Enhancing the Intelligence of Web Tutoring Systems using a Multi-Entry Based Open Learner Model

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ABSTRACT

The accuracy of learner model is the heart of any Intelligent Tutoring System (ITS). More intelligence in the ITS needs a more accurate learner model. In the earlier versions of ITS, the student must submit a test before using the ITS. That test was used to build the student model, which contains information about the knowledge of the student, his/her misconceptions, preferences and other related issues. However, this method doesn't work efficiently for school students, because one test canfit accurately evaluate their knowledge and misconceptions. In this research, we implement a system (web application) to get the student model for school students by allowing the students, parents, and instructors to add their assessment and feedback to the model. Then the system uses these multi-entries together with the traditional test to build an enhanced student model (smart learner model). Furthermore, in order to support collaborative learning, the implemented system gives the student the access to open his/her model for other instructors and peers. The proposed system has been applied on a group of students, their parents and instructors. According to the obtained results and the surveys, the studentfis knowledge has been improved in many students. also the students, parents, instructors found the system to be useful, interesting and easy to use. Furthermore, all parties were happy to be engaged in the educational process.

KEYWORDS

Intelligent Tutoring System, Student Model, Open Learner Model, Web application.

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1 INTRODUCTION

With the huge development in the Information Technology and the wide spread of the Internet, which becomes an essential source for receiving information, many developers tend to implement educational systems that participate in rising the educational level through Information and Communications Technology (ICT)[14][1].

These systems were able to spread all over the world[7], and they raised the educational level of students. Nevertheless, they could not replace the real teacher who takes into account the individual differences between students, which makes the real teacher provides the suitable information for students that fits in with their educational level[9]. In later time, more accurate and intelligent systems appeared and tried to simulate the human teachers in their ability in defining misconceptions with students and providing solutions. These systems are considered and called as Intelligent Tutoring Systems (ITSs). This paper concentrates mainly on the studentsfi model and aims to enhance it as the student model is considered as the heart of any ITS.

Knowing the studentfis level, preferences and other issues related to the student are very essential for an efficient educational process [3]. Thus, the student model is an essential component for ITSs. The traditional ITSs depend only on a short test to evaluate the student and to build his/her student model.

However, it is found that using only the short test/exam is not sufficient to reflect the real knowledge and the educational level of the student. In fact, the exam could be one of the factors that makes many students hate the schools and the educational process. It may also be the main factor that makes the student feel frustrated and he might leave school. In the same time, we canfit neglect the examfis evaluation because it can be easily applied to get a perspective about the studentfis level. That's why in this research, we are going to supply the ITSs with other entries to evaluate the student knowledge in order to create a more accurate student model. Also, we found that this way makes the students more happy and self-confident, and encourages them to learn efficiently.

This research will specifically be for school students, and the final system will be an integrative system with the school without canceling its role. In this research we have used four sources to evaluate the student knowledge and to build the smart student model: Firstly, the student evaluates himself/herself based on the subject that he/she is going to learn. This is important because we really want to know from the student himself what he thinks about himself regarding the knowledge and the educational needs. Secondly, the teacher enters his evaluation according to what he knows about the student from the school. The teacher is the closest person to the student in school. In this way we can take benefit from the accumulative experience of the teacher about the studentsfi level and their educational needs. That would give the system a better ability to evaluate the students more accurately. Thirdly, the parents evaluate their children. It is known that most parents care

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about their children level, and they are interested in raising their children educational level. Therefore, they are often aware of their children needs. As a result, the system will use this evaluation and benefit from it. In this way, parents will actually participate in developing the educational process for their children. Finally, the system evaluates the student. This is a former procedure used in ITSs by using a short test to evaluate the studentsfi level. Then, after collecting these four entries concerning the studentsfi level, the central system studies all these opinions, and try to build an accurate learner model.

This research include in addition to this introduction a background and literature review, this section shows a background about e-learning and it's and Intelligent tutoring system. Then the proposed model section presents our new model in detail. The sent section talk about collecting and analyzing data. Evaluation the system by users presented in the next section. Finally we present the conclusion.

2 BACKGROUND

The term Intelligent Tutoring System (ITS) expresses the development of computer programs for teaching students effectively, in order to provide tutors to know what they teach, who they teach and how to teach it[12].

Wenger defined ITS as Computer-based instructional systems with models of instructional content that specify what to teach, and teaching strategies that specify how to teach[13] The motivation to build the (ITS) is to emulate the human teacher and effectiveness of one-to-one learning. In real classroom, there is one teacher for many students, so its difficult to apply the one-to-one approach[14]. Most teachers are trying to take into account the individual differences between students, as-much-as possible, although, some students may be neglected.

Since the advent of computer science, there were many attempts to completely replacing the human teacher with applications[8]. Theoretically, these attempts wont be science fiction, given in Artificial Intelligence (AI) field. Ideally, advancing in natural language processing allow the system to talk with student as human teacher. Developing a powerful ITS must have a combination of computer science (AI)[7], cognitive psychology and educational research (as shown in Figure 1 1), so many researches in this filed are producing by involving scientists in computer and education.

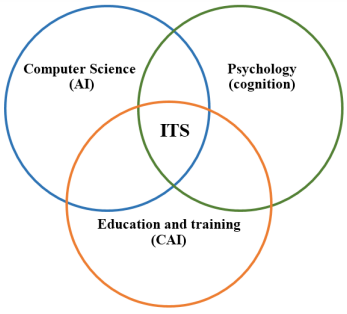

Figure 1: Intelligent Tutoring System.

3 RELATED WORK

In this section, wefill show similar systems:

(1) German Tutor :

It is an intelligent language tutoring system to learn German grammar [10], the main features in this system are as the following: it is a full intelligent tutoring system, it supports open learner model,and there are three levels to learn German grammar (Beginners, Intermediate, and Advanced). In the other hand, the system does not allow the instructors or peers to see the student model, and it does not support the groups, also the student model presents the level of the student textually only as shown in see figure 2.

Figure 2: Student Model- German Tutor[10].

(2) SQL-Tutor:

It is an intelligent educational system to learn structured query language (SQL) [11]. The main features in this system are as the following: itfis a complete intelligent tutoring system, it is specially developed for university-level students only, it supports the open learner model, and the student model presents a textual and graphical information, see figure 3. In the other hand, the system does not allow the instructors or peers to see the student model, and it does not support the groups.

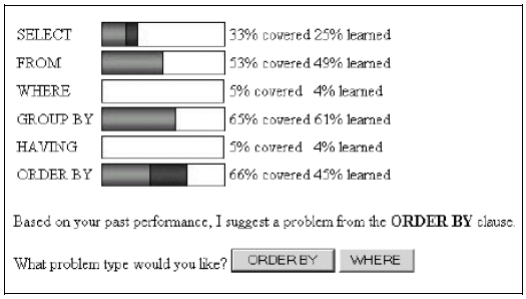

Figure 3: Student Model- German Tutor[11].

4 PROPOSED MODEL

Our contribution is to involve the assessment of students, teachers, and parents in building the student model. By this, the system will have more resources about the students knowledge level, which makes the student model more accurate. However, the data entered

by these different actors may have some contradictions regarding the students knowledge. In this case, the system will test student in different ways about these contradictions in order to build an accurate learner model. The student can still negotiate his/her model if he/she thinks that it does not reflect his/her real knowledge as shown in figure 4.

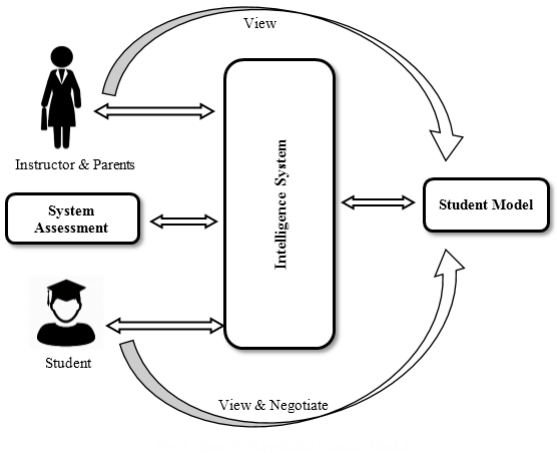

Figure 4: Proposed Open and Negotiable Learner Model Based on Multi-Entries

Choosing the weight for each type of assessment for students takes a long time and considerable effort. In our research, we focus on the field of education through interviews and surveys with senior members experts in the field of education According to these surveys, the used weights for each assessment type (entry type) were put as the following:

(1) The biggest weight is given to the short test (35%). The system evaluates the student in five different concepts with multiple questions for each concept. And for each concept the system tries to find whether the student is good, average or weak in this concept. Also, if the student has a misconception in that concept then it can be detected by the system as this is considered in while programming and while putting the questions and the answers.
(2) The second weight is for the instructor (30%) because he/she is the closest person to the student in the real education world. Thus, the instructor knows about the student knowledge level in each concept and whether the student has a misconception or not.
(3) Student self-evaluation weight is (20%). The system allows the student to assess himself/herself and to enter for each concept what they think about themselves.
(4) Parent weight (15%), where the parents goes to the system and evaluates their kids for each concept.

In addition to building the student model, the implemented web system aims to support learning reflection by making the model open for the students themselves, teachers and parents. We will also support collaborative learning by giving the students the access to open their models for other peers. This will help the educational process in several aspects, [2] Successful collaboration means asking questions to gain a better understanding of the main concepts, elaborating and justifying opinions and sharing and explaining ideas, and they will be achieved with open learner model, especially between peers[5][4][6].

5 SYSTEM NEEDS ANALYSIS

Some questionnaires were prepared for students, teachers and parents. These questionnaires had four objectives. Firstly, to know the confidence of the students, teachers and parents on only using the exam to determine the knowledge level and the educational needs for students and to build the student model. Secondly, to know the studentsfi confidence about themselves and their ability to determine their educational needs. In this way, the teacher will use this self- evaluation to choose the best pedagogical strategies. Thirdly, to know the ability of teachers to determine the level of their students and understand their educational needs in order to improve the educational process in general. Finally, to know the ability of parents to follow up their children and determine their needs, and to share this knowledge with the teachers so that they can develop the educational process as well. The results of the primary analysis for the questionnaire were as the following:

(1) There was a lot of confidence that the exam is irreplaceable because itfis good and can easily be applied; the rate was 69%. The standard deviation of the data was less than 0.9, and that is an indicator of agreement. However, all agree that the exam alone shouldnfit be used to build the learner model.
(2) There was a lot of self-confidence between students that they are capable of identifying their needs and pass them to their teachers; the rate was more than 90%. The standard deviation of the data was less than 0.7, and that is an indicator of a big agreement.
(3) The students were confident with their teachers to determine their weaknesses and fix them, and to choose the suitable educational strategies for each one; the rate was 70%. The standard deviation of the data was less than 0.9, and that is an indicator of agreement.
(4) The students were confident with their parents that they had the ability to determine their educational needs and transfer this assessment to the teachers; the rate was 63%. The standard deviation of the data was less than 1.0, and that is an indicator of agreement.

In conclusion, students really prefer to have other entries (not only the exam) to determine their educational needs in order to improve their knowledge level.

6 SYSTEM IMPLEMENTATION

Each student has a model, which presents the results of the four different entries. These four entries determine the knowledge level of the student. The implemented system mainly focuses on the open learner model in which the system allows the student to see his/her model and to negotiate with the system about his/her knowledge level in each topic. The student model presents the results in different ways; in graphical bar chart as shown in figure 5, graphical circle pointer as shown in figure 6 and data table as shown

in figure 7. In the other hand, the student can view a list of his/her misconceptions. Also, the student can view the peers models who are in his group. Moreover, the student can help his/her peers in specific concepts.

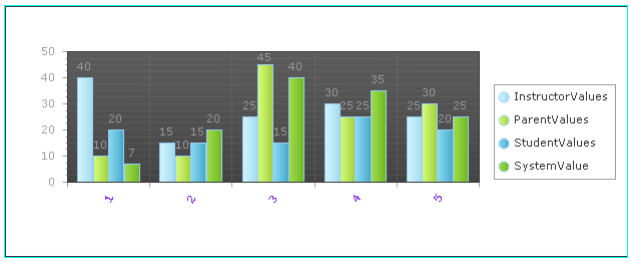

Figure 5: Chart Bar Result.

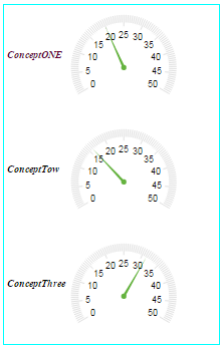

Figure 6: Circle Pointer.

Parent Id	Inst ID	concept ID	System Value	Parent Value	Instructor Value	Student Value	student ID	id
1	1	1	7	10	40	20	5	38
1	1	2	20	10	15	15	5	39
1	1	3	40	45	25	15	5	40
1	1	4	35	25	30	25	5	41
1	1	5	25	30	25	20	5	42

Figure 7: Table of Data.

7 EVALUATION OF THE SYSTEM BY USERS

In this section, the results of the evaluation from the users point of view will be shown. In our system, there are four main types of users: students, parents, instructors and supervisors. Therefore, we will give an evaluation result from all types of users.

7.1 Evaluation Strategy

We chose a group of 90 students, and gave them an exam from their instructor. After that, the students were divided into three groups; each group had 30 students. The instructor repeated the 5 concepts for the first group in the classroom. In the second group, the students applied the normal ITS (with system evaluation only). In the third group, the students tried our system with (multi entries). At the end, all students were given another exam from the instructor. The different results of our evaluation were due to the differences in the level of enhancement of the students in each group.

7.1.1 Results Analysis. The results of all groups show us the Group1 which the students do not using the ITS they have a 60% of the students improved, 10% fixed and 20% of the students declined, show the figures 8 and 11. Whereas, the Group2 which the student use the classic ITS (with system exam only) they have 80% of the students improved, 20% fixed, no one declined, show the figures 9 and 11. Finally, the Group3 which was used our system (with multi entries) have 90% of the students improved, 10% fixed, and no one declined, show the figures 9 and 11.

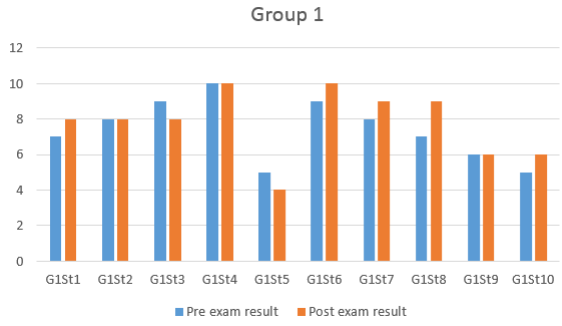

Figure 8: Group1

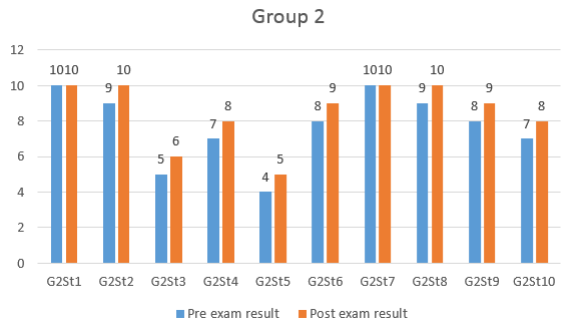

Figure 9: Group2

7.2 Users Evaluation

A questionnaire was prepared to evaluate the system by users after using it, and the results are as the following:

(1) The experiment was likable and caused enthusiasm to: 90% of students, 65% of teachers and 85% of parents. The experiment was useful to: 100% of students, 90% of teachers and 100% of parents.
(2) The experiment was fun and interactive to: 90% of students, 80% of teachers and 85% of parents. The information inside the student model was useful to: 80% of students, 75% of teachers, 90% of parents.

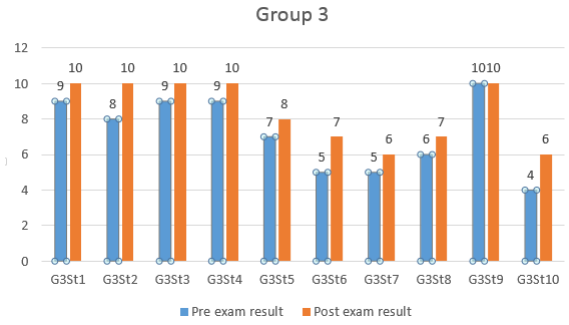

Figure 10: Group3

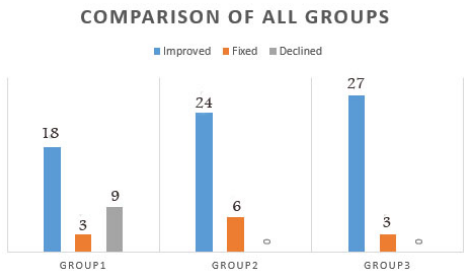

Figure 11: comparison

(3) Students groups were useful to: 90% of students, 85% of teachers and 90% of parents.

Statistics from the Web Application

(1) 100% of students viewed their models.
(2) 100% of parents viewed their children models.
(3) 30% of students opened their models for their peers.
(4) 65% of students were in groups.
(5) 35% of students had misconceptions.
(6) 10% of students provided assistance to their peers

8 CONCLUSIONS

A Web-Based system was implemented to improve the student model. The proposed student model (smart model) was not only based on using a test to generate it, but also to take other entries from the students themselves, the instructors, and the parents. The implemented learner model supports the concept of open learner model where the model is open for the student, and instructor. Also, the student is given the access to open it for his/her peers as well. The system was evaluated in many ways. One of them is pre and post exams. The other way is by questionnaires. Both ways proved that the implemented learner model achieved better results than traditional way of generating the learner model.

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