

Smart Assessment Model in E-learning

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Abstract: Rapid developments in computer technology transformed the form of testing from traditional Paper-And-Pencil Tests (PPT) to Computerized Adaptive Testing (CAT). Assessment has another role. It became tool for learning rather than tool for grading. In the adaptive test, the multiple-choice test is a commonly used method for an assessment. The strategy followed by student in problem-solving questions in test it is consider the important assessment component. Feedback in problem-solving yields the most effective learning model than those that do not provide such a feedback. In this paper we present Smart Assessment Model (SAM) of students. SAM allows producing and providing CAT through web interfaces. Also, this model capable to assess such complex type of questions and provide student with appropriate instruction and feedbacks to improve learning

Keywords: CAT (Computerized Adaptive Testing), Adaptive e-assessment, Smart assessment, Learning Style (LS)

I. INTRODUCTION

Today, assessment considered as critical component of learning and teaching process. The goal of student assessment is to gather information about student knowledge level and his/her abilities [1]. Therefore, assessment needs tool that can measure student knowledge level with more accuracy. Different methods of knowledge evaluations are in use. However, testing considered the most common evaluate tool that is used [1]. Different testing methods available today. From all these tools, the CAT (Computerized Adaptive Testing) offers the best balance of accuracy and efficiency [1]. This a type of test proposed to rise the efficiency of estimating the student's knowledge [1]. This is done by adapting the questions to the student based on his/her abilities.

Now, assessment has another role in e-learning. It is supposed to be more a tool for learning, rather than a tool for grading. The theory of learning from performance errors was suggested by [2] and attempts to describes how student detect and grade their errors during problem solving. The theory applies to the learning of complex skills such as computer programming [2]. Accordingly, these researches suggested that explicit guidance is necessary to improve the efficiency of learning. Recently, the authors in [3] described approaches which seek to highlight assessment aspects which support student learning as "learning-oriented assessment". The learning-oriented assessment is built on three principles [4]: assessment tasks, active student participation and 'feedback as feed-forward'.

Most adaptive assessment tools are not high enough especially regarding problem solving questions. Studies [5,6] have shown that immediate feedback in problem-solving gives the most effective learning model than those that do not provide such a feedback. This requires smart system that simulates instructor's behaviour. smart system can assist students studying a variety of subjects by posing questions, analyzing responses, then present personalized instruction and feedback. Therefore, this paper presents a **Smart Assessment Model (SAM)** of students. This model capable to tailor and customize the questions according student abilities, knowledge level. Also, SAM can enhance and improve learning by providing immediate feedback to student during test duration. The rest of this paper is organized as follows. Section II defines literature review. Section III presents comparison between related works. Section IV describes problem statement. Section V presents the proposed assessment model. Finally, this paper concludes in section VI.

II. LITERATURE REVIEW

Web-based assessment tool of the AulaNet™ learning environment called **Quest** proposed in [7]. It provides the user with mainly three set of presentation styles for answering: multiple choice (true/false and fill in. If necessary, it may contain the matching and listing. It also has a graphical interface which makes the handling of questions and answer easier even for the naive user of computer.

Hot Potatoes in [8] was developed by Research and Development team at the University of Victoria Humanities Computing and Media Centre which consists of a set of authoring tools (JQuiz, JCloze, JCross, JMix, JMatch). These tools allow to create several types of Web-based exercises that will be more interactive. HTML and JavaScript technologies are used to develop this software whose primary goal is to make the subject interactive. JQuiz is the most commonly used Hot Potato. It used for creating the quizzes. There are several other features that include this JQuiz such as getting feedback on the grade answers, wrong answers. The short answers are internally parsed and would show up the comments on which part are grade and which part was wrong. There are certain additional features such as getting the hint in the form of free letter format the answer itself.

Integrated Web-based e-Assessment Tool was proposed in [9] which is integrate all the three types of assessments in one single tool that a student can access on the web. If the student wants to access any lecture first the system will check whether he has completed his diagnostic assessment. If not, then he/she will force to complete it and then only the lecture details will be displayed to his/her. If the student struggles in attempting the exam, then the system provides him with the guide to refresh himself with the background knowledge. Students can get familiar and increase their learning skills by practicing themselves through “Self-Assessment” while the grading of student’s performance would be done through “Summative Assessment” at the end course or end of a semester which is linked up with the time limit.

The SIETTE [10] is a web-based tool used by instructors to assist student in the assessment process. Instructors can create assessments that students can take through the Web. SIETTE is based on the adaptive testing adaptation technique. The tests are adaptive since they consist of questions which are intelligently chosen to correspond to the student’s knowledge level. This tool results in a more accurate estimation of a student’s level of knowledge using a shorter test.

AthenaQTI presented in [11] is a web-based adaptive assessment authoring system, and it gives the authors and educators the capability of creating and preparing questions which are in the format of multiple choice, fill in the blanks, true/false, multiple image choice (single or ordered response) and image hot spot (multiple or ordered response). **CoSyQTI** in [12] it is also another adaptive web-based assessment conforming to the QTI specification which makes it reusable and interoperable in other learning environments.

Several smart assessments were developed to learn student programming language. **JO-Tutor ITS** in [13] was developed for learning Java objects. The system automatically produces exercises and during the process of exercising it uses feedback information from the student performance. The questions have different styles either asking the student to grade a Java code, write a Java code, multiple choice, or true/false. **CPP-Tutor** in [14] has been developed to learn student C++ programming language. The database in this system contains a set of problems and a possible solution to every problem and some possible errors and some hints for each error. **The PHP ITS system** in [15] has been developed to learn student's basics of PHP programming. It provides practical exercises to students. Then the, solutions are analyzed, and appropriate feedback is given. The feedback relates to the specific error made by the student.

III. COMPARISON BETWEEN RELATED WORKS

The Table I below shows the comparison between assessment systems / tools.

TABLE1: COMPARISON OF ASSESSMENT TOOLS

Tool	Using standard	Using adaptive technique	Assessing problem-solving question
Quest [7]	x	x	x
Hot Potatoes [8]	x	x	x
Integrated Web-based e-Assessment [9]	x	x	x
SIETTE [10]	√	√	x
AthenaQTI [11]	√	√	x
CoSyQTI [12]	√	√	x
JO-Tutor [13]	x	x	√
CPP-Tutor [14]	x	x	√
PHP ITS [15]	x	x	√

IV. PROBLEM STATEMENT

Most adaptive assessment tools are not high enough especially regarding problem solving questions. In these tools the assessment questions are made in the form of True/False or Multiple-Choice Question (MCQ) and other question that are basically graded automatically. Therefore, strategy followed by student to achieve answer is not assessed, which is

a critical assessment component. In the previously smart assessment tools /systems the test used as learning tool. So, these systems are not support the grading process. The grading is important goal in assessment. It helps instructor to know the student's level and it can be used to adapt the learning content in adaptive e-learning systems. Our aim in this paper to develop smart assessment model, named "SAM". This model capable to tailor and customize the questions according student abilities and characteristics. Also, this model capable to assess complex type of questions and provide student with appropriate instruction and feedbacks to improve learning.

V. PROPOSED MODEL

SAM is a web-based adaptive testing system. It allows producing and providing CAT through web interfaces. SAM is based on the adaptive testing adaptation technique. The tests are adaptive since they made up of questions which are intelligently chosen to correspond student's answers and evaluation of his/her knowledge level. Therefore, chosen questions in SAM could be more suitable for student and then present it according his/her learning style. CAT is based on an algorithm, usually iterative, which consists of the following steps [1]:

- Given the currently estimated ability level, determine the best item to administer next by evaluating all items which have not been administered.
- Administer the next best item, and the student responds.
- Estimate a new ability estimate based on responses to previous administered items.
- Repeat Steps 1 to 3 until a stopping condition is met.

As shown in Fig. 1, the flowchart serves as an illustration of the CAT algorithm [1].

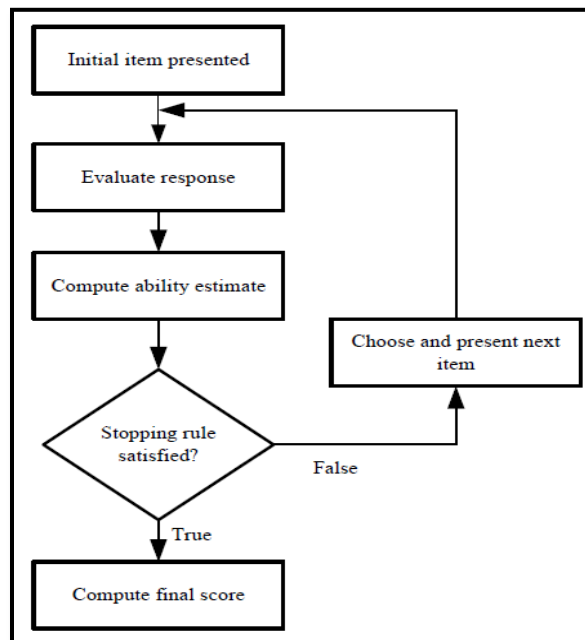


Fig. 1. Illustration of the CAT Algorithm [1]

In SAM all concepts must be supported with various types of questions that are specified using IEEE LOM metadata standard which supports an addition of some attributes especially for this model and through it we can search for each question. The selection of question is based on right identification of the suitable values of metadata attributes specifying the required material. When the student takes assessment, SAM model can infer which questions could be suitable for student and then present it according his/her learning style. SAM has two graders which are: traditional grader and Problem-Solving Questions Grader (PSQG). Traditional grader responsible to grade simple type of questions which can simply grade correct or not while **Problem-Solving Questions Grader (PSQG)** specially developed to assess complex type of questions (such as: programming exercise) and provide student with appropriate instruction and feedbacks to improve learning. PSQG can assess student answers by posing questions, analysing complex student responses and determining whether the student's answer is correct / incorrect. In programming exercise SAM provides student with a C++ editor to write his/her answer. As shown in Fig. 2, once the student submits his/her an answer of an exercise, first PSQG, syntactically and semantically analyses the answer, then PSQG compared student answer to the knowledgebase of expert's solutions. Variations are considered and explanations for errors are recognized, and later, comments and feedbacks are gathered for reporting back to the student with good explanations and suggestions.

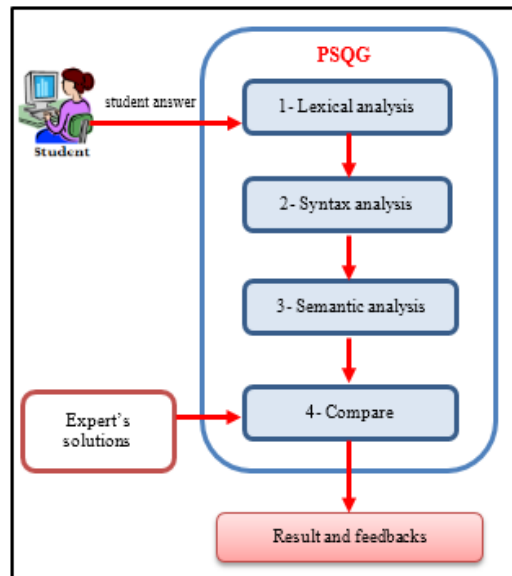


Fig.2. Evaluation Process of Programming Exercise

PSQG includes four phases which are: **lexical analysis**, **syntax analysis**, **Semantic analysis**, **evaluation**. When student submits answer, "**the lexical analysis**" is read student answer and converted it into a sequence of tokens, checks for legal tokens, and then passes series of tokens to the syntax analyzer. The next phase is called the "**syntax analysis or parsing**". This phase takes the set of tokens formed in the analysis phase and attempts to build data structure to represent that input (often known as syntax tree or other hierarchical structure). The aim of syntax analysis or parsing is to check that we have a valid sequence of tokens. "**Semantic analysis**" is the third phase of PSQG. It checks whether the parse tree constructed follows the rules of language. This phase makes semantic checks such as type checking (checking for type errors, for example, when we assign a float variable to a variable of another type int, it will give a type error) or definite assignment (requiring all local variables to be initialized before use). "**Evaluation**" is the last phase of PSQG. In this phase PSQG compares student answer with solutions that recognize by instructor/expert. Variations are studied and causes for errors are identified, and hence, comments and feedbacks are compiled for reporting back to the student with proper explanations and suggestions. For example, when student writes answer of question and press (Result Button), PSQG analyzes the student answer and explains his/her mistakes. And then it gives appropriate grade to student (see Fig. 3).

Write C++ program that calculate factorial of 4

Answer:

Language: C++

```

1 #include<iostream.h>
2 void main()
3 {
4   int Fact=1;
5   for(int i=4;i>=1;i++)
6     Fact=Fact*i;
7   cout<<i;
8 }
```

Hint
Help
Rephrasing
Result

Parsing expression...
Parse was successful.
Evaluating...
Result: Wrong in Decrement part in For Statement
To calculate factorial must multiply varibale'
Must Print Fact value

Fig.3. Student Answer and Result Example

VI. CONCLUSION

In this paper, we present Smart Assessment Model (SAM). This model has traditional grader and Problem-Solving Questions Grader (PSQG). PSQG developed in SAM to assess complex type of questions and provide student with appropriate instruction and feedbacks. SAM combines the advantages of smart assessment systems with those of adaptive systems. Our model is different from other smart assessment models. The smart assessment systems focus on simulating a human tutor's behaviour and guidance. It can assess complex questions by posing questions, analyzing responses, and present personalized instruction and feedback, such systems provide only little, or in most cases, no adaptivity for students. On the other hand, adaptive systems support students by providing assessment tasks that are tailored to their needs and characteristics. The aim of this paper was to extend typical smart assessment systems by the functionality of providing adaptivity. This model provides adaptive functionality by generation dynamic sequence of questions according student response and present them in appropriate structure that match students learning styles

ACKNOWLEDGMENT

This work was supported by King Abdulaziz City of Science and Technology (KACST) funding (Grant No. AT-204-34). We thank KACST for their financial support.

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