International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2000-006X
Vol. 2 Issue 2, February – 2018, Pages: 1-8

ITS for Teaching Introduction to CS

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Abstract: *The paper describes the design of an intelligent tutoring system for teaching Introduction to Computer Science-a compulsory curriculum in Al-Azhar University of Gaza to students who attend the university. The basic idea of this system is a systematic introduction into computer science. The system presents topics with examples. The system is dynamically checks student's individual progress. An initial evaluation study was done to investigate the effect of using the intelligent tutoring system on the performance of students enrolled in computer science curriculum at Al-Azhar University, Gaza. The results showed a positive impact on the evaluators*.

Keywords*:* Intelligent Tutoring System, Computer Science, self-education, Computer Assisted Instruction (CAI), Expert Systems.

1. Introduction

Intelligent Tutoring Systems (ITSs) first created in the '70s, when Carbonell involved methods of Artificial Intelligence (AI) in Computer Aided Instruction (CAI)[9]. Thus, man can say: the first generation of ITSs is a kind of "intelligent" CAI. Their main task is stated by Lelouche: "The basic principle of 'intelligent' CAI is that it should know the taught material"[15]. Knowledge about the taught material is embedded in the ITS in form of expert systems, that is, the expert module [3, 11]. The integration of insights of cognitive science in ITSs, has led to what today is called an Intelligent Tutoring System [2]. In addition to the knowledge about the taught material, these systems have knowledge about pedagogical strategies and knowledge about the student, realized as pedagogical module and student module, respectively.

2. LITERATURE REVIEWS

There are many designed and development of Intelligent Tutoring System, ITS has attracted much attention of the researchers. There are many intelligent tutoring systems, such as ITS that teach students English dialogues through interaction with students and it takes into account the individual differences of students through levels [3]. ITS Design based on Leeds Modeling System (LMS) to examine errors in algebra [4]. MYCIN [5] is expert system for diagnosing diseases such as cancers, based on MYCIN, Designed GUIDON to display the lessons of the disease and symptoms, showing rules in the knowledge base of the student [6]. A comparative study between Animated Intelligent Tutoring Systems (AITS) and Video-based Intelligent Tutoring Systems (VITS) [7], Affective tutoring systems (ATS) based on embedded devices is a system that relies on embedded devices for detecting the feelings, emotion, psychology student and also adapt to the student's mood such as angry, frustrated and fatigued etc. Based on the mood and feelings of the student, the student will learn [8, 9], teaching AI searching algorithms [10], teaching database to sophomore students in Gaza [11], Predicting learners performance using NT and ITS [12], learning to program in C++ [13], and advanced security course[41-51].

3. Architecture of a Typical ITS System

A typical ITS, has the following four basic components [20].

1. **The Domain model:**
   The domain model (also known as the cognitive model/expert knowledge model) consists of the concepts, facts, rules, and problem-solving strategies of the domain in context. It serves as a source of expert knowledge, a standard for evaluation of the student's performance and diagnosis of errors.

2. **The Student model:**
   The student model is an overlay on the domain model. It emphasizes cognitive and affective states of the student in relation to their evolution as the learning process advances. As the student works step-by-step through their problem solving process, the system engages itself in model tracing process. Anytime there is any deviation from the predefined model, the system flags it as an error.

3. **The Tutoring model:**
   The tutor model (also called teaching strategy or pedagogic module) accepts information from the domain and student models and devices tutoring strategies with actions. This model regulates instructional interactions with student. It is closely linked to the student model, makes use of knowledge about the student and its own tutorial goal structure, to devise the

pedagogic activity to be presented. It tracks the learner's progress, builds a profile of strengths and weaknesses relative to the production rules (termed as ‘knowledge-tracing’).

4. **User Interface model:**

This is the interacting front-end of the ITS. It integrates all types of information needed to interact with learner, through graphics, text, multi-media, key-board, mouse-driven menus, etc. Prime factors for user-acceptance are user-friendliness and presentation. Figure 1 presents a typical ITS architecture.

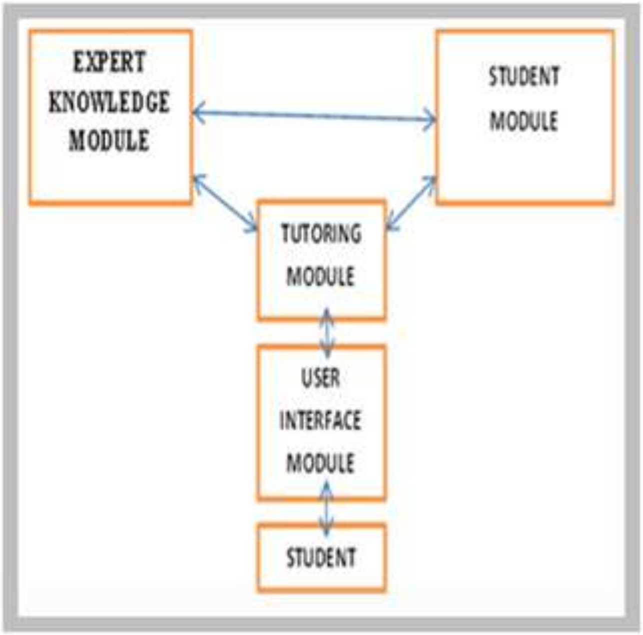


Figure 1 : Architecture of a Typical ITS System

4. The objectives of the Computer Science-Course Tutor are:

- To build an intelligent tutoring system for problems for which the answers might not be always quantitative
- To have a system that is dynamically adapt at run time to the student’s individual progress

5. Computer Science-Course Tutor Design

Over the years a few innovative tutoring tools have been studied in an attempt to improve the quality, flexibility and cost effectiveness of teaching and learning. Kashy developed a tutor called CAPA to help students in solving Physics problems[12].

Barker have developed a tutor for homework assignment in electronic and control system discipline [6].

Bridgeman developed Interactive tutors like: PILOT and SAIL [7,8]. PILOT was for Learning and grading. PILOT is a problem generation tool for graph algorithms, while SAIL is a LaTeX-based scripting tool for problem generation.

Computer Science-Course Tutor is unique with respect to the previous work in the following manner:
The intelligent tutoring system was built for problems for which the answers might not be always quantitative [1,2].
Computer Science-Course Tutor is designed to help students learn introduction to Computer Science by:

1. Gradually teaching the material to the students
2. Giving hints and examples using text and pictures
3. Obtaining the proper feedback.

Computer Science-Course Tutor is designed to replace the teacher. It has the following modules: Pedagogical Module, Expert Module, Student Module, and Tutoring process module.

5.1 Computer Science Course -Tutor Pedagogical Module Design

It has been noticed that students are having difficulties in understanding this course because it contains too much material with difficult scientific phrases. To overcome these difficulties, an Intelligent Tutoring System for teaching this course called **Computer Science-Course -**Tutor have been developed to students enrolled in Computer Science I as a compulsive course at Al-Azhar University in Gaza.

Computer Science Course:

a) First Chapter: An Introduction to Computers
   1. Introduction
   2. What is computer?
   3. The constituents of computer
   4. Using computers
   5. categories of computers
   6. elements of an information system
   7. glossary

b) Second Chapter: The Internet and www
   1. The Internet
   2. The World Wide Web
   3. Web browsers and web address
   4. Searching the web
   5. Types of websites
   6. E-commerce
   7. Other internet services

5.2 Expert Module of Computer Science Course -Tutor

Expert Module was implemented to gather the necessary information for generating the feedback [4]. In addition to whether the user's answer is correct/incorrect, the module can provide the student with the hints when it is requested. Furthermore, the module provides the student the proper feedback in response to the student's answer.

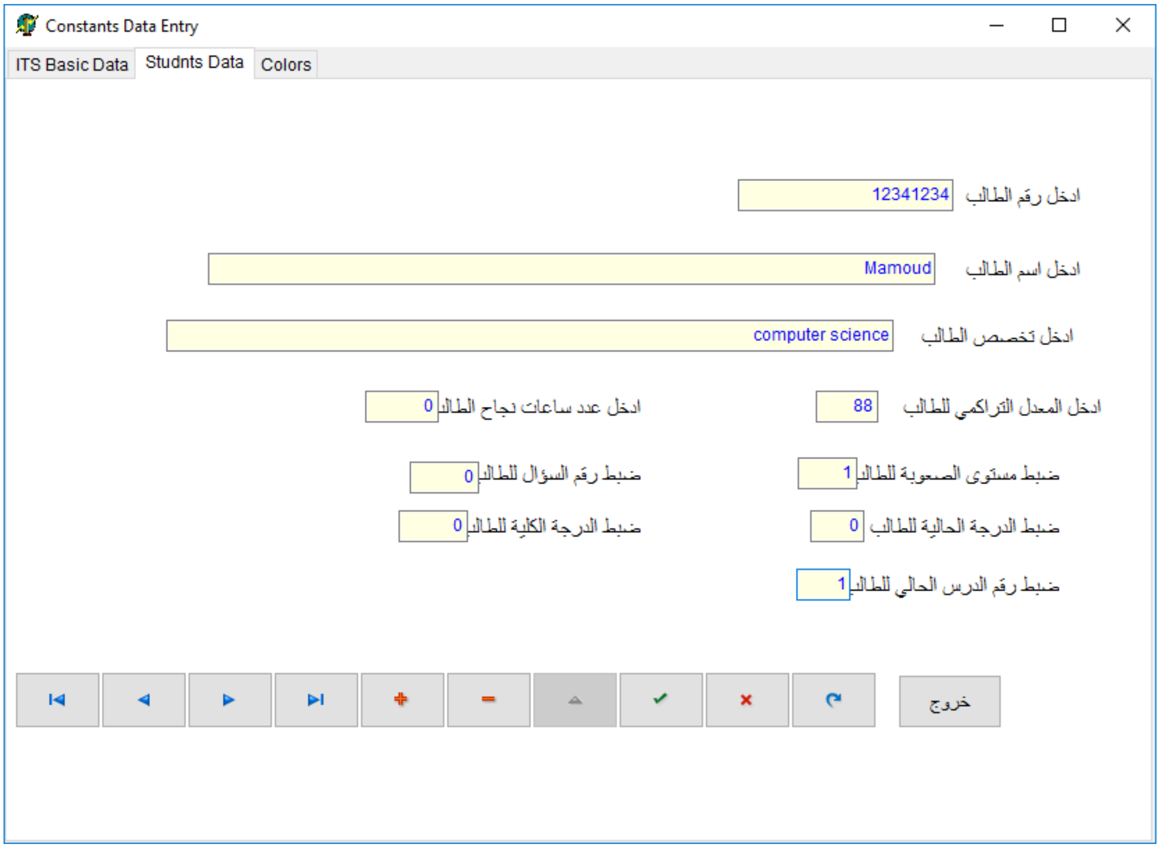
5.3 Student Module of Computer Science Course -Tutor

A new student must create his own account to have a profile. The profile has information about the student such as his name, dates of login, score of each session, and learning progress during the each session. The student's score can be viewed at any time during the session as a table that describes the student performance in solving problems.

5.4 Tutoring process module of Computer Science Course -Tutor

Tutoring process module works as a coordinator that controls the functionality of the whole system.

Computer Science Course -Tutor User Interface Design



ادخل رقم الطالب 12341234

ادخل اسم الطالب Mamoud

ادخل تخصص الطالب computer science

ادخل المعدل التراكمي للطالب 88

ادخل عدد ساعات نجاح الطالب 0

ضبط مستوى الصعوبة للطالب 1

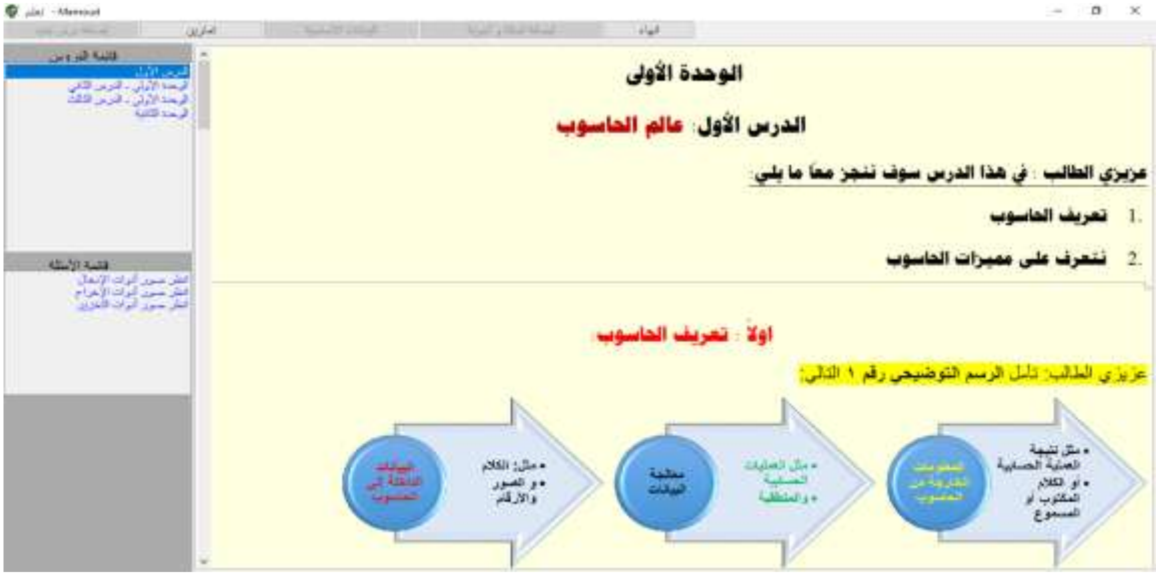
ضبط رقم السؤال للطالب 0

ضبط الدرجة الحالية للطالب 0

ضبط الدرجة الكلية للطالب 0

ضبط رقم الدرس الحالي للطالب 1

Figure 2 shows the user-creation interface of the tutor.



الوحدة الأولى

الدرس الأول: عالم الحاسوب

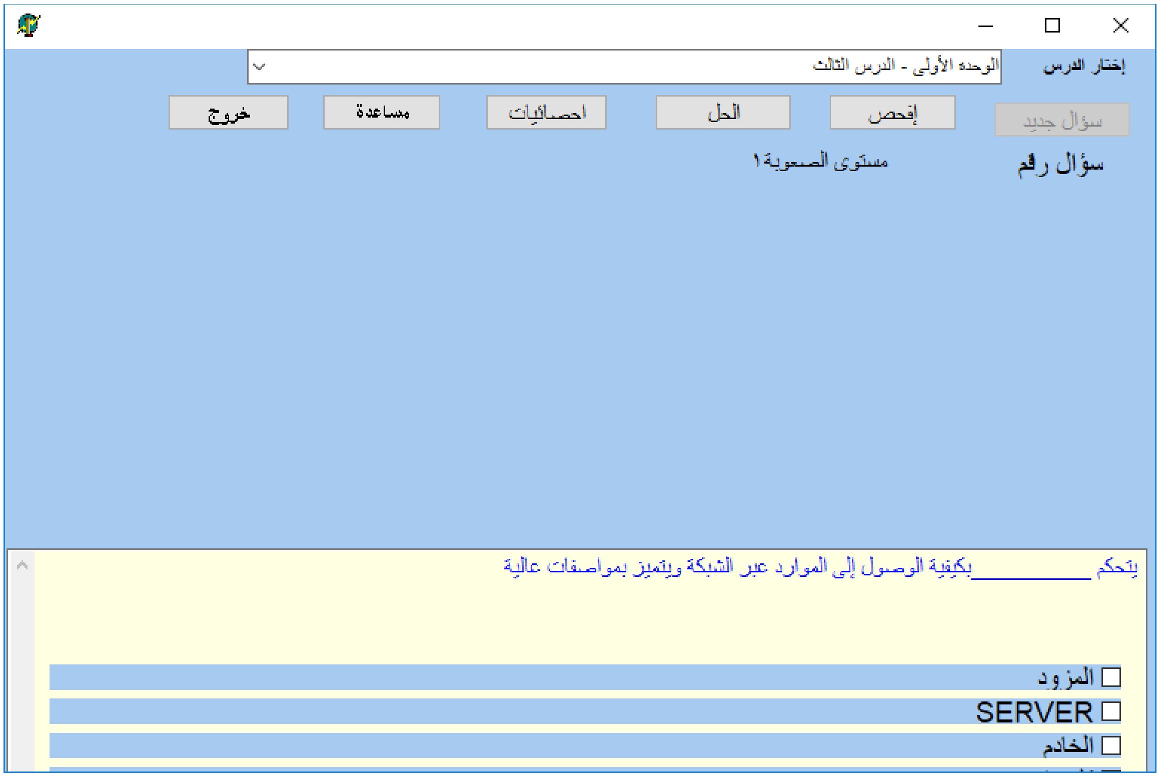
عزيزي الطالب : في هذا الدرس سوف ننجز معاً ما يلي:

1. تعريف الحاسوب
2. نتعرف على مميزات الحاسوب

اولاً : تعريف الحاسوب

عزيزي الطالب: تأمل الرسم التوضيحي رقم ١ التالي:

Figure 3: lesson interface



إختار الدرس: الوحده الأولى - الدرس الثالث

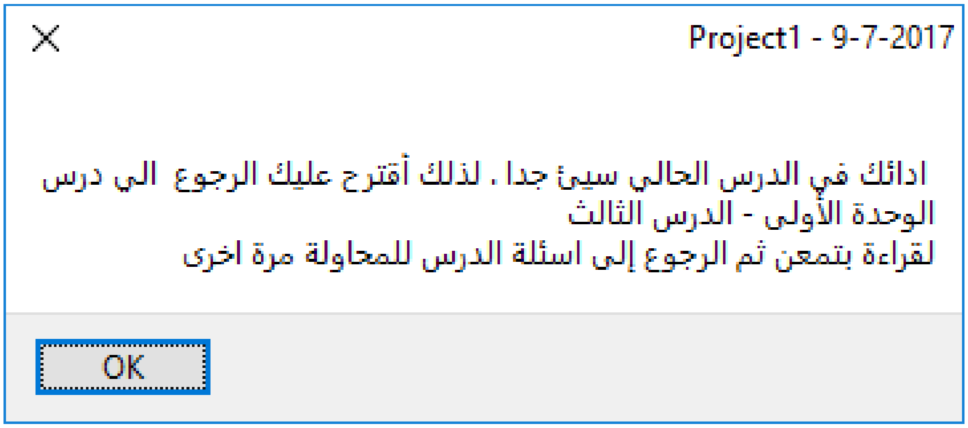
سؤال رقم

مستوى الصعوبة ١

يتحكم __________بكيفية الوصول إلى الموارد عبر الشبكة ويتميز بمواصفات عالية

□ المزود
□ SERVER
□ الخادم

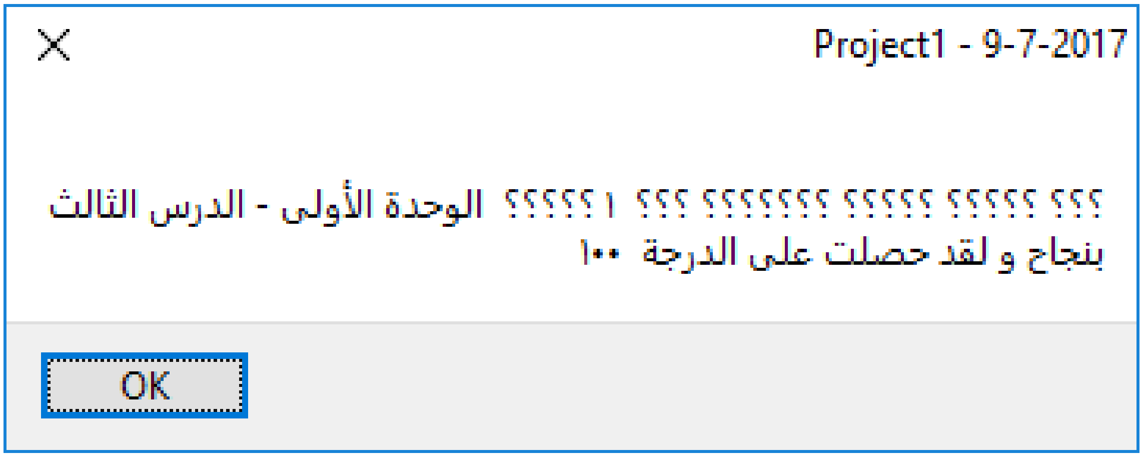
Figure 4: the exercises interface



Project1 - 9-7-2017

ادائك في الدرس الحالي سيئ جدا . لذلك أقترح عليك الرجوع الي درس
الوحدة الأولى - الدرس الثالث
لقراءة بتمعن ثم الرجوع إلى اسئلة الدرس للمحاولة مرة اخرى

Figure 5: ITS directs the learner to relearn the lesson



Project1 - 9-7-2017

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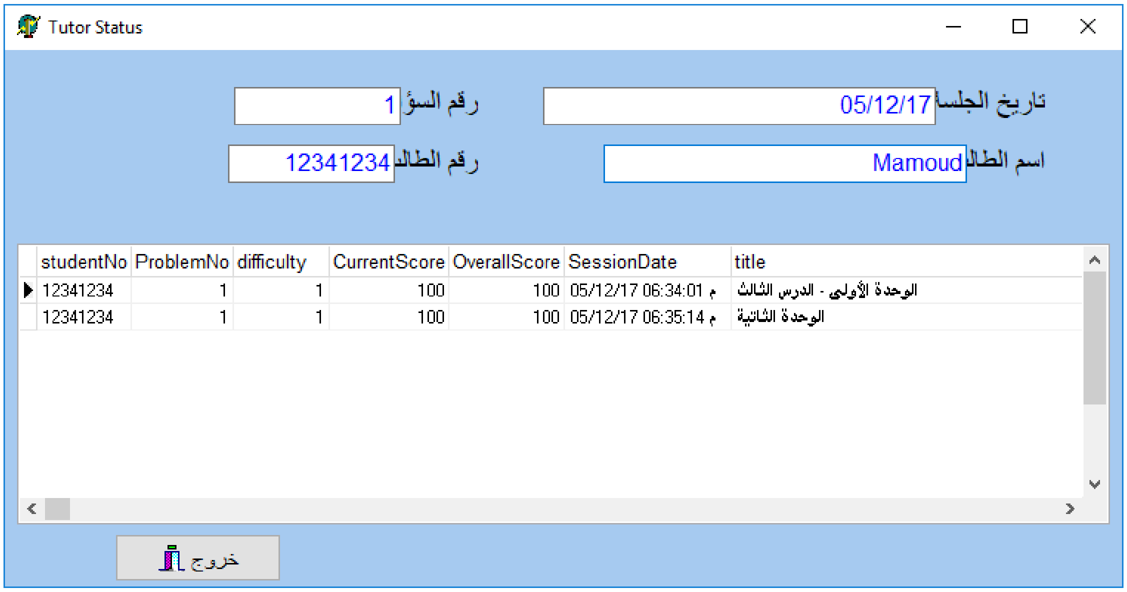
بنجاح و لقد حصلت على الدرجة ١٠٠

Figure 6: ITS informs the learner about his degree



Tutor Status

تاريخ الجلس	05/12/17
رقم السؤ	1
اسم الطال	Mamoud
رقم الطال	12341234

studentNo	ProblemNo	difficulty	CurrentScore	OverallScore	SessionDate	title
12341234	1	1	100	100	05/12/17 06:34:01 م	الوحدة الأولى - الدرس الثالث
12341234	1	1	100	100	05/12/17 06:35:14 م	الوحدة الثانية

Figure 7: Statistics about learner's progress

6. CONCLUSIONS AND FUTURE WORKS

The design of an Intelligent Tutoring System called Computer Science Course -Tutor was described in this paper. Computer Science Course-Tutor was designed to teach students Computer Science Course to overcome their difficulties. Computer Science Course-Tutor is dynamically adapted at run time to the student's individual progress. An initial evaluation of Computer Science Course-Tutor was carried out by a lecturer and some students in the faculty of Engineering and Information Technology at Al Azhar University in Gaza. The outcome of the evaluation was positive and suggested that other intelligent tutoring systems should be designed for other courses. We recommend a comprehensive evaluation of the system to be carried out next time the course is offered.

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