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Intelligent Tutoring System for Teaching Computer Science I in Al-Azhar University, Gaza

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Abstract: *Intelligent Tutoring System ITS is a computer software that supplies direct and adaptive training or response to students without, or with little human teacher interfering. The main target of ITS is smoothing the learning-teaching process using the ultimate technology in computer science. The proposed system will be implemented using the "ITSB" Authoring tool. The book "Introduction To Computer Science" is taught in Al-Azhar University in Gaza as a compulsory subject for students who study at humanities faculties. In this thesis, the researcher demonstrates an intelligent tutoring system for teaching the above mentioned subject. The system was assessed by a group of teachers and students and the results were promising.*

Keywords: ITS, Intelligent Tutoring System, ITSB, Intelligent Tutoring System Builder, Expert system, CAI, Computer Science, Artificial Intelligent.

1. INTRODUCTION

Nowadays; enormous effort is paid toward education and learning, because simply education forms economy, industry, and the culture of humans. Therefore education technology has evolved exponentially. All great educators advocate involvement of technology in the teaching-learning environment as a facilitating tool or as a subject of study.
No one can disregard the role of computer science and the power of artificial intelligent in educational systems.
In the literature review we find numberless studies about computer science in education and how to improve teaching-learning process using this technology.
My work will be a small contribution to enrich the educational process in my country.

1.1 Statement of the Problem

Each humanities colleges student in Al-Azhar University of Gaza must go through a subject called " Computer Science 1" . Due to the catastrophic circumstances in Gaza Strip (at the time of this study), learning and teaching become harder and harder. We can make it easier for teachers and students to get their share in education by involving computer and technology in the teaching-learning process.
There is some of the difficulties to do that in the traditional teaching:

- Individual differences among students: Some students learn slowly, with human teachers there is no sufficient time.
- Availability: Some students cannot come to the university regularly. In addition teachers are not available every time and everywhere.
- Innovation: Using computer in learning is interesting for most students.
- Attendance: There are students with special needs, so they can't follow the teacher as their normal class mates do.

All these problems can be solved by using ITS technology.

1.2 Objectives

This project is expected to decrease the difficulties faced the students in learning computer science 1, and creating a suitable environment for studying.

1.3 Significance of the study

The proposed ITS for teaching computer science 1 uses artificial intelligence to carry out educational tasks. It introduces the scientific material to the students and shows some examples that simplify the topics to them. Moreover; exercises are provided to evaluate students achievement.
The system controls the students' progress related to their scores that they obtained. The student's performance is depicted through appropriate statistics.
The questions, which are posed to the learner are chosen randomly from the system each time the student logs in.

1.4 Limitation of the thesis

The course was designed in Arabic language only.

1.5 Research Methodology

In this section the researcher describes how he accomplished the work.
These steps have been followed:

1. Get the Arabic version of the e-book:
   The English version was translated into Arabic successfully by Prof. Dr. Samy Abu Naser.
2. Organizing lessons:
   The units of the book being used were divided to several lessons depending on the scientific material contained in each unit, and each lesson was saved in rich-text format so that the author tool can identify them. Each lesson is given a difficulty level for its questions e.g. questions of lesson 1 are of difficulty level 1, and questions of lesson 2 are of difficulty level 2 …etc. Since we have 21 lessons in the system, these levels are prepared in sequential

order beginning from 1 to 21.
(see appendix B.1)

3. Add the lessons to the authoring tool ITSB:
   ITSB is an authoring tool designed and developed to help teachers in constructing intelligent tutoring systems in multidisciplinary fields.
4. Prepare examples for each lesson to make matters as easy as possible. (See appendix B.2)
5. Attach each lesson with its examples.
6. Prepare questions:
   Each lesson has its associated questions. The questions are given grades according to their difficulty levels, in such a way that the student can't proceed to the next lesson without finishing the current lesson.(See appendix B.3)
7. Prepare a hint for each question. These hints serve as help tool to solve the question. They give evidence or explain the question in more detail in such a way that the student can answer the question correctly. The hints are available when is needed.(See appendix B.4)
8. Prepare the final exam. Students are encouraged to test themselves to make sure that
9. They have a satisfiable understanding of the scientific material. (See appendix B.5)
10. Execute and test the system.
11. Let learners and professors use the system to make feedback.
12. Use the feedback to enhance the system.
    Some students and professors were chosen randomly to execute and test the system, and a questionnaire(see appendix A) was given to them to qualify the system. Results from the questionnaire were taken in account to improve the system.
13. Check the system again and again depending on the feedback gained from professors and learners.

2. INTELLIGENT TUTORING SYSTEMS(ITS)

Thanks to advances in technology (computers, Internet, networks), advances in scientific progress (artificial intelligence, psychology), and improved understanding of how people learn (cognitive science, human learning), basic research in the field has expanded, and the impact of these tools on education is beginning to be felt. The fi eld now has a supply of techniques for assessing student
knowledge and adapting instruction to learning needs. Software can reason about its own teaching process, know what it is teaching, and individualize instruction[6].
ITS is a software that provides teaching or training using artificial intelligent techniques, such as neural networks , face recognition and machine learning technologies.
ITS can introduce the scientific material in many different ways depending on the profile of the student

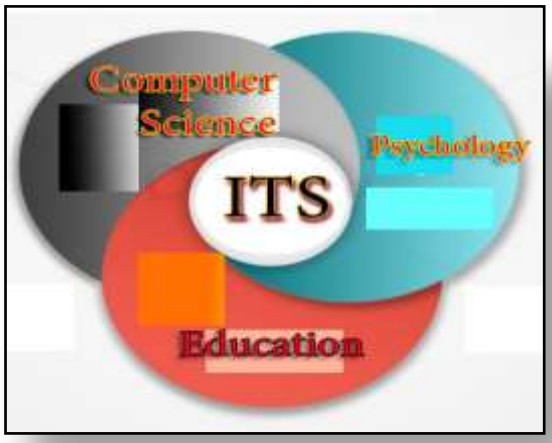

Figure 1: The field of ITS is grounded on three disciplines: computer science, psychology, and education.

Figure 1 shows that ITS makes use of several disciplines, hence it uses education to select teaching strategies suitable for students and to apply theories of teaching-learning process. Psychology helps to analyze the behavior of the students and to understand how students learn and how to motivate them properly. Computer science is crucial to build the software and to determine the hardware needed to help the students[6].

2.1 Definitions of ITS

1. Abu Naser states: "An intelligent tutoring system (ITS) is a software that aims to provide immediate and customized instruction or feedback to learners, typically without interference from a human teacher. ITSs have the general aim to facilitate learning in an evocative and efficient way by using a diversity of computing technologies"[1].
2. Giuseppe Fenza et al. defines ITS as: "An Intelligent Tutoring System (ITS) is a software system providing adaptive educational experiences."[2]
3. Yanjin Long et al. say that "Intelligent Tutoring Systems often are strongly system-controlled learning environments that adaptively select problems for students based on their knowledge level"[31].
4. Hoang Nam Ho et al. define ITS as : "ITSs are called cognitive tutors that must be able to achieve three main tasks: improve the student's knowledge level, decide what to do next, adapt instruction accordingly and provide feedback"[32].
5. Dr. Neelu Jyothi Ahuja et al. define ITS as "It is a computer-based program not only to emulate a 'human tutor', but to personalize the instructions based on the background and progress of each individual learner" [5].

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From the definitions above we can see that they emphasis on adaptivity, self-decision-making, and individuality. So we can formulate the following understanding for the ITS:
ITS is a computer system that is intelligent enough to tackle teaching tasks, in such a way that it can replace the human teacher as possible as it may be could.

i. Architecture of ITS

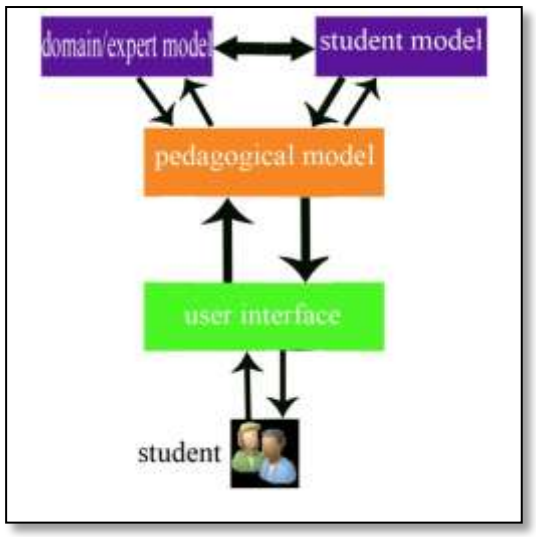

Figure 2: ITS components

2.2.1 Domain Model

Domain Model contains the knowledge about the actual teaching material (e.g. physics, computer science and mathematics).
Domain Model represents the domain knowledge and how the expert performs in the domain of knowledge.
Some literatures named it "expert model" while other literatures assumed that expert and domain models are two extinct models. [2]

2.2.2 Student Model

It observes student's behavior and creates a qualitative representation of her/his cognitive and affective knowledge. Its purpose is to provide knowledge that is used to determine the conditions for adjusting feedback. It supplies data to other tutor modules.
A primary goal for the student model is to ensure that the system has principled knowledge about each student, so it can respond effectively, engage students' interest, and promote learning. [4,6]
There are three techniques to represent the students misconceptions[3]:

1. The overlay model: This model tries to compare the behavior of a student with the behavior of an expert. The difference between those two states can be seen as the skills and knowledge the student has not gained yet .
2. The perturbation model: This model adds bug library to the overlay model. It tries to model the student not only with regard to the correct knowledge but additionally with regard to known errors and misconceptions in the domain.
3. Another type of student modeling is the learner-based modeling. The focus of learner-based modeling lies in the process of knowledge acquisition because the misconceptions are produced during that process. Problem solving rules which explain the steps taken until a misconception was created by the student, can be generated by utilizing machine learning techniques.

2.2.3 Pedagogical Model

It is called sometimes teaching model or expert model, it provides the knowledge infrastructure to select and plan the teaching elements according to the student model. It selects the suitable action (e.g. feedback or providing a hint) in order to react to the student's interaction with the system. Pedagogical model works depending on the teaching strategy adopted by the system, taking care of student's time of respond and student's profile.
The main tasks of the expert model are summarized. It should [3]:

- select the content that is displayed by the communication model,
- select a tutoring strategy depending on the learning process,`
- control and adjust the speed of tutoring actions,
- select and generate questions to check the learning progress,
- select and generate constructive feedback,
- provide assistances and additional information to deal with gaps in student's knowledge,
- take actions to guarantee student's motivation during instruction.

2.2.4 User Interface Model

Also called communication model it is responsible of the interaction between learner and system.
The communication between the learner and the system can be of various types. We mention some of them:[6]

1) GRAPHIC COMMUNICATION, which can be of the following types:
   a. Animated pedagogical agents. They are intelligent computer characters that guide learners through an environment.
   b. Synthetic humans. They are pedagogical AI agents rendered as realistic human characters.
   c. Virtual reality. It immerses students in a graphic environment that includes the pedagogical agent.
2) SOCIAL INTELLIGENCE: emotional and social connection. This is done by:
   a. verbal analysis (e.g. problem-solving time, mistakes, and help requests)
   b. Visual systems, this includes facial emotion recognition , understanding eye movement .

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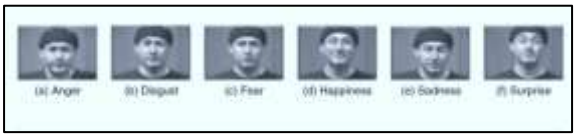

Figure 3 : The face exposes emotions

c. Metabolic indicators. Student's affective states are sensed by noninvasive physiological devices (i.e. devices that do not puncture the skin or entering a body cavity) , that measure heart rate change, voice inflections, eye and body movements.

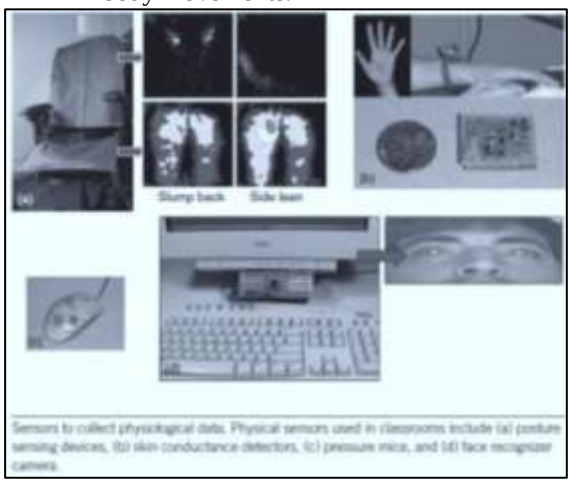

Figure 4: Physiological states can be captured by the computer

d. Speech Cue recognition. Negative, neutral, and positive emotions can be extracted using speech cues. The best performing feature set contained both acoustic-prosodic and other types of linguistic features.[6]

3) COMPONENT INTERFACES: These interfaces process student input (understand formulas, equations, vectors) or evaluate symbols specific to discipline (e.g., molecular biology, chemistry)[6].

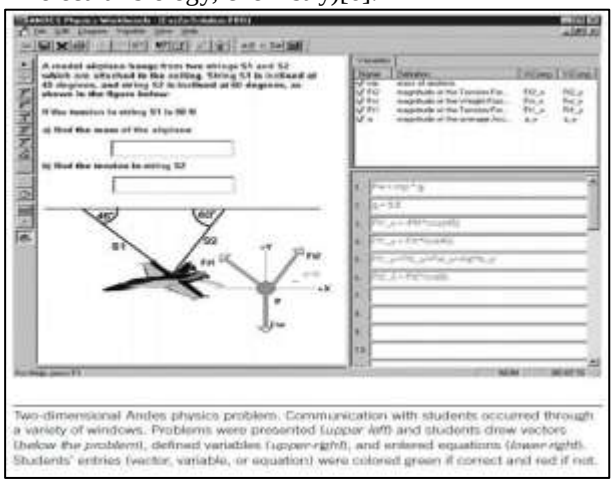

Figure 5: A screenshot from ANDES Tutoring System whose interface consisted of several windows and multiple tools

4) NATURAL LANGUAGE COMMUNICATION.

There are four types of natural language-based tutors :

a. Mixed Initiative Dialogue: either tutor or students initiate and direct the conversation.
b. Single-Initiative Dialogue Tutor: considers students' previous and next utterance; but only the tutor has true initiative.
c. Directed Dialogue: tutor remains in control and prompts students for explicit information. Tutor understands short student answers and generates NL explanations.
d. Finessed Dialogue: dialogue is simulated through menu-based input, logical forms, or semantic grammars [6].

2.3 History of ITS

Since the sixties, ITS have been announced as one of the hopeful methods to deliver individualized teaching. In the early 1960, programmed instruction, enhancing learning for low achievers, was educationally fashionable, moving towards structured and goal oriented instruction.

The dawn of seventies saw a new era of ITS development with knowledge representation, student modeling, Socratic tutoring, skills and strategic knowledge, buggy library, expert systems and genetic graph. In the eighties the emphasis in ITS development was case-based reasoning, more buggy based systems, discovery worlds, progression of mental models, simulation, natural language processing, authoring systems and systems based on model tracing. Model tracing tutors contained a cognitive model or simulation of an expert's correct thinking in the domain.

In the nineties focus shifted to learning theory that embodied concepts such as learner control, collaborative learning, information processing and virtual reality.

In the 21st important issues related to ITS development concentrated on student modeling approach, learning through games, adaptation to emotional state of user, web based tutoring systems, knowledge modeling by fuzzy linguistic information, WIMP (windows, icons, menu & pointer) interfaces, summary assessment techniques, motion capture technology, interrelation between person's cognitive load and pupil's size and education data mining[7].

2.4 Some examples that highlight the development of ITS technology:

BASIC Instructional Program (1970) employed teaching procedural skills in learning programming language BASIC. Exercises were dynamically and individually selected per user using Curriculum Information Network (CIN).

Carbonell's SCHOLAR (1970) used semantic net to represent domain knowledge as well as the student model.

Collins in 1975 outlined set of tutorial rules for Socratic tutoring. One such system was WHY. It stores domain knowledge in script hierarchy containing stereotypical sequences of events.

WEST helped students to improve arithmetic expression manipulation skills. It was called issue-based tutoring.

SOPHIE (Sophisticated Instructional Environment) assisted learners in developing electronic troubleshooting skills. SOPHIEI, SOPHIE II, SOPHIE III have extended the environment of their predecessors.

BUGGY (1978) employed buggy library approach for diagnosis of student mistakes (bugs). It was a framework for modeling misconceptions underlying procedural errors in addition and subtraction exercises offered to student for solving.

DEBUGGY was an offline version of a system based on BUGGY using the pattern of error. IDEBUGGY developed by Burton in 1982 was an on line version to diagnose student's procedure bit by bit while giving the learner a new problem to solve at each step. Limitation of buggy library was its inability to anticipate all possible misconceptions. MYCIN was a rule-based expert system for diagnosing certain Infectious diseases such as meningitis. Using the learning of MYCIN, **GUIDON** was constructed by Clancey in 1979 to interface with MYCIN for tutoring, interactively presenting the rules in the knowledge base to a student .

WUSOR was the name of the on-line training for the game WUMPUS, developed by Stansfield, Carr and Goldstein in 1976 .

LISP Tutor by Anderson Boyle and Reiser and a Geometry Tutor by Anderson Boyle and Yost arrived in mid-1980 employed the approach of model tracing.

PROUST by Johnson and Littman Soloway in 1984 diagnosed non-syntactic student errors in PASCAL.

PIXIE developed by Sleeman in 1987 is an online ITS based on Leeds Modeling System (LMS) having a diagnostic model for determining sources of errors in algebra due to incorrect (mal) rules that are inferred from basic principles and bugs at abstraction level.

In late 1980 arrived the Case-based Reasoning (CBR) research by Schank and Kolodner which had a more adaptive learning environment, with the advantage of being suitable to domains where there are too many ways in which the rule can be applied (e.g. programming , game playing) and suggests approximate answers to complex problems.

The year 1990 brought the new trend of graphic simulations. Hauk Mack III was a system that expanded number of components and complexity of animations by orders of magnitude . The other areas of research and development that gained prominence were Natural Language Processing (NLP) and authoring shells.

SOPHIE was built on a powerful and original NLP technique developed by Richard Burton; called Semantic Grammar. It represented a powerful combination of carefully selected keywords with algorithms that searched the context for meaningful variables and objects.

Authoring shells are kind of e-learning systems that feature authoring environments for system users, simplify the software development life cycle. Domain knowledge in such systems can be represented by using different knowledge representation specifications.

In recent years, progress has been towards providing adaptivity and personalization in computer based education through student modeling, mobile technologies, educational games and standalone educational applications.

An adaptive educational system has to provide personalization to the specific needs, knowledge and background of each individual student which is challenging since students not only have different learning needs, but also different learning styles.

The processes of observation of student's action and behavior in an adaptive and/or personalized tutoring system, and of induction, should be made automated by the system. A solution for this is machine learning, which is concerned with the formation of models from observations and has been extensively studied for automated induction. The cognitive theory attempts to explain human behavior during the learning process by understanding human's thinking and understanding. The **Constraint-Based Model (CBM)** proposed by Ohlsson in 1996 is based on Ohlsson's theory of learning from errors, and proposes that a learner often makes mistakes when performing a task, even when he/she has been taught the correct way to do it.

Fuzzy Student Modeling was applied, by Stathacopoulou et al. in 2005 to a discovery-learning environment that aimed to help students to construct the concepts of vectors in physics and mathematics . Several student models have been built based on ontologies. These support the representation of abstract concepts and properties so as to be easily reused and, if necessary, extended in different application contexts.

Adaptive Intelligent Web Based Education Systems (AIWBES) were developed as an alternative to traditional e-learning environments according to 'one-size-fits-all' approach.

Affective tutoring systems (ATS): The system utilizes a network of computer systems, prominently, embedded devices to detect student emotion and other significant bio-signals and adapt to the student's mood and display emotion via a life-like agent called Eve, whose tutoring adaptations are guided by a case-based method for adapting to student states - confused, frustrated or angry.

Multi Criteria decision model has been employed to integrate expert's knowledge modeled by fuzzy linguistic information, enhancing accuracy of diagnosis for adaptation of computerized test of the student competence level.

Pen-based tutoring systems are based on WIMP interfaces. Newton's Pen is a "statics tutor" implemented on a ''pen top computer,'' a writing instrument with an integrated digitizer and embedded processor. This project entailed the development of sketch understanding techniques and user interface principles for creating pedagogically sound instructional tools for pen top computers. Development on the pen top platform presented

novel challenges because of limited memory and computational power resources .

Automatic Summary Assessment has been a widely used mechanism. Several techniques such as latent semantic analysis (LSA), n-gram co-occurrence and BLEU ((bilingual evaluation understudy) is an algorithm for evaluating the quality of text which has been machine-translated from one natural language to another) have been proposed to support automatic evaluation of summaries. Landauer et al in 1998 first developed latent semantic analysis in the late'80s with the purpose of indexing documents and information retrieval. LSA works by using a matrix to capture words and frequency of the words appearing in a context that is transformed using Singular Value Decomposition (SVD). Based on the result of Landauer's experiment, LSA is capable of producing acceptable results. However, LSA does not make use of word order as Landauer claims that word order is not the most important factor in collecting the sense of a passage. Pérez et al. in 2004 modified the BLEU algorithm, which was originally developed for ranking machine translation systems, into one that is capable of marking students' essay. Lin and Hovy in 2003 conducted a study on using the two machine translation evaluation techniques, BLEU and NIST's n-gram co-occurrence scoring procedures, on the evaluation of summaries to measure the closeness of the candidate to the reference summary. With the recent success of e-learning and advances in other areas such as Information Extraction (IE) and NLP, automatic assessment of summary writings has become possible.

Handwriting Based Intelligent Tutors use handwriting input .

Educational Data Mining (EDM) is concerned with developing, researching, and applying computerized methods to detect student access patterns in large collections of educational data that would otherwise be hard or impossible to analyze due to the enormous volume of data within which they exist .

Motion Capture Technology is being used in automated lesson generation systems for example one such system is 'Dance Learning from Bottom-Up Structure (DL-BUS)' for guiding beginners to learn basic dance movement, analyzing the dance to generate a two-phase lesson (phase-1 to divide dance into small segments and phase -2 to combine patterns in temporal order) providing suitable cognitive load thus offering an efficient learning experience.

Intelligent Pupil Eye Analysis System, involving the interrelation between person's cognitive load and pupil size. This sensitivity of the pupil can provide exhaustive data about the cognitive loads. Different works such as by Klingner et al., in 2008; Partala and Surakka, in 2003; Valverde et al., in 2010; Klingner, in 2010; Just and Carpenter, in 1993; Backs and Walrath, in 1992; and Porter et al., in 2007 demonstrate that task-induced dilations can serve as reliable proxies for cognitive load, and the sizes of blink pupil dilations reliably reflect a diverse scale of the difficulty of different activities thus validating pupillary dilations.

Non-crisp learner responses that are uncertain usually belong to completely understanding or not understanding case for the content of learned courseware.

One of the Response Theory was Personalized Learning Item Response Theory (PELIRT),which including the fuzzy aspects, transformed into Fuzzy Item Response Theory (FIRT), proposed by Chih-Ming Chen and Ling-Jiun Duh correctly estimated learner ability via the fuzzy inference mechanism.

UZWEBMAT: (Turkish abbreviation of Adaptive and Intelligent WEB based Mathematics teaching–learning system) -teaches secondary school level permutation, combination, binomial expansion and probability.[7]

2.5 Advantages of ITS:

1. Providing a teacher for every student. This is the holy grail of teaching technology. Studies showed that one-to-one teaching is able to boost students' achievement the following figure shows a comparison between one-to-one teaching, teaching by a conventional teacher, and teaching by a master teacher. The results were biased in behalf to the one-to-one teaching[6].

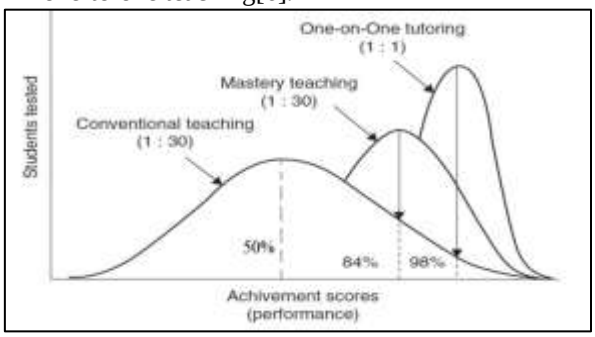

Figure 6: Student achievement in classroom instruction (1:30 teacher/student ratio) was found to differ from achievement based on individual tutoring (1:1 teacher/student ratio) by about two standard deviations[6]

2. Protecting student privacy: Student privacy will be critical and a heavily protected portfolio for each student, including grades, learning level, past activities, and special needs will be maintained[6].
3. Intelligent tutors work with students who have various abilities and disabilities. Some students have physical, visual or aural impairment, if they were put with other normal students they would face difficulties in learning and they would miss the learning opportunity. Using ITS helps such students take their chance in learning effectively.
4. Students can learn at their own pace. Interactive animated pedagogical agents offer a low-pressure learning environment that allows students to gain knowledge at their own pace[6].
5. ITS makes team-work easier: Collaboration tools support synchronous, symmetric cooperation

through the Internet and encourage students to question processes and monitor each other's reasoning. To an increasing degree, software transparently supports the exchange and sharing of information among students and provides artifacts or tools and services. Technology might direct students to interact with teammates or indicate how and when to communicate, or when to question, inform, and motivate one's teammate. Other technologies represent collaboration as a dialogue grammar, maintain a relational and hierarchical representation of dialogue, or ask participants to refine their beliefs[6].

6. Progressing in science and technology: The field of artificial intelligence and education has many goals. One goal is to match the needs of individual students by providing alternative representations of content, alternative paths through material, and alternative means of interaction. The field moves toward generating highly individualized, pedagogically sound, and accessible lifelong educational material. Another goal is to understand how human emotion influences individual learning differences and the extent to which emotion, cognitive ability, and gender impact learning[6].

2.6 Study Community

My study community is the students enrolled in Humanities colleges at Al-Azhar University in Gaza who have to pass the curriculum named as "Computer Science 1".

3. LITERATURE REVIEW

Because of the development of technology and massive development of computer science, human being has become dependent on computer applications heavily in most fields, especially in learning. Special effort was dedicated to intelligent tutoring systems. In this part of the study, the researcher reviews what has been fulfilled recently in the domain of ITS technology.

1. An Intelligent E-Learning System for Beginner Programming – Using Analogical Reminder for Error Classification and Explanation(a master thesis). It was designed by Robert Pollack, at Otto-Friedrich University, Bamberg. The tutor system is a prototype of an Intelligent Tutoring System that assists a learner during solving programming exercises in the functional programming language SCHEME by displaying an example that has been solved correctly in the past[3].

2. Expert tutoring system for teaching computer programming languages. By M.M. El-Khouly, B.H. Far, Z. Koono. This is an Expert tutoring system (E-TCL) for teaching computer programming languages through World Wide Web. In this version, many teachers can cooperate together to put the curriculum of one or more computer programming languages. Their contributions may include:
    a. Add or modify the commands' structure that will be taught;
    b. Generate different tutoring dialogs for the same command; and
    c. Generate different tutoring styles.

   On the contrary, the students can access the system through WWW, select any language they want to learn as well as the style of presentation they prefer and they can exchange their experiences. A personal assistant agent for teachers (PAA-T), a personal assistant agent for students (PAA-S) with an adaptive interface, and tutoring agent (TA) has been built. The TA resides on the server side and communicates via HTTP and IIOP with both the PAA-T and PAA-S on the clients side. This structure allows customization of the PAA-T and PAA-S to the needs of the teachers and students, without putting extra burden on the server. In addition, this allows having many teacher agents attending to the needs of a single or multiple student agent(s) [9].
3. AnimalWatch. AnimalWatch supported students in solving arithmetic word problems about endangered species, thus integrating mathematics, narrative, and biology. Mathematics problems—addition, subtraction, multiplication, and division problems—were designed to motivate 10- to 12-year-old students to use mathematics in the context of solving practical problems, embedded in an engaging narrative[6].
4. PAT. It is a full-year algebra course for 12- to 15-year-old students. PAT was developed by the Pittsburgh Advanced Cognitive Tutor (PACT) Center at Carnegie Melon University and through Carnegie Learning [6].
5. Movafegh, H. et al. An adaptive and intelligent tutor by Expert systems for mobile devices.
   The aim of this application is to investigate the role of mobile devices and expert systems in disseminating and supporting the knowledge gained by intelligent tutors and to propose a system based on integration of intelligent M-Learning with expert systems. It acts as an intelligent tutor which can perform three processes - pre-test, learning concept and post-test - according to characteristic of the learner. The proposed system can improves the education efficiency highly as well as decreases costs. As a result, every time and everywhere (ETEW) simple and cheap learning would be provided via SMS, MMS and so on in this system. The global intention of M-Learning is to make learning "a way of being" [10].
6. Intelligent Tutoring Systems with Conversational Dialogue , by *Arthur C. Graesser et al.*

The tutoring systems present challenging problems and questions to the learner, the learner types answers in English, and there is a lengthy multi-turn dialogue as complete solutions or answers evolve [11].

7. A Critical Review of Development of Intelligent Tutoring Systems: Retrospect, Present and Prospect by Dr. Neelu Jyothi Ahuja et al. This paper introduces, Intelligent Tutoring Systems along with their typical architecture, developmental history, past and present systems and concludes with a broad discussion on wide-spanning focus areas for future developmental research. A critical analysis of the developmental history highlighting the theme behind the developed systems, their purpose and the key ITS concept, have been presented [12].
8. In 2011 Van LEHN conducted a study to compare the effects of human tutoring, computer tutoring, and no tutoring on the achievement of the student .The researcher found no significant difference between human tutoring and intelligent computer tutoring systems [13].
9. A similar study was executed by Ma, Wenting et al. in 2014 .And they got the same results as in the previous study [14].
10. Recent research has indicated that misuse of intelligent tutoring software is correlated with substantially lower learning. Students who frequently engage in behavior termed "gaming the system" (behavior aimed at obtaining correct answers and advancing within the tutoring curriculum by systematically taking advantage of regularities in the software's feedback and help) learn only 2/3 as much as similar students who do not engage in such behaviors. Baker and others presented a machine-learned Latent Response Model that can identify if a student is gaming the system in a way that leads to poor learning [15].
11. Desmarais with other researchers published a paper in 2011, reviewing the learner models that have played the largest roles in the success of learning environments, and also the latest advances in the modeling and assessment of learner skills [16].
12. The book " Advances in Intelligent Tutoring Systems" by Roger Nkambou and others ,published in2010, summarizes foundations, developments, strengths and weaknesses of ITS. And gives a solid floor for advanced research in this field [17].
13. Recently, Jyothi Ahuja, Neelu proposed an intelligent tutoring system(ITS) that teaches geology- especially seismography. His work was tested and accepted [18].
14. Keeley Crockett and others plotted an ITS (called OSCAR) with the ability to predict the preferred learning style of the student using the natural language dialogue during tutoring [19].
15. Jon Wetzel et al. describe the design and development of "Dragoon", an ITS that teaches the construction of models of dynamic systems. Dragoon can be classified as a step-based tutoring system that uses example-tracing, an explicit pedagogical policy and an open learner model. Dragoon can also be used for computer-supported collaborative learning, and provides tools for classroom orchestration [20].
16. The most important thing to mention are the efforts made by Dr. Samy Abu Naser . He led a lot of studies in this field. I mention only some of them:
    a. Design and Development of Diabetes Intelligent Tutoring System. Implemented by Suheir H. Almurshidi, this is a desktop based intelligent tutoring system for teaching diabetes disease to the student to overcome the difficulties they face [21].
    b. Development and Evaluation of the Oracle Intelligent Tutoring System (OITS). Implemented by Rami Aldahdooh. The system presents the topic of Introduction to Oracle with automatically generated problems for the students to solve. The system is dynamically adapted at run time to the student's individual progress [22].
    c. An Intelligent Tutoring System for Learning Android Applications UI Development. Implemented by Hazem Al Rekhawi. It is a web based intelligent tutoring system for teaching Android Applications Development to students to overcome the difficulties they face [23].
    d. DES-Tutor: An intelligent tutoring system for teaching DES information security Algorithm. Applied by Abed Elhaleem A Elnajjar. The DES-Tutor targets the students enrolled in cryptography course in the department Information Technology in Al-Azhar University in Gaza. Through DES-Tutor the student will be able to study course material and try the exercises of each lesson [24].
    e. CSS-Tutor: An intelligent tutoring system for CSS and HTML. Applied by Mariam W. Alawar. The learning material contains CSS and HTML. We divided the material in a group of lessons for novice learner which combines relational system and lessons in the process of learning. The student can learn using example of CSS, and types of CSS color. Furthermore, the intelligent tutoring system supports not only lessons; but exercises of different difficult levels for each lesson. When a

student finish successfully the first difficulty level in a lesson, the student is allowed to move to the next difficulty level of the exercises of the lesson [25].

f. An Intelligent Tutoring System for Teaching Grammar English Tenses. Implemented by Mahdi and Alhabbash. The system provides all topics of English grammar and generates a series of questions automatically for each topic for the students to solve. The system adapts with all the individual differences of students and begins gradually with students from easier to harder level [26].

g. Design and Development of an Intelligent Tutoring System for C# Language. Implemented by AL-BASTAMI. This teaches C# programming language using Intelligent Tutoring System. This ITS was developed using ITSB authoring tool to be able to help the student learn programming efficiently and make the learning procedure very pleasing. A knowledge base using ITSB authoring tool style was used to represent the student's work and to give customized feedback and support to students [27].

h. An intelligent tutoring system for teaching advanced topics in information security. Implemented by Mahdi and Alhabbash. It is intelligent tutoring system for teaching information security. This intelligent tutoring systems target the students enrolled in Advanced Topics in Information Security course in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza [28].

i. An Intelligent Tutoring System for Learning Java Objects. Designed by a group of students in Al-Azhar University of Gaza. It is a web based intelligent tutoring system for teaching Java objects to students to overcome the difficulties they face. The basic idea of this system is a systematic introduction into the concept of Java objects. The system presents the topic of Java objects and administers automatically generated problems for the students to solve. The system is dynamically adapted at run time to the student's individual progress. The system provides explicit support for adaptive presentation constructs. 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 III in the Faculty of Engineering and Information technology at Al-Azhar University, Gaza. The results showed a positive impact on the evaluators[29].

17. Sunandan Chakraborty, Tamali Bhattacharya and others announced the design of an ITS authoring tool Shikshak. They claim that "Low literacy scenario in India and other developing nations demands an alternative learning environment to deal with the problem. Lack of trained teachers, high dropout rates are some of the major problems that need to be addressed. Intelligent Tutoring System (ITS) or ITS Authoring tools (ITSAT) can be thought of as a possible solution to these problems"[8].
18. Sintija Petrovica, Alla Anohina-Naumeca, and Hazım Kemal Ekenel made a paper presenting an analysis of emotion recognition methods used in existing systems to enhance ongoing research on the improvement of tutoring adaptation. Regardless of the method chosen, the achievement of accurate emotion recognition requires collecting ground-truth data. To provide ground-truth data for emotional states, the authors have implemented a self-assessment method based on Self-Assessment Manikin". [30].

3.1. Comments about previous studies

Through reading the above mentioned studies, I found that the design of Intelligent Tutoring System is used for a variety of subjects and in many fields such as programming languages (Java, PHP, C#), Algebra, Mathematics, English grammar, and even in national security.

In addition, ITS technology came through many stages of development and in various designs, and it still in developing and improving.

My thesis is different from the previous studies in its goal that it makes benefit from the technology of ITS to make teaching-learning process easier and more efficient in Al-Azhar University of Gaza.

4. OVERVIEW OF THE PROPOSED SYSTEM

The system of our study has a role-based access control, i.e. there are two types of users that can log in the system:

a) a teacher (or admin) user, and

b) a student user.

Once logged in the system decides which interface to introduce to the specific user.

The teacher interface enables him (or her) to:

1) Add a new student.
2) Add new lessons or modify existing ones.
3) Add new examples or modify existing ones.
4) Add new questions and hints or modify existing ones.
5) Adjust the themes of the system.

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The student interface enables him (or her) to:

1) Read the scientific material and related examples.
2) Go through the lessons in a hierarchical pattern.
3) Solve the questions.
4) Request for hint.
5) Do the final exam.
6) See his (or her) result in a statistical view.

4.1. Authoring Language Used

ITSB Authoring Tool Overview:

ITSB authoring tool is a shell for creating intelligent tutoring systems. It is designed and developed using Delphi Embarcadero XE8, 2015; ITSB authoring tool is two systems in one application. The first one is the teacher system where he/she add the course materials, questions and answers etc. and the second system is the students where he/she learn the course material and practice exercises[1].

The authoring process goes through several steps as follows:

- Add lessons and examples,
- Add questions and hints,
- Put level difficulty for each question, and
- Add students. Every student has his own profile.

The following figure explains the authoring process as a flow chart:

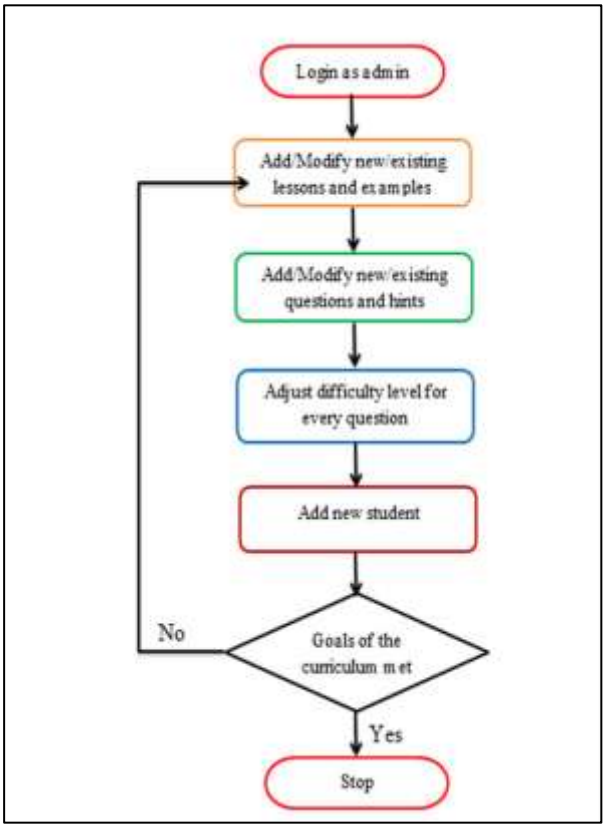

Figure 7 : shows the authoring process as a flow chart

4.2. Architecture of the proposed ITS system

A normal ITS has four fundamental modules: domain model, teaching model, student model and user interfaces.

The domain model adds the course configuration in an structured style. A course may have a variety of parts, such as division, sub-divisions, and topics. These parts are stored in the domain model together with their dependencies. All the materials and resources necessary to tutor a student are also kept in this module.

The student model is the demonstration of the students the system is coping with. The student model provides the system with all required information so it can adapt itself with the student. Therefore, student model is a vital tool for the adaptation process.

The teaching module contains all the decision-making procedure concerning course preparation and adaptation. Often, this module is called the control engine, because this module controls the entire system, by accepting inputs from the other parts.

Lastly, the user interfaces have two sections - one for the student and the other for the teacher. Teacher's interface is accustomed to arrange and adjust the system and its different parts. So, the teacher's interface behaves as the authoring tool. By his interface, the teacher can add new lessons, adjust the established ones, and revise teaching methods. The student's interface is used to convey all the teaching commands. The sort and the type of these commands would differ with student's ability and performance level [1].

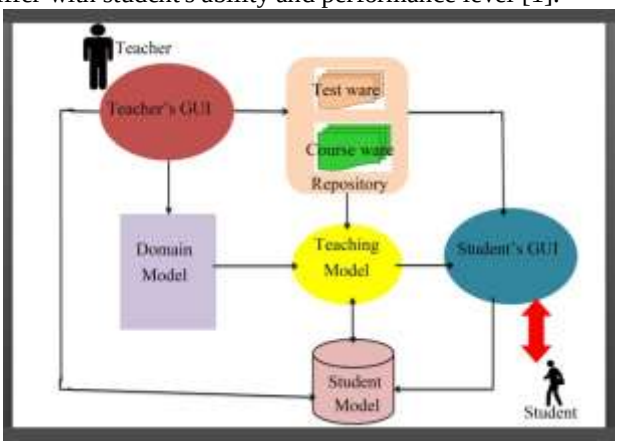

Figure 8: Overall System Architecture of ITSB

4.3.1 Domain Model

The domain model (expert model) is concerned with the lessons, its arrangement and a range of elements. There are two fundamental components in domain model:

- The first component: Domain Organization Model, deals with the arrangement and organization of the lessons and its topics.
- The second one: Repository, deals with the materials being taught themselves [1].

The domain of my ITS system covers the following chapters:

- **Chapter 1: Introduction: A preliminary to computer science.** It was divided into 3 lessons(

lesson 1, lesson 2 and lesson 3) .It talks about computer literacy. It covers the following topics: A World of Computers, What is A Computer? The Components of A Computer, Advantages and Disadvantages of Using Computers, Networks and the Internet (in brief), Computer Software, Installing and Running Programs, Software Development, Categories of Computers, Personal Computers, Mobile Computers and Mobile Devices, Game Consoles, Elements of an Information System, and Computer Applications in Society.

- **Chapter 2: The Internet And World Wide Web:** It explains the main topics related to the Internet and the world wide web. It was divided into 4 lessons. It focuses on practical matter that is important for every internet user, namely: Evolution of the Internet, Internet2, Connecting to the Internet, Access Providers, ISP, How Data and Information Travel the Internet, Internet Addresses (IP), Browsing the Web, Web Addresses (URL), Navigating Web Pages, Searching the Web, Search Engines, Subject Directories, Types of Websites, Web Application, Evaluating a Web Site, Multimedia on the Web, Plug-ins, Web Publishing, E-Commerce, and Other Internet Services.
- **Chapter 3: Application Software:** explains what application software are, and mentions the various types of them giving many examples about them. It was divided into 3 lessons. It includes the following titles: Packaged Software, Custom Software, Open Source Software, Shareware, Freeware, Public-Domain Software, The Role of System Software, Utility Programs, Working with Application Software, Business Software, Word Processing Software, Spreadsheet Software, Database Software, Presentation Software, Note Taking Software, Personal Information Manager Software, Business Software for Phones, Project Management Software, Accounting Software, Document Management Software, Enterprise Computing Software, Graphics and Multimedia Software, Computer-Aided Design, Desktop Publishing Software, Photo Editing Software (Professional), Multimedia Authoring Software, Web Page Authoring Software, software for Home, Personal, and Educational Use, Computer-Aided Instruction, Entertainment Software, and Web Applications.
- **Chapter 4: The Components Of The System Unit.** It was divided into 2 lessons .In this chapter the electronic parts of the computer, such as the motherboard and main memory are introduced. It contains the following topics: The Motherboard, The Processor, The Control Unit, The Arithmetic Logic Unit, Machine Cycle, Registers, System Clock, Comparison Processors Of Personal Computers, Buying a Personal Computer, Processor Cooling, Parallel Processing, Data Representation, Bytes and Addressable Memory, Types of Memory, RAM Configurations, Cache Memory, Memory Access Times, Expansion Slots and Adapter Cards, Removable Flash Memory, and Ports and Connectors.
- **Chapter 5: Input Devices.** It takes only one lesson. Various types of input devices are discussed, like keyboard and OCR. Titles were included: What Is Input ?Program Respond, User Response, What Are Input Devices? The Keyboard, Pointing Devices, Touch Screens and Touch-Sensitive Pads, Devices for Smart Phones Other Input, Game Controllers, Digital Cameras, Digital Camera photo Quality, Voice Input, Video Input, Video Conference, Scanners and Reading Devices, Optical Character Recognition, Magnetic Stripe Card Readers, MICR reader, Data collection devices, Biometric devices, Signature Verification Systems, and ATM Machine.
- **Chapter 6: Output Devices.** It was put in one lesson. Here a lot of output devices are exhibited, for example monitors and plotters. Titles were included: What is output? Display Devices, LCD technology, Graphics Chips and ports, Printers, Impact and Nonimpact Printers, Multifunction Peripheral, Plotters and Large-Format Printers, Speakers, Headphones, and Ear buds, and Other Output Devices such as game controllers and data projectors.
- **Chapter 7: Storage Devices.** It is one lesson only. Handles nearly all types of storage devices that exist nowadays, such as hard disk and smart card. The topics it handles are: Storage capacity, The Hard Disk, Format, Redundant Array of Independent Disks RAID, Network Attached Storage, External and Removable Hard Disks, Miniature Hard Disks, Serial Advanced Tech. Attachment SATA, Small Computer System Interface SCSI, Maintaining Data Stored on a Hard Disk, Solid State Drives, Memory Cards, USB, Cloud Storage, Express Cards, Optical Discs , that include CD, DVD and Blue Ray discs, Tape, Cartridge, Microfilm & Microfiche, Magnetic Stripe Cards and Smart Cards, and Enterprise Storage.
- **Chapter 8: Operating Systems And Utility Programs.** It was divided into 3 lessons. Discusses briefly the tasks of operating systems and sheds light on some types of operating systems and utility programs like stand-alone operating systems and server operating systems. Some utility programs, such as administering security and monitoring system performance, are also discussed. Titles are: Operating System Functions, Starting & Shutting Down a Computer, The Kernel, Shut Down

Options, Graphical User Interface (GUI), Command-Line Interface, Managing Programs, Multiuser Operating System, Multiprocessing Operating System, Managing Memory, Coordinating Tasks, Configuring Devices, Monitoring Performance, Controlling a Network, Administering Security, Types of Operating Systems, File Manager, Image Viewer, Disk Cleanup, and Backup and Restore Utilities.

- **Chapter 9: Communication And Network.** It was divided into 3 lessons. It explains some topics in computer communication such as network topology, network communications standards and communications devices. It covers the following topics: Uses of Computer Communications, Wireless Messaging Services, Wireless Internet Access Points, Hot Spots, Cybercafés, Global Positioning Systems GPS, Groupware, Voice Mail, Collaborative Software, Web Services, Networks, Value-added Network, LAN, WAN, MAN,WLAN, Network Architectures, Network Topologies, Intranets, Network Communications Standards, TCP/IP, Wi-Fi, Bluetooth, Ultra Wide Band (UWB), IrDA, RFID, WiMAX, WAP, Communications Software, Communications over the Telephone Network, Dial-Up Lines, Dedicated Lines, Fiber To The Premises (FTTP), T-Carrier Lines, Communications Devices, Network Cards, Wireless Access Points, Routers, Modems, Hubs and Switches, Home Networks, Communications Channel, Cables, Microwaves, and Communications Satellites.

These chapters are distributed in 21 lessons. Each lesson is related with many examples. From 3 to 17 questions are listed for each lesson, depending on length of the lesson, and each question is associated with a suitable hint.

4.3.2 Student Model

State based approach was implemented in the student model. However, there are quite a few parameters for educational modeling of a student throughout a learning procedure. Two parameters were taken into account in this tool:

- Coverage: the topics covered by a student and
- Performance of a student: (measured through his ability to comprehend and his problem solving skills[1].

4.3.3 Teaching Model

Teaching model **(**Pedagogical model**)** is considered to be the most important component of an ITS. The primary task of this module is to arrange a sequence of teaching actions to be taken during a teaching process. These actions and their sequence should go with the student's ability, requirement and objectives.

The arrangement is done at two stages. At the first stage, ordering of the topics for the student needs to be arranged. This stage begins from the initial state and finishes when all the topics are included in the sequence. At the second stage, after a topic is chosen another arrangement is essential to compute the exact technique of teaching that topic. This engages selecting the proper type of the document and the proper medium [1].

The student should read the lesson and its examples then he/ she should go through the exercises related to the lesson. If the student succeeds i.e. he /she obtained 75 points and the last lesson (lesson number 21) was not yet reached then he /she can study the next lesson else he/she should re-study the lesson he failed to pass through.

(Note: 21 stands for the number of lessons stored in the system). This is illustrated in the next figure:

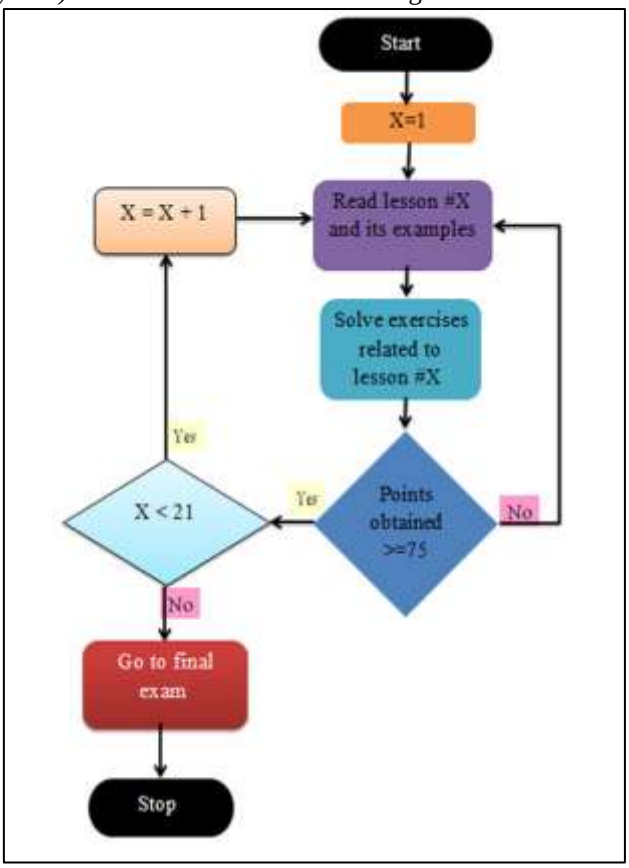

Figure 9: student's progress is controlled by the pedagogical model

4.3.4 User interface model

Interfaces are an essential part of the ITSB system. There are two class of users, teachers and the students. The ITSB authoring tool has both interfaces. Each class of users see different interface for their interactions with the system. The teachers interface is the shell of ITSB for configuration and adjustment of the system. The teacher's interface or the authoring interface consists of three parts, used to configure the different parts of the system, one to configure the Student Model, one for authoring the Domain Organization Model and the third for maintaining the Repository (see Fig. 4). Through these interfaces a teacher can configure various

aspects of the system, like initial information about the student , enter students lessons, questions and answers, configure and adjust the color, font name and size of all menus, buttons, combo boxes etc. Thus, this interface provides the system with the required flexibility and robustness. Moreover, due to this interface the system can become domain independent [1].

Screen shots from the teacher's interface are shown in Figures 6 through 9.

Figure 6 shows the screen where the teacher can add new lessons and examples. Figure 7 shows the screen where the teacher can add new students. Figure 8 shows the screen where the teacher can add constants of the project, such as : the author name and the title of the tutor. Figure 9 shows the screen where the author can adjust colors of buttons and the other controls of the program.

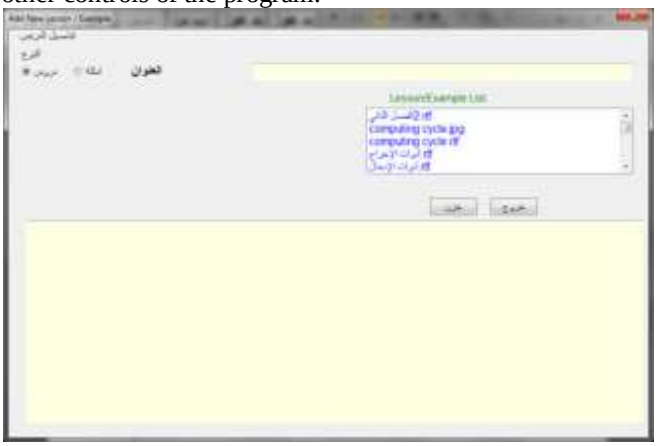

Figure 10: Form for adding Lessons and Examples

Figure 11: Form for adding initial students' information

Figure 12: Form for adding constants of the system

Figure 13: Form for adjusting Fonts of all screens of the system

Student interface is the front-end for the student to interact with the system. The interface has a bidirectional communication mechanism (see Fig. 4). The system presents all the learning documents and test materials to the student through this interface. Performance of the student in the tests is conveyed back to the system, specifically to the student model by it. This feedback is vital because the adaptation process would depend on this. So, the success of adaptive planning depends on it and its communication with teaching module (See Fig 10, Fig11, Fig12).[1]

Figure **14**: Student lessons and examples form

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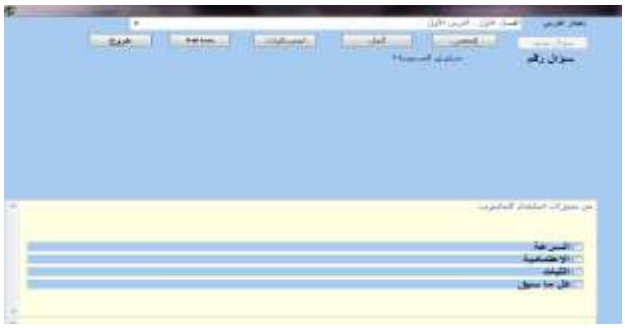

Figure15: Student Exercises form

Figure16: Student statistics form

Multiple Language Support

ITSB authoring tool support currently two languages. The default language is English language. If the user prefers Arabic Language, He/she can just click on one button in first Login form. Once the user clicks the Arabic button, it translate all buttons, menus, titles, and subtitles; furthermore it switch the direction of the forms from Left-to-Right into Right-to-Left (See Fig 13, Fig 14).[1]

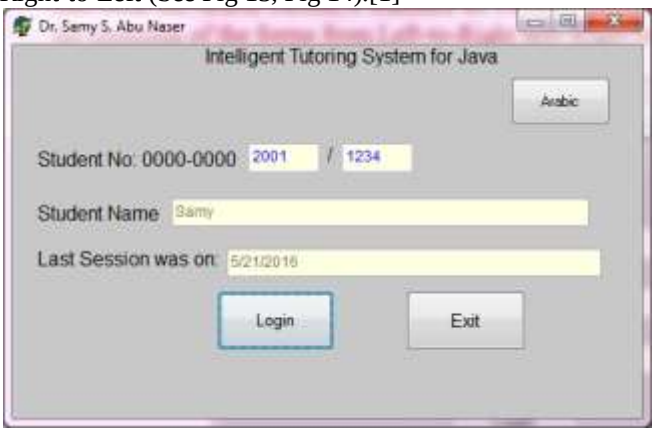

Figure17: Logging Form in English Language

Figure18: Logging Form in Arabic language

4.3.5 Screen captures

These are some screen samples for the proposed ITS system. This is the login screen where the user enters his (or her) number, and the system will recognize the person if he (or she) is a student or a teacher. This is called role based authorization.

Figure 19 Login screen

When logged in as administrator, sections of adding new lessons, exercises, students and editing existing ones are activated.

Figure20 Admin division

When logged in as a student previous sections are closed (made inactive) and only exercises section is allowed to be accessed (highlighted as active)

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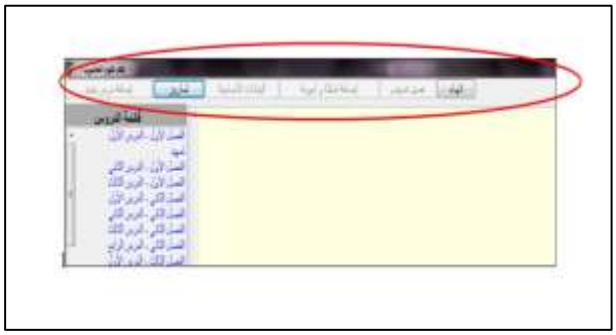

Figure21: Student division

The following figure shows the interface where the teacher can add new question or edit existing ones.
Here we can see the spaces for the question and the spaces for the multiple choices. Note we can put true or false questions by letting two choices only namely: "True" and "False"

Figure22: Interface for adding questions and answers

When choosing a lesson, its related examples are shown automatically, as shown in figure 14(a) and 14(b)

Figure23 *(a)*

Figure19(b)

Figure 24: *User Exercises interface1*

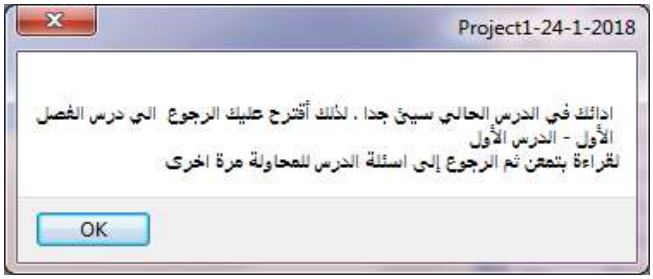

Figure 25*: A message for a bad achiever*

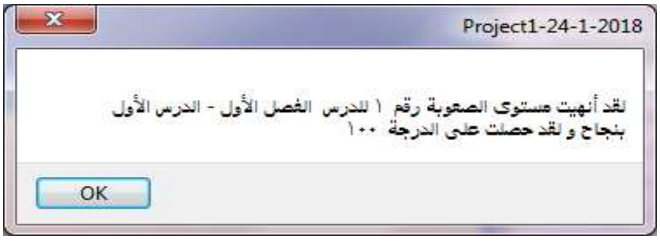

Figure 26*: A message for a good achiever*

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***Figure 27**: Some statistics showing Students achievement*

5. System Evaluation

In evaluating the proposed ITS system, evaluators (39 students and 5 professors) were required to use the proposed ITS system. After that, they were asked to provide their feedback about the proposed ITS system through filling the questionnaire which consists of 13 questions. Beside the questions we let a space in the questionnaire for the participants to write their suggestions of system improvements (see appendix A).In this way, effectiveness, efficiency and satisfaction of the proposed ITS system were measured. The results were very positive.

According to the American scientist Rensis Likert, the questionnaire was divided into five columns: strongly disagree, disagree, neutral, agree, and strongly agree.
Every category was given a weight as follows:

CATEGORY	WEIGHT
Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

To average Likert scale we compute the sum the products of number of responses R_i times the weight of related category weight W_i, divided by the number of respondents n, in symbols:

$$Average\ of\ Likert\ scale = V = \frac{\left(\sum_{i=1}^{5} Ri * Wi\right)}{n}$$

Where V must be between 1, which means: "strongly disagree", and 5, which means: "strongly agree".
If V<3 then it indicates disapproval, while if V>3 then it indicates approval, and if V=3 then it indicates neutrality.
Example: we will compute V for the first question:

Table 1: Likert Scale

1	2	3	4	5	Weights	
Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Question	#
0	0	3	23	13	The ITS is easy to use	1

V = (0*1 + 0*2 + 3*3 + 23*4 + 13*5) / 39 = (0 + 0 + 9 + 92 + 65) / 39 = 4. 3

5.1. Analysis of the questionnaire that was circulated among the students:

Average	Question 1
4. 3	نظام التعليم الذكي سهل الاستخدام The ITS is easy to use

- The first question is about if the system is easy to use.

According to the average acquired of this question which is greater than 3 : the system is easy to use.

Average	Question 2
4.3	نظام التعليم الذكي ممتع The ITS is interesting

- This question is about if the system is interesting or not.

Clearly read from the average : the system is really interesting.

Average	Question 3
4.1	نظام التعليم الذكي مفيد جدا The ITS is very useful

- Is the system useful?

The average here indicates that the system is pretty useful.

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Average	Question 4
4	أسئلة نظام التعليم الذكي مناسبة للطالب The questions contained in the ITS are suitable for the students

- If the questions of the system are appropriate for the students (not so easy nor very hard).
  The average indicates that the questions in the system are appropriate for the students.

Average	Question 5
4. 4	الأسئلة الموجودة في نظام التعليم الذكي مناسبة للمقرر الدراسي علوم حاسوب (1) The questions contained in the ITS are suitable for the curriculum "Computer Science 1"

- Are the questions in the system suitable for the curriculum (they meet the pedagogical goals of the curriculum)?

The average 4.4 tells that they are.

Average	Question 6
4	الموضوع الذي يشرحه نظام التعليم الذكي مهم The subject that is taught by the ITS is important

- Is the subject that is taught by the tutoring system important?

The average tells it is.

Average	Question 7
2.8	استخدام نظام التعليم الذكي يغني الطالب عن حضور المحاضرات The ITS is a replacement for the lectures

- Does the tutoring system make attending lectures redundant?

The average 2.8 , which is less than 3, indicates it doesn't.

Average	Question 8
3.2	نظام التعليم الذكي ذو جودة عالية The ITS is of a high quality

- Has the tutoring system high quality?

This average tells that the quality cannot be decided definitely.

Average	Question 9
4	نظام التعليم الذكي يساعد على فهم أكثر للمادة العلمية The ITS makes it easier to understand the scientific material

- The tutoring system makes it easier to understand the scientific material?

The average 4 tells: Yes, it does.

Average	Question 10
4	استخدام نظام التعليم الذكي يجعل تعلم المادة المقررة اكثر سهولة The use of ITS makes learning the curriculum easier

- The tutoring system makes it easier to learn the scientific material?

The average 4 tells: Yes, it does.

Average	Question 11
4	أنصح باستعمال نظام التعليم الذكي لمقررات دراسية أخرى I recommend to use the ITS in other curricula

- I recommend the tutoring system to teach other curricula.

According to the average 4, the participants do recommend to use the system in other curricula.

Average	Question 12
4.3	يمكن استخدام نظام التعليم الذكي كأداة مساعدة مع المقرر الدراسي The ITS can be used as a help tool during learning the curriculum

- The tutoring system can be used as a help tool for the curriculum .

The average 4.3 indicates : Yes , it can be helpful for the student to study the curriculum.

Average	Question 13
3.5	نظام التعليم الذكي يحتاج إلى تحسينات كثيرة The tutoring system needs a lot of improvements

- The tutoring system needs a lot of improvements.

3.5 tells us that it needs a lot of improvements. Because of this result we gave a chance to the participants to write their opinions and suggestions to improve the system. Some suggestions are:

1. make the font of lessons larger,
2. make the system faster ,
3. add more visual and acoustic effects to the lessons and
4. make other systems related to their fields of study such as pharmacy and medicine.

Student evaluation results:

From the questionnaire analysis we concluded that:

- The system is easy to use,
- The system is useful and interesting,
- The system is good in explaining the scientific matter and has appropriate questions and hints,
- The system has the ability to conduct teaching but it doesn't make lecturer abundant,
- The system is recommended for other curricula,
- The system needed a lot of improvements. These improvements were suggested by the participants and we applied them to the system as it may be possible.

5.2. Analysis of the questionnaire that was circulated among the professors:

Average	Question 1
4.8	نظام التعليم الذكي سهل الاستخدام The ITS is easy to use

- The first question is about if the system is easy to use.

According to the average acquired of this question which is greater than 3 : the system is easy to use.

Average	Question 2
4.2	نظام التعليم الذكي ممتع The ITS is interesting

- This question is about if the system is interesting or not.

Clearly read from the average : the system is really interesting.

Average	Question 3
4.2	نظام التعليم الذكي مفيد جدا The ITS is very usefu

- Is the system useful?

The average here indicates that the system is pretty useful.

Average	Question 4
4.4	أسئلة نظام التعليم الذكي مناسبة للطالب The questions contained in the ITS are suitable for the students

- If the questions of the system are appropriate for the students (not so easy nor very hard).

The average indicates that the questions in the system are appropriate for the students.

Average	Question 5
4. 4	الأسئلة الموجودة في نظام التعليم الذكي مناسبة للمقرر الدراسي علوم حاسوب (1) The questions contained in the ITS are suitable for the curriculum "Computer Science 1"

- Are the questions in the system suitable for the curriculum (they meet the pedagogical goals of the curriculum)?

The average 4.4 tells that they are.

Average	Question 6
4.4	الموضوع الذي يشرحه نظام التعليم الذكي مهم The subject that is taught by the ITS is important

- Is the subject that is taught by the tutoring system important?

The average tells it is.

Average	Question 7
3.6	استخدام نظام التعليم الذكي يغني الطالب عن حضور المحاضرات The ITS is a replacement for the lectures

- Does the tutoring system make attending lectures redundant?

The average 3.6 , indicates it does that somehow.

Average	Question 8
4	نظام التعليم الذكي ذو جودة عالية The ITS is of a high quality

- Has the tutoring system high quality?

This average tells that the system is.

Average	Question 9
4	نظام التعليم الذكي يساعد على فهم أكثر للمادة العلمية The ITS makes it easier to understand the scientific material

- The tutoring system makes it easier to understand the scientific material?

The average 4 tells: Yes, it does.

Average	Question 10
4.4	استخدام نظام التعليم الذكي يجعل تعلم المادة المقررة اكثر سهولة The use of ITS makes learning the curriculum easier

- The tutoring system makes it easier to learn the scientific material?

The average 4.4 tells: Yes, it does.

Average	Question 11
4.8	أنصح باستعمال نظام التعليم الذكي لمقررات دراسية أخرى I recommend to use the ITS in other curricula

- I recommend the tutoring system to teach other curricula.

According to the average 4.8, the participants do recommend to use the system in other curricula.

Average	Question 12
4.8	يمكن استخدام نظام التعليم الذكي كأداة مساعدة مع المقرر الدراسي The ITS can be used as a help tool during learning the curriculum

- The tutoring system can be used as a help tool for the curriculum .

The average 4.8 indicates : Yes , it can be helpful for the student to study the curriculum.

Average	Question 13
3.4	نظام التعليم الذكي يحتاج إلى تحسينات كثيرة The tutoring system needs a lot of improvements

- The tutoring system needs a lot of improvements.

3.4 tells us that it needs a lot of improvements. Because of this result we gave a chance to the participants to write their opinions and suggestions to improve the system.

Professors evaluation results:

From the questionnaire analysis we can see that the professors response is very similar to that of the students:

- The system is easy to use,
- The system is useful and interesting,
- The system is good in explaining the scientific matter and has appropriate questions and hints,
- The system has the ability to conduct teaching but it can replace the lecturer in some way,
- The system is recommended for other curricula,
- The system needed a lot of improvements. These improvements were suggested by the participants and we applied them to the system as it may be possible.

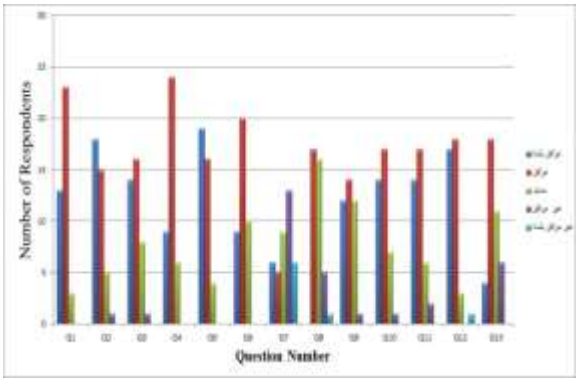

Chart 1: The results that were obtained from the students' questionnaire

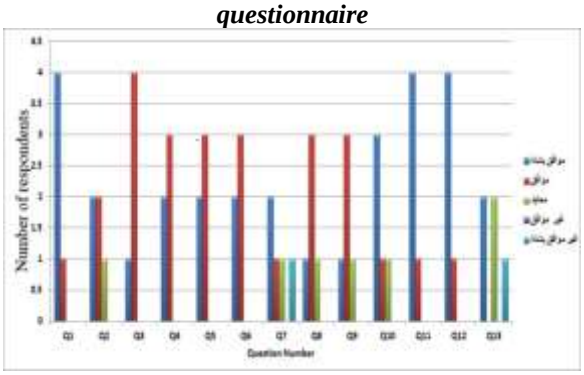

Chart 2: The results that were obtained from the professors' questionnaire

Table 2: A legend for the previous charts:

Question **السؤال**	**Code** **الرمز**
نظام التعليم الذكي سهل الاستخدام The ITS is easy to use	Q1
نظام التعليم الذكي ممتع The ITS is interesting	Q2
نظام التعليم الذكي مفيد جدا The ITS is very useful	Q3
أسئلة نظام التعليم الذكي مناسبة للطالب The questions contained in the ITS are suitable for the students	Q4
الأسئلة الموجودة في نظام التعليم الذكي مناسبة للمقرر الدراسي علوم حاسوب (1) The questions contained in the ITS are suitable for the curriculum "Computer Science 1"	Q5
الموضوع الذي يشرحه نظام التعليم الذكي مهم The subject that is taught by the ITS is important	Q6
استخدام نظام التعليم الذكي يغني الطالب عن حضور المحاضرات The ITS is a replacement for the lectures	Q7
نظام التعليم الذكي ذو جودة عالية The ITS is of a high quality	Q8
نظام التعليم الذكي يساعد على فهم أكثر للمادة العلمية The ITS makes it easier to understand the scientific material	Q9

استخدام نظام التعليم الذكي يجعل تعلم المادة المقررة اكثر سهولة The use of ITS makes learning the curriculum easier	Q10
أنصح باستعمال نظام التعليم الذكي لمقررات دراسية أخرى I recommend to use the ITS in other curricula	Q11
يمكن استخدام نظام التعليم الذكي كأداة مساعدة مع المقرر الدراسي The ITS can be used as a help tool during learning the curriculum	Q12
نظام التعليم الذكي يحتاج إلى تحسينات كثيرة The tutoring system needs a lot of improvements	Q13

6. CONCLUSION

The importance of intelligent tutors is evident. And providing students with their own intelligent computerized tutor is the holy grail of education technology. And my project demonstrated these facts.

In this study, the Intelligent Tutoring System's theory and architecture have been described.

An Intelligent Tutoring System (ITS)was designed and developed to help students learn in Al-Azhar University, in Gaza strip.

My study concluded that intelligent tutoring systems are very useful and interesting tool to learn scientific materials such as computer science.

This can be easily extracted from the questionnaire analysis we used in the study. Where students and teachers are agree that ITS can be very helpful in studying and some have suggested to make other ITS for various subjects such as pharmacy and medicine.

At last the researcher found that the ITSB is a useful and efficient tool for building Intelligent tutoring systems.

6.1 Future Work

ITS will keep developing over time.

Discoveries in cognitive science and progress in computer science will make them capable to cope with human-teaching expertness and teach more and more scholastic subjects.

In the future (if God permits) the researcher seeks to design other ITS for various subjects.

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