others. According to the result majority of students "agreed" on seven question items that they were highly recommended the tutor, the tutor has quality features, satisfied with the marking, interested on the subject of study, the tutor is easy to use, and it has overall quality withstanding that significant portions of the student also indicated that the ITS had drawbacks and problems indicating that effort should be applied to pinpoint exactly the hitches and applying remedial features.*

Keywords: artificial intelligence (AI), artificial intelligence in education (AIED), intelligent tutoring system (ITS)

1. Introduction

Various strategies have been adopted to address the knowledge, skill and attitude requirements for graduates in the work place. There are many activities conducted in engineering universities and departments to reform the engineering education curriculum to be in conformance with engineering accreditation requirements (Felder, 2003) and to be in line with the Conceiving - Designing - Implementing - Operating (CDIO) approaches that focus on project based and team work as a teaching method (Berggren et al, 2003).

In parallel with employing standard requirements of engineering accreditation programs and other reform approaches, it is highly advisable to use the benefit that the education could get from the present development in Artificial Intelligence in Education (AIED) to achieve the one standard deviation on student achievement from tailored tutoring and to achieve educator's ambition in solving the 'two-sigma' problem of education.

According to Benjamin S. Bloom a mastery learning method aided students by more than one standard deviation. When combined this with personal tutoring such as human or computer tutor, it increased to two standard deviations, a so called 'two-sigma' effect on performance on students (Levine, 2017). However, personalized tutoring and mastery learning are both challenging. The former is extremely financially costly and the latter is also extremely but temporally costly and thus, the 'two-sigma' problem was born (VanLEHN, 2011).

For much of the last 30 years, the artificial intelligence in education (AIED) community has been concentrating, to a great significant, on addressing the two-sigma problem, moving towards creating systems that are as effective as

human one-on-one tutoring. So, they come up with artificially intelligent tutoring system (ITS), which is one of the most important applications of AIED.

In order to improve existing teaching practices, many universities and research laboratories has been developing ITSs that allows teaching and learning of several subjects. Various researchers have defined ITSs. Simply an Intelligent Tutor System (ITS) can be defined as a computational system that incorporates artificial intelligence techniques to act as tutor of a student in a given field of knowledge. A more comprehensive definition of ITS is found in Ma et al (2014). According to Ma et al. (2014), an ITS is a computer system that for each student performs three functions. First performs tutoring functions by presenting information to be learned, asking questions or assigning learning tasks, providing feedback or hints, answering questions posed by students, or offering prompts to provoke cognitive, motivational or metacognitive change. Second by computing inferences from student responses constructs either a persistent multidimensional model of the student's psychological states (such as subject matter knowledge, learning strategies, motivations, or emotions) or locates the student's current psychological state in a multidimensional domain model. Third ITS uses the student modeling functions identified to adapt one or more of the tutoring functions.

Various studies have indicated that ITSs have achieved comparable performance with human tutoring in effectiveness. Among these studies VanLehen (2011), Ma et al. (2014), Kulick and Fletcher (2016), and Mousavinasab et al. (2018) can be mentioned.

However, most of the study of the effectiveness of ITS is at laboratory stage with controlled experimental studies. There

is a lack of studies about the effectiveness of ITS in a real classroom situation and this study is tried to fill this gap by assessing the effectiveness and weakness of the usage of ITS in classroom from the subjective view of students.

Research question

It is survey research that evaluated the effectiveness of ITS in a classroom by assessing student's subjective on the specific tutoring system used in the classroom to support their study. It evaluated the following issues related to the tutor: Experience and practice with the tutor; Interest on the subject matter study using the tutor; Easiness and interest using the tutor; Quality features of the tutor; Drawbacks or weakness of the tutor; Satisfaction with the marking and result of the tutor; Overall quality of the tutor; Suggestion and recommending of the tutor to be used or not by other students.

2. Methodology

Research Design: A survey research method has been used in this study as it is suitable to assess the effectiveness of intelligent tutor system (ITS). The questionnaire was designed by referencing other studies that conduct survey questionnaire research method in assessing the experience and opinions of students about ITS impact on their learning there by studying its effectiveness. The questionnaire was prepared after assessing the questionnaire prepared by Moro et al. [8], Grivokostopoulou et al. [9], Grivokostopoulou et al. [10], Dzikovska et al. [11] and them improving the questionnaire to be more comprehensive.

Source of Data: A primary source of data was obtained through administering questionnaire to students who have experience in using intelligent tutoring system (ITS) to study its effectiveness

Samples and Sampling Techniques: A simple random sampling techniques was adopted. The method was applied by choosing randomly the required number of respondents from a list of computer science students in Tianjin University of Technology and Education.

Data gathering tools and procedures: 261 students of School of Information Technology and Engineering participated by filling questionnaire administered through WeChat platform. The questionnaire was prepared by Wenjuan (<http://wenjuan.com/>) online data surveying tool. The questionnaire contained of 8 questions required answers based on a five-point Likert scale (1- strongly disagree to 5- strongly agree). The demographic data also collected from the students. After collecting the student's response to the questionnaire, the reliability of the questionnaire was calculated using Cronbach alpha and it was reliable.

3. Result and Analysis

Table 1 showed the result in percent (%) of a data obtained from TUTE School of Information Technology and Engineering students rating using Likert scale from "strongly disagree" to "strongly agree" on the nature, quality and effectiveness of intelligent tutoring system they experienced.

The question items assessed the subjective experience of the students on the usage of ITS for their study in regards of the following points: experience and practice on the ITS; interest on the subject of study using the tutor; easiness and interest towards the tutor; quality features of the tutor; drawback or weakness of the tutor; satisfaction with the marking and result of the tutor; overall quality of the tutor; suggestion and recommendation of the tutor to be used or not by others.

Table 1: Survey questionnaire result (in %) on the effectiveness of ITS

Items	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Suggestion and recommendation of the tutor to be used or not by others	2.30%	4.79%	34.10%	50.77%	8.43%
Quality features of the tutor	2.04%	4.47%	35.38%	50.89%	7.73%
Satisfaction with the marking and result of the tutor	2.43%	4.34%	37.04%	49.42%	7.15%
Interest on the subject of study using the tutor	1.53%	8.05%	34.68%	50.19%	6.13%
Easiness and interest towards the tutor	2.30%	8.26%	34.01%	49.43%	6.55%
Overall quality of the tutor	1.53%	7.15%	35.89%	48.78%	7.15%
Experience and practice on the ITS	3.83%	6.90%	34.68%	50.19%	4.60%
Drawback or weakness of the tutor	2.30%	18.01%	41.57%	32.38%	6.13%

The first question item of Table 1 rated the attitude of the students in suggesting and recommending the tutor to other students. Majority of the students were "agreed" in recommending with 50.77 % to other students that the tutor is a valuable way to realize effective learning.

The second question item of Table 1 evaluated the quality features of the tutor. According to their rating majority of the students "agreed" with 50.89 % that the tutor interacted with students by providing hint, immediate feedback and scaffolding techniques, were satisfied with the feedback arrangement, the provision of conducive learning environment that customize learning according to their need and also the visualization examples had augmented the quality of the intelligent tutor system they used.

The third question item of Table 1 measure students' subjective perception on the marking system of the tutor. Accordingly, majority of the students "agreed" with 49.2 % that they were satisfied with grade or mark given to them by the tutor, the marking system were accurate and also the marking system of the tutor were a good platform that facilitate assessment.

The fourth question item of Table 1 rated the interest students had on the subject matter of study. According to their rating majority of the students "agreed" with 50.19% that they had interest on the subject matter of study and thus gave the required attention to the subject of study using the tutor.

The fifth questions item of Table 1 valued students' attitude towards the tutor about the easiness and interest towards the tutor. Majority of the respondents "agreed" with 49.43% that the tutor was easy to use, enjoyed using the tutor and the problems & challenge presented by the tutor with the tutor facilitating learning contents easily using real world examples, and preferable than reading books.

The sixth question items of Table 1 evaluated the overall quality of the intelligent tutoring system students used to study their course. In overall, majority of the students "agreed" with 48.78% that they were satisfied with the quality of the tutor, got substantial knowledge from the tutor and be confident in their knowledge after experiencing the tutor.

The seventh question item of Table 1 measured whether the students have used the tutor as much as needed to be comfortable to give information on the issue. Majority of the students "agreed" with 50.19% that they have sufficiently used the tutor for their study.

The eighth question item rated the drawbacks and problems of the tutor system according to students' subjective evaluation. Majority of the student "undecided" with 41.57 % whether the problems presented by the tutoring system was boring and confusing while 32.38% of students "agreed" on the issue. These indicated that the tutoring system has to revise the problems and the way it presented problems so that the problems be interested and also not confusing.

In general, according to Table 1 majority of students "agreed" on seven question items that they were highly recommended the tutor, the tutor has quality features, satisfied with the marking, interested on the subject of study, the tutor is easy to use, and it has overall quality withstanding that significant portions of the student have indicated that the ITS had drawbacks and problems indicating that effort should be applied to pinpoint exactly the hitches and applying remedial features.

4. Conclusion

The survey result showed that ITS can deliver to the learner an innovative way of learning the teaching contents in the classroom in an enjoyable way. The Intelligent Tutor System (ITS) used in TUTE supported the student by carrying out teaching and learning in a more dynamic and innovative way, thus departing from the conventional and traditional classroom of teaching which promote a passive attitude of the learner and replaced it with an active, interactive and adaptive learning. The tutors strengthen the learning about the Computer Science contents using a practical and intuitive ways such as by providing tailored feedback, hint and scaffolding with increasing interaction of learner and tutor.

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