ONLINE TESTING – THE CONSTRUCTION OF A FUNCTIONAL MODEL IN ASSESSING STUDENT'S PERFORMANCE USING THE PEDAGOGY OF BLOOM'S TAXONOMY

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Abstract: Assessment is an integral learning process that has a significant impact on what students learn and how effectively they learn. It involves the participation of both students and lecturers and can be used as a tool to gauge students' performance. However, educational researchers are concerned if there are special education needs that are needed in measuring students' performance. This is because, if a lecturer wants to perform efficient student evaluation, an assessment system that enfolds a tracking ability that tracks and records student's performance on test questions and answers should be made available. Therefore, in this study, a functional model that utilizes the tracking and analysis abilities of an on-line test is constructed. The functional model constructed has successfully shown that evaluating students' performance in terms of cognitive level knowledge, comprehension, analysis and application is possible through the implementation of the pedagogy of Bloom's Taxonomy.

Keywords: Assessment, Online Test, Functional Model and Bloom's Taxonomy

INTRODUCTION

Lecturers need a better way to monitor students' learning throughout the semester where lecturers, specifically, needs a continuous flow of accurate information on student learning (Angelo and Cross, 1993) [2]. There are several concerns with the use of online testing methods of one, which include the student assessment consideration (Alexander, Bartlett, Truell and Ouwenga, 2001) [1]. If a lecturer wants to provide a more efficient means of performing student evaluation, a reusable and adaptable tool for automatic evaluation needs to be developed (Tinoco, Fox and Ehrich, 1999) [10]. Besides that, a continuous assessment must be more than just a final add-on to instruction for determining a grade; it must be planned carefully and systematically as an ongoing part by requiring specific skills of instruction of which include several levels of Bloom's Taxonomy (Harvey and Mogey, 1999). Furthermore, according to Aronson and Briggs, feedback is a vital and indispensable instructional activity (Aronson and Briggs, 1983).

Bocij and Greasley have asserted that the majority of the computer based assessment packages are incapable of testing cognitive skills (Bocij and Greasley, 1999) [3]. An interactive feedback is also lacking in the Web interfaces that are readily available today (Gibson, Brewer, Dholakia, Vouk and Bitzer, 1995) [6]. With the unavailability of a functional model that address all processes that should be made available for a successful implementation of assessment system may indirectly increase unnecessary workload or cost to the faculty (Thellwall, 2000).

MATERIALS AND METHODS

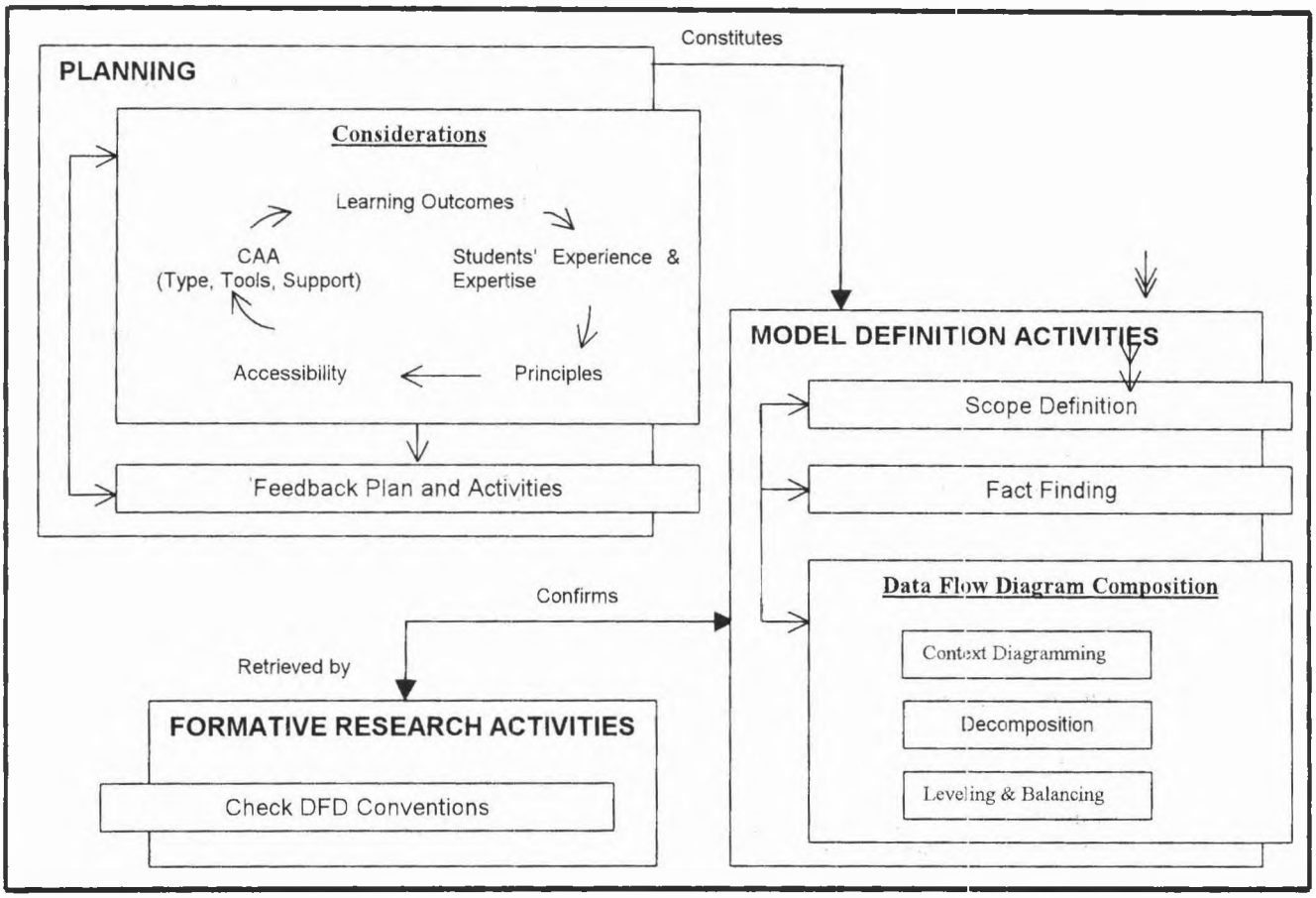

Figure 1: Project Development Methodology

This methodology (see Figure 1) itself is a model for building models. The activities in this methodology are written in sequence, but that is purely a constraint of the written medium. Also, to aid readability, the following descriptions are ordered in some logical fashion; placing those activities that should be precursory first, followed by other activities. Each individual activity informs all the others, generating a web of events and processes.

Planning

The planning stage is concerned primarily with pedagogic considerations. It comprises of two main elements namely considerations and feedback plan and activities.

Considerations

The consideration stage gathers together some of the issues affecting the use of online assessment. This stage allows the reflection of assumptions, constraints and opportunities that influences the use of online assessment in learning. The five sub-activities of consideration phase are:

Learning Outcomes	Students' Experience And Expertise
Principles	Accessibility
Computer Assisted Assessment's Type, Tools, And Support	

Each of the sub-activities are closely interrelated and their integration provides a provision for a good fact-finding that takes place in the model definition activities.

Feedback Plan and Activities

Feedback plan places together common and advised feedback activities found from scholar's researches. This activity involves finding answers and reasons for the following questions:

Why is feedback constituted?	When is feedback activity suitable?
How is the feedback activity done?	What does online assessment intent to assess?

Model Definition Activities

Model definition phase consist of three main activities, which are scope definition, fact-finding and data flow diagram composition.

Scope Definition

This stage states the boundaries of the functional model, and act as a delimiting activity that clarifies which situations are within and without the concerns of the model under construction

Fact Finding

Available research which contents ranges from educational ideas to results of current commercial system analysis were referred to in understanding and learning how people, data and process fit together to support assessment operations. The information retrieved is critically analyzed to see how it fits accordingly into the model structure.

Data Flow Diagram Composition

As seen from Figure 1, context diagramming precedes the other sub-activities implying that a top-down approach is used. In a top-down approach, the overall objectives of the system are defined and broken down into modules in a process called decomposition. It also involves leveling to show individual elements in a complete, working structure. Data Flow Diagram composition involves three sub-activities:

Context Diagramming	Decomposition	Leveling and Balancing

Formative Research Activity

In this stage, only one activity is involved, which is check DFD conventions.

Check DFD Conventions

After a set of DFDs are drawn, it is important to check that the sets follow all DFD conventions or rules. This activity confirms the accuracy of a complete DFD as well as act as a rule of thumb during DFD composition.

RESULTS AND DISCUSSION

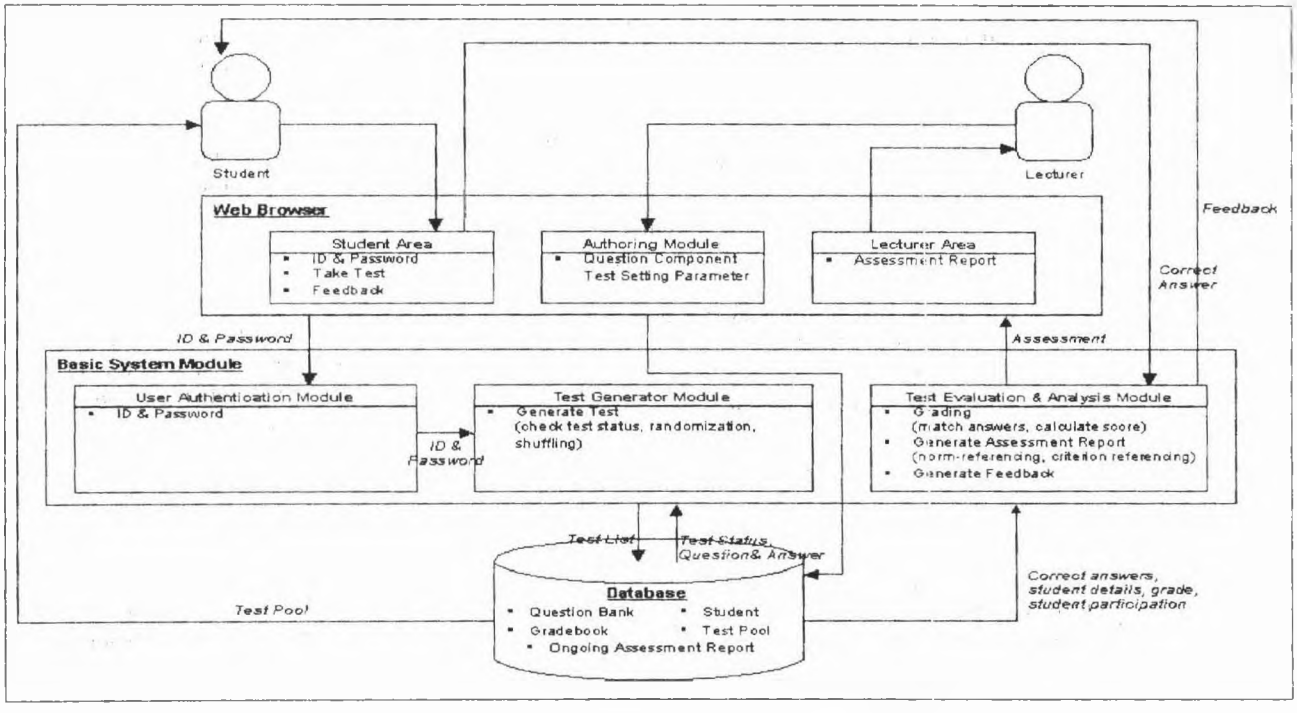

Figure 2: Functional Model

There are many provisions provided by a functional model when it is used as a system's representation. By using a functional model, the assessment system can be presented as a small set of boxes in which various high-level functions are performed. Moreover, it helps indicate needed data or metadata flows at the interfaces between each function. It should be noted that these data or metadata are characterized by the set of standards to which it must conform.

From Figure 2, it can be seen that the two main areas of an assessment system involves a Web Browser and a Basic System Module. Student and lecturer would be the main users of which their interactions with the assessment system substitute the assessment system's boundaries and scope, which unswervingly shows the context in which assessment system should be built within.

User Authentication Module

In order for a student to have access into the test, he is required to key in his ID and password that is proctored by the lecturer before a test. Most assessment system only requires a student to key in his own ID and password, however this provision alone is not enough in ensuring that the candidate is who they say they are. By doing this, cheating can be deterred and lecturers can use this as attendance taking and determine that the student is the genuine candidate. The ID and password is brought to the user authentication module for verification and if it matches, Generate Test process will take place in the Test Generator Module.

Test Generator Module

Abundance sets of test are generated in this module through the following activities:

a. *Check Test Status* - There are two possible results from the process, which are low mastery test status (enables a student to retake a test) or no attempt test status. Student would not be able to simply take any test as they wish as the function of Take Test process will only function when the lecturer enables it. Additionally, test retake can only take place in a time frame deemed suitable by the lecturer.

b. *Check Question Sufficiency* - Firstly, a lecturer must submit a test setting parameter through the Authoring Module. This testing parameter would contain the desired quantity of questions of each cognitive domain suitable to the content of the chapter being tested. This information would also be used as a dynamic template in organizing test questions as well as acts as a data input in enabling the Check Question Sufficiency process.

   Check question sufficiency process would determine if questions available in the question bank data store is sufficient by having the total number of questions determined for a particular test checked against the amount of each cognitive domain questions plus total number of students (derived from question bank data store and Gradebook data store respectively).

c. *Randomization Process* - Randomization process will take place if the following is met:
   Total number of x domain question $\geq$ *Total number of students * Parameter value on x domain*

   If it is met, a test is randomly generated from one or more question pools retrieved from the question bank (Omari and Oliver, 1996 [8]; O'Shea, Richmond and Allen, 2000 [9]) otherwise shuffling process will take place where a test is generated by shuffling a list of question retrieved from the question bank.

   All these activities would generate abundant sets of tests that are stored in the temporary Test Pool data store. Students would be able to sit for the test in the Student Area designated in the Web Browser.

Test Evaluations and Analysis Module

The two outputs produced by this module are the assessment report for the viewing of lecturers at the Lecturer Area and a feedback for the viewing of student in the Student Area. These outputs are made possible through the following activities:

a. *Grading Process* - Process for Grading begins when student submits the test's answers. These test answers would be matched against the question's correct answer retrieved from the Question Bank through the Match Answer process. The Match Answer process should produce and forward an output of result list consisting of question's unique identifier, and the result (matching or clashing) to the Calculate Score process. In Calculate Score process, if the answer for a particular question from the student matches with that acquired from the question bank data store, the student would be given credit for the question, if otherwise, no credit will be given (O'Shea, Richmond and Allen, 2000 [9]; Zaharias, Poulymenakou and Samiotis, 2002 [11], Jun Da, 2000 [5])

b. *Generate Assessment Report* - This process requires the sub-activities of norm referencing and criterion-referencing to take place. Norm referencing compares student's performance to that of other students (Musa, 2001; Morgan, 2002 [7]) by acquiring a particular student's grade and the highest score grade of the class. Criterion-referencing on the other hand compares a student's performance to a well-documented content domain. Criterion referencing requires the performance of a student on each cognitive level based on Bloom's Taxonomy, list of questions and correct answers from the question bank data store and test answers as submitted by the student.

   Assessment report would also contains the students' participation and involvement during class as observed by the lecturer of which the data is retrieved from Ongoing Assessment Report data store. All of this data input would help generate an assessment report that is able to aid lecturers in evaluating the success of a learning experience and adjust the learning objectives, courses and learning materials to the level of learner's performance wherever and whenever necessary (Zaharias, Poulymenakou and Samiotis, 2002 [11]; College of DuPage, 2001).

c. *Generate Response Feedback Process* - Generate response feedback process requires input in the form of student grade and student's test answers in order to take place. The outcome of this process, which is the feedback itself, generates additional and essential teaching moment as it helps place the student in a valuable position of being able to compare their answers to the correct answers as well as evaluate their own understanding, which serves as another opportunity to learn (Richmond, O'Shea and Allen, 2000 [9]). The feedback should also contain a list of references for students to refer to in order to grasp a full and objective understanding as well as the student's score against the class average score for the test for them to gauge their progress relative to their peers.

Authoring Module

Besides submitting the test setting parameter, question components are also submitted by the lecturer through this module. The question component submitted would have the following components:

a. *A Question* - The domain of the question is initially defined where lecturers decide what does a particular question intend to measure (refer Appendix II). Bloom's Taxonomy is used as a guide in developing questions as it can help assert students' level of knowledge acquisition in terms of knowledge, comprehension, application and analysis.

b. *A List Of Possible Answers* - The distracters developed should be incorrect but plausible in order to avoid students from eliminating a distracter simply because it is clearly wrong (Campy, 2002).

c. *Feedback For The Question* - Feedback would be easily written if the distracters provided for each question were plausible.

d. *Question Category* - Each question is categorized by applying the following formula:

Cognitive Level + Chapter Number + Question Unique Identifier

The lecturer determines both cognitive level (based on Bloom's Taxonomy) and chapter number while the question's unique identifier is automatically given by the system sequently in order to avoid duplication of numbering. The combination of the labeled category and question unique identifier would form standardized tags that indicate different level of the questions and help ensure that grading could be done accurately (O'Shea, Richmond and Allen, 2000).

From the given statements it can be seen that a model provides the facility in simplifying design considerations as it helps highlight all processes required for the implementation of a system. Bloom's Taxonomy has categorized educational objectives into separate cognitive levels. The categorization of cognitive level aids in the enhancement of assessment system as lecturer is given a guide on question construction through the provision of verb examples provided in the Bloom's Taxonomy. Furthermore, the categorization of cognitive level eases the analysis of students' performance as lecturers would be able to gauge how students perform in a particular cognitive domain. Both of this capability was highlighted in the functional model constructed.

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REFERENCES

1. Alexander, M. W., Bartlett J. E., Truell A. D. and Ouwenga K. 2001. *Testing In A Computer Technology Course: An Investigation Of Equivalency In Performance Between Online And Paper And Pencil Methods.* 69-71, 80 (1)

2. Angelo, T. A. and Cross, P. K. 1993. Classroom Assessment Technique. *Classroom Assessment Technique, A Handbook For College Teachers* (2). San Francisco: Jossey-Bass (1)

3. Bocij, P. and Greasley, A. 1999. Can Computer-Based Testing Achieve Quality and Efficiency in Assessment. *International Journal of Educational Technology,* 4,7-8,12-13 (1)

4. Campy, D. 2002. *Changing Practice In Learning And Teaching Celebrating Opportunities.* Retrieved December 5th 2003 from University of Wales Institute: http://www.uwic.ac.uk/ltsu/2002event/theme8-campy.htm (6)

5. Da, J. 2000, *Online Language Testing System.* Retrieved December 22nd 2003 from http://www.bio.utexas.edu/staff/jun/call/interactive/onlinetest.htm l (5)

6. Gibson, Brewer, Dholakia, Vouk & Bitzer. *A Comparative Analysis of Web-Based Testing and Evaluation Systems.* North Carolina State University: Department of Computer Science (1)

7. Morgan, M. T. 2002. *Quiz! Graded Interactive Web-Based Quizzes.* Washington State University: School of Biological Sciences (5)

8. Omari, A., and Oliver, R. 1996.. *The WebASSESS System: Online Creation and Management of Testing Using the World-Wide-Web.* Western Australia: Edith Cowan University (5)

9. O'Shea, P. M., Richmond, S. and Allen D. W. 2000.. *Telequiz: A Web-Based Multiple Choice Testing Protocol.* Norfolk: Old Dominion University (5)

10. Tinoco L. C., Fox E., Ehrich, R. and Fuks, H. 1999. *QUIZIT: An Interactive Quiz System for WWW-based Instruction.* Virginia: Virginia Polytechnic and State University (1)

11. Zaharias P., Poulymenakou A., and Samiotis K. 2001. *Web-Based Testing: Providing Learners With Customized Feedback And Instructors With A Powerful Tool For Constructing Tests.* Greece: Department of Informatics, Athens University of Economics and Business (5)