The Design of Interactive Assessment-Cognitive Schema-based System: An Exploratory Study in E-learning Implementation

Melvin A. Ballera, maballera@yahoo.com.ph
Omer Masoud Salih, omeryomery@yahoo.com
Computer Science – Faculty of Science
Sirte University – Sirte, Libya

ABSTRACT

An e-learning website is not sufficient to fully attain the results of online education. There also is a need to align the educational objectives into the design of the assessment to improve and develop cognition, critical thinking and problem-solving skills. Previous studies have explored the potentials of the assessment models but few ventured into their implementation. Others only proposed and introduced conceptual frameworks. The implementation of these proposals, however, revealed that the question type in the assessment phase neglected to align their questionnaire formats into a cognitive schema. At present, the standard multiple-choice question is the most frequently used of the question type of e-learning assessments. However, if this type is the only format adopted by e-learning developers, then the potentially rich and embedded assessment of the computer platform can be will be given up. This paper then focuses on the design of assessment questions, which is created and guided by the hierarchical Bloom cognitive taxonomy and by utilizing rich media formats. Preliminary results conducted for four weeks show a dramatic increase in the academic performance of the students.

KEYWORDS

Bloom cognitive taxonomy, assessments, e-learning, cognitive, interactive

1 INTRODUCTION

Assessment is defined as "a device or procedure used for evaluation by obtaining a sample of a learner's behavior in a specified domain and scoring this behavior in a standardized process [1]. It constitutes a vital part of web-based learning instruction. Through assessment, educational strategists can determine how effective their lessons are in teaching students the intended facts and skills. To effectively assess students, educational strategists must not simply relegate assessment at the end of the learning process or training. This must be also fully integrated into the process of educating students [2]. Assessment designs can greatly influence the learning of the students. It can also be a tool for data gathering and the results gathered can help teachers decide on the performance of the students [3]. At present, many learning e-learning assessments used the standard multiple-choice questions. However, it can be argued that if e-learning developers adapt only this type of assessment, then the potentially rich and embedded assessment of the computer platform will not be totally utilized [4].

Today, the question type currently dominating many e-learning assessments is the standard multiple-choice question. It is necessary for assessment practices to reflect the combinations of acquired skills and knowledge. The complexity and use of these combinations will enable students to interpret, analyze, evaluate problems and explain their arguments. These assessments, which should be fully integrated into the learning process, provide information about the learner's progress and support them in selecting appropriate learning tasks. The consistency of the content, methodology, and the manner of assessment will make teaching become more effective. Therefore, it is a worthy undertaking to invest in the design of performance assessments because assessment provides multidimensional feedback for fostering learning [5].

The objective of this paper is to present an assessment questionnaire format by adapting a number of the assessment designs which were investigated and discussed in the related literature. These designs are redesigned and realigned into the Bloom Cognitive Theory Schema and is presented in a more interactive way to suit the computer science curriculum at tertiary level. The paper is organized according to the discussion of related literature, methodologies, initial findings and lastly, the conclusion and future works.

2 RELATED LITERATURE

For the alignment of an effective assessment design, three components are investigated in this section: 1. the search and adaptation of the existing assessment design that can be useful in the computer science curriculum; 2. The design of the assessment according to Bloom Cognitive Taxonomy schema (manner or way to present question in accordance to cognitive prescription) and 3. The incorporation of simulations interactivity in the assessment process.

2.1 E-Learning Assessment Questions

There are several ways to make assessment items innovative and creative. The use of technological enhancements of sound, graphics, animation, video or the incorporation of media can be utilized also for e-learning assessment designs [6]. Figure 1 below shows the summary of the 13 questions types collected from 15 various sources of scientific research and publications. Each question type has a different cognitive level and requires demonstration of varying skills from the learners during assessment process. Although there are many existing assessments that used various question types, few have been tested from the computer science perspective and at the level of tertiary education. Majority of these assessments were implemented in a pencil-paper test and few transformed these assessments into digital form [7], [8], [9], [10], [11], [12], [13], [14]. If such assessment features will be implemented fully into the e-learning, the system will hypothetically deliver cognitive gain among students.

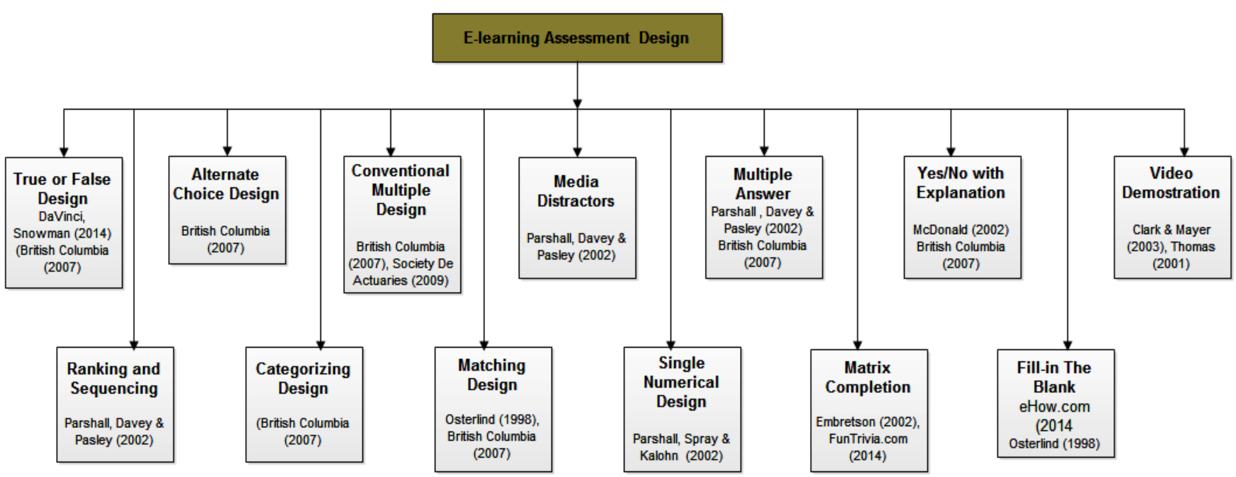

Figure 1: Question Types for E-Learning Platform

2.2 **Bloom Cognitive Schema**

The cognitive domain of Bloom involves knowledge and the development of intellectual skills, therefore it is necessary to align assessment according to this schema. This schema includes recall or recognition of specific facts, procedural patterns and concepts that help in the development of intellectual abilities and skills [15]. There are six major categories, starting from simplest behavior to the most complex in this schema. The categories can be viewed as degrees of difficulties [16]. Layer one is, “Remembering” which entails establishing definitions, creating fact charts, lists or oral activities. Layer two, “Understanding”, includes producing drawings or summaries.“ Applying” is layer three, and models, presentations, interviews or simulations are applied to new situations. Analyzing” is layer four which includes “distinguishing” between the parts creating spreadsheets, surveys, charts, or diagrams. Evaluating, which is layer five involves critiquing, recommending, and reporting. Putting the parts together in a novel and unique way falls in the sixth layer which is Creating [17]. At present, this model becomes a basis in developing e-learning by transforming its contents, instructional delivery and most importantly the assessment. The layers represent the levels of learning and increasing complexity.

Figure 2 shows the cognitive levels in Bloom’s original taxonomy, arranged in ascending order. Each step suggests activities for the specific level. A list of verbs which are commonly used to create learning objectives can be found below each step. When Bloom created this cognitive schema, he intended to use this in assessing the expertise in order to develop new ways in measuring what college students learn. At present, this model becomes a basis in developing e-learning by transforming its contents, instructional delivery and assessment to suit the learners’ needs. His work contributed greatly in shifting the focus of educators to learning from teaching.

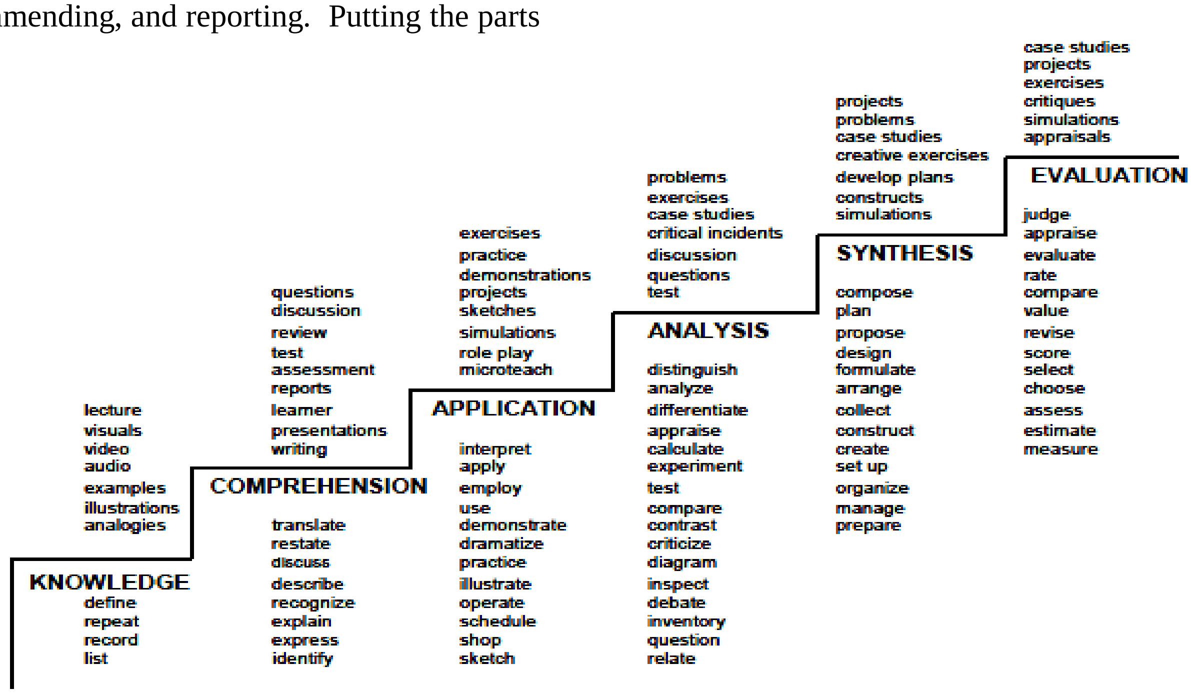

Figure 2: Bloom’s Taxonomy Staircase [17]

2.3 Multimedia and Interactivity

Many educators believe that interactive e-learning assessments allows “learning by doing”, arouses interest and generates motivation. Interactivity leads to a more meaningful learning because students are able to test their comprehension, learn from their errors and make sense of what is unpredictable. It can also improve the students’ knowledge and performance during the assessment process [18]. Simulations and modelling tools are the best examples of complex, meaningful interactivity in assessments. Such applications models represents a real or theoretical system, and allows users to manipulate input variables, change the system’s behavior and view the results. With such applications, learners can construct and receive feedback as a result of their actions. Inclusion of interactive simulations in e-learning assessment improves the quality and outcomes of e-learning. Simulations and visualization tools make it possible for students to bridge experience and abstraction which help to deepen their understanding of ambiguous or challenging content [19]. Interactivity, when used in assessment, is a factor that has the biggest impact on cognitive learning and is the most powerful model of instruction [20].

The use of multimedia in assessment such as graphics refers to the variety of illustrations that include line drawings, charts, photographs, motion graphics such as animation and video. These multimedia can indeed increase learning. Research shows that graphics improve learning through cognitive exercises, storing and retrieving ideas. Mayer claims that a student who practices on assessment with text and graphics is claimed to gain an average of 89% on transfer text as compared to those students who rely on texts alone [21]. It is also found out that the integration of text near the visuals during assessment yielded an average improvement of 68%. Furthermore, explaining graphics with audios followed by a question improved learning t by almost 80%.

Adapting question types from different researches and re-aligning its questionnaires or small tests into cognitive model and presenting it in an interactive and simulative manner can thus hypothetically guarantee learning.

3 METHODOLOGY

3.1 Respondents

The study is organized within the context of Design and Analysis of Algorithms class which is taught at Sirte University, Libya. The entire data collection and training lasted for 4 weeks for initial testing. All students are familiar with the use of electronic materials and had seen the implementation of the e-learning system and were given one week familiarization of the system flow and navigation. During the training, student were given several examinations (diagnostic, formative and summative) to determine their knowledge level of the course. The passing mark is 75.

Prior to implementation, students were informed about the research and the task involved. Students were given time to navigate the e-learning system so that they would be familiar and be directly involved in the learning process. If issues arouse during the learning process, the researcher provided necessary assistance in support for blended learning. At the beginning, participants were given diagnostic assessments, while at the end of each lesson, a formative assessment is given. All students were subjected to summative assessment at the end of the course training.

3.2 Data Collection

In this study, primary data were collected in two ways. The first was the experimental collection where various tables were populated dynamically, manipulated and extracted to generate several reports such as examination results, graphs, frequency of the practice examination and trials. The second was the survey which was divided into two parts. The first part was the measure of the internal reliability of all the questionnaires stored in the Item Bank. The second part was the acceptability of assessment design factors. Factors that affect the assessment design were content of the item, the visual design (colors, balance, readability), accessibility (links, feedback and explanation facilities), assessment types (difficulty, bloom level), navigation (transition of questionnaires, pop-up windows, reminders), learning support (specific part of the lesson, additional references) and interactivity. To measure the internal consistency of the questionnaires, the Cronbach alpha was used while z-test was used to evaluate the acceptability of the assessment design factors.

Degree of Difficulty

The 13 question types investigated and presented in the literature were categorized according to the Cognitive Bloom Taxonomy. Table 1 shows the question types description and the degree of difficulty *df*, for each type in different assessment formats. In formative assessment, the *df* is 1 for reviewing purposes and practice examination at the end of each lesson. The *df* of Bloom Cognitive examination (diagnostic) on the other hand is also 1, to measure the cognitive improvements of the learner which is usually administered every two weeks of the training.

The *df* of summative assessment differs accordingly since it is the most important performance matrix. As the Bloom category goes to the bottom of the table, the more difficult the questions and the deeper the cognitive development become. Every question has a level of difficulty, and this level is also utilized upgrading the students' performance matrix. Higher ability is demonstrated when a student answers harder questions that correctly answering an easier question. The *Remember* category has *df* 1 while the *Understand*, *Application*, and *Analyze* categories have a *df* of 1.5 while *Evaluate* and *Create* have *df* of 2.

Table 1: Questions Types and their Degree of Difficulty (*df*)

			Degree of Difficulty		
Bloom Taxonomy	**Question Types**	**Description**	**Summative**	**Formative**	**Diagnostic**
REMEMBER	MATF	Multiple True or False Questions	1	1	1.5
	MTCQ	Matching abd Categorizing Questions	1	1	1.5
	TOFQ	True or False Question	1	1	1.5
UNDERSTAND	MCMA	Multiple Choice Multiple Answer	1	1	1.5
	MCID	Multiple Choice with Illustrative Diagram	1	1	1.5
APPLICATION	CSMA	Complex Single Multiple Choice Questions	1.5	1	1.5
	SNCQ	Single Numerical Construction Questions	1.5	1	1.5
ANALYZE	SMCQ	Situational Multiple Choice Questions	1.5	1	1.5
	SAMC	Single Answer with Enumeration Questions	1.5	1	1.5
EVALUATE	MSOQ	Matrix Completion Questions	2	1	1.5
	MALT	Multiple Alternative Questons	2	1	1.5
CREATE	FIBE	Situational Fill-in the Blanks and Enemuration	2	1	1.5
	DSVQ	Video Simulation with Audio Play Qiestions	2	1	1.5

After aligning the colleceted question types as shown in Table 1, questionnaires underwent fornatting using the guided cognitive verbs schema as presented Figure 2 and then the interactivity and simulation to the question were added. The use of graphs, videos and other media formats, and required-response questions was incorporated in the system. The Item Bank is currently a repository of different questions types with varying difficulty level. It contains 280 questions with explanation facilities divided among thirteen (13) questions types and were used to produce the Bloom Cognitive Taxonomy examination, the random formative examination and the random summative examination.

3.4 Question Item Design and Interactivity

For brevity, two live illustrative question types were extracted from the system prototype for the purpose of illustration. Alternate choice items are somewhat similar to true/false type of questions. However, rather than letting the students determine whether a single statement is correct or not, this type of questions asks the student to select the better answer between two choices. Choices are often scenarios or cases, as shown in Figure 3 below.

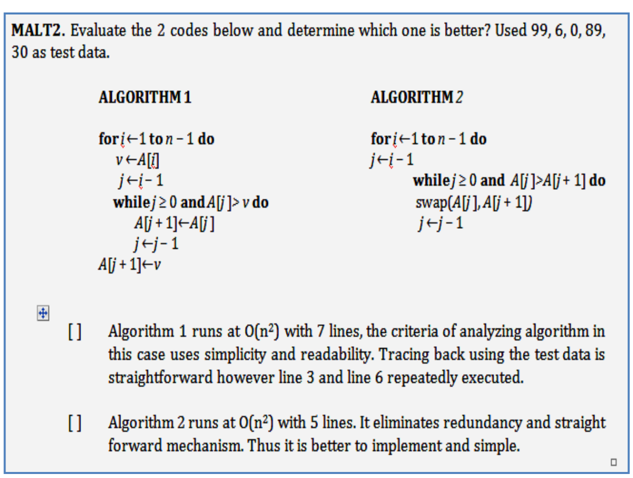

Figure 3: Alternate Choice Example

In this type, students were shown two possible algorithmic models for computing their running time complexity and must choose the most accurate response option. In this case, the correct answer was the second option due to its simplicity. Innovations in the multiple-choice category for online settings can include new response actions not commonly found in paper-and-pen settings. This entails clicking on an area of a graphical image. It can also include new media, such as sound clips which can be considered as distractors. Such new media innovations are represented in Taxonomy as Multiple Choice with Illustrative Diagrams. An example is given in Figure 4.

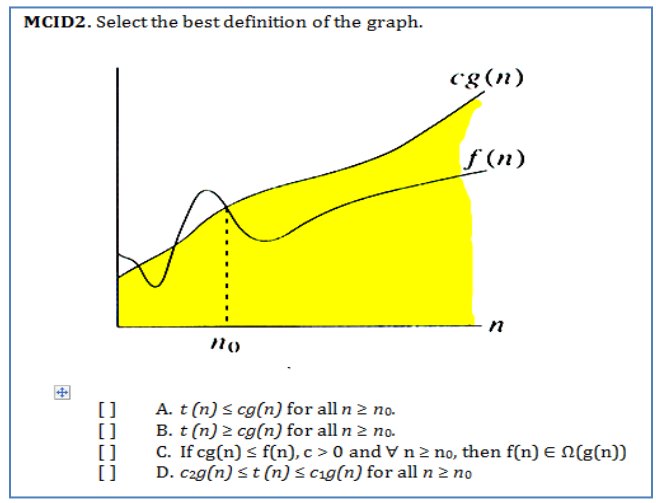

Figure 4: Multiple Choice with Illustrative Diagrams Example

In this example, respondents must select one of the four choices that corresponded to the meaning of the graph. There were four choices to choose from. This is similar to the standard multiple choice question but aside from choosing from the four possible answers, this method of response involves also analysis.

Many interactive activities were included in the assessment design to give learners the "personal touch and control" in the assessment process. Student could write their answer using the fill-in the blank question types, compute the next sequence and analyze the pattern in completion matrix question type. Students could also enumerate answers, view and analyze graphs and allow feedback. The explanation facilities could also derive the solution and link student's misconception into specific part of the learning materials. To enhance the learning process further, videos, and other simulative process were incorporated into the system to allow the method of "learning by doing". Student could view the algorithm and its simulative effects given certain inputs and variables.

4 RESULTS AND DISCUSSION

4.1 Internal Consistency and Z-test Results

Prior to the post survey for students, the survey forms were presented among the academic staff to validate the measurement scale and questionnaires. The Cronbach's Alpha coefficient for internal consistency reliability test was used for each scale. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. It provides the following rules of thumb: $\alpha \geq .9$ – Excellent, $.7 \leq \alpha < .9$ – Good, $.6 \leq \alpha < .7$ – Acceptable, $.5 \leq \alpha < .6$ – Poor and $\alpha < .5$ – Unacceptable [22]. The results of Cronbach's Alpha coefficients for each scale are presented in Table 2.

The results indicated that all scales satisfied the requirement for internal reliability. All Cronbach's alphas of the scales were higher than .60. The lowest value of Cronbach's alpha is .62 in Accessibility scale while the highest is .74 in Navigation scale. The impact of the reliability of each question in the survey can be determined by calculating Cronbach's alpha the ith variable for each $i \leq k$ is deleted. Thus, for a test with k questions, each score x_j alpha was calculated for x_i for all i where $x_i = \sum_{j \neq i} x_j$.

Table 2: Cronbach's Alpha Coefficient for each Measurement Scale

VARIABLES	CRITERIA						
	Content	Visual Design	Accessibility	Assessment	Navigation	Learning Support	Interactivity
k	5	5	5	5	5	5	5
Cumulative Variance (Yi)	0.86	0.99	1.08	1.00	0.99	1.01	1.01
Variance	1.75	2.06	2.14	2.14	2.41	2.08	2.31
α (Alpha)	**0.63**	**0.65**	**0.62**	**0.67**	**0.74**	**0.64**	**0.70**

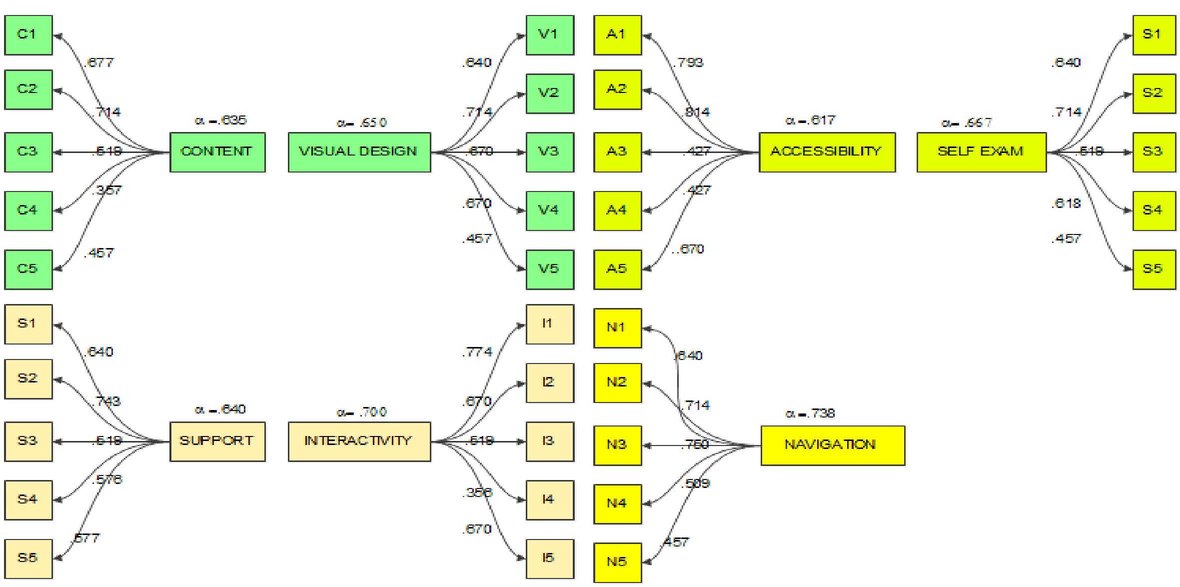

Figure 5: Reliability Coefficient after Deleting an Item

ISBN: 978-1-941968-02-4 ©2014 SDIWC

Figure 5 shows that the overall reliability for Content is .636 while individual reliability of questionnaire within the scale are: for C1 is .677, C2 is .774, C3 is .519, C4 is .337 and C5 is .457. In this scale, C4 was the most affected and could be deleted from the survey form. The Visual Design overall reliability is .650 and the most affected was V5 with Cronbach value of .457. On the other hand, Accessibility scale overall reliability is .617 and the most affected questions were A3 and A4 which both have values of .427. Similarly, with the remaining scale, questions with smaller Cronbach alpha compared to the overall scale reliability were the most affected and could be deleted from the survey form. If the reliability coefficient increased after an item was deleted, it can be assumed that the item was not highly correlated with the other items. Additionally, the decrease in reliability coefficient can lead to the assumption that the item is highly correlated with other items. [23]. As shown in the table, the omission of any single question does not affect the Cronbach's alpha very much. Questions with low reliability compared to its overall measurement scale were not deleted because small set of questionnaires affects the reliability value [24]. In this case, five questions in each measurable scale were acceptable and there was no need to delete the item since the uniqueness of each item could easily be seen. According to Cortina [25], the uniqueness of the item can be assessed with the coefficient alpha.

Table 3 shows the results of the post survey conducted among staff members to determine the overall reliability of the software and the 280 questionnaires stored in the Item Bank. These questions were used for various assessments employed in the prototype. During the survey, random questions were shown from the system to evaluate and rate their reliability. The overall internal consistency of the software is .81, which is considered good while the overall reliability for the 60 questionnaires for Bloom Cognitive Taxonomy is .84. Similarly, the internal reliability for questionnaires which were used for formative and summative assessment is .72.

Table 3: Crobach's Reliability of Questionnaires and Overall Acceptability

	Software Acceptability	Bloom Taxonomy	Questionnaires
K	13.00	3.00	3.00
sum var	7.10	2.22	1.13
var	28.64	5.02	2.19
α= alpha	0.81	0.84	0.72

Table 4: Z-test of Different Measurable Scale

Criteria	Mean	Standard Deviation	z
Content	4.37	0.79	2.89
Visual Design	4.29	0.69	2.57
Accessibility	4.26	0.76	2.13
Self Assessment	4.34	0.88	2.40
Navigation	4.21	0.62	2.09
Learning support	4.29	0.93	1.92
Interactivity	4.26	0.92	1.76
Motivation	4.29	0.80	2.22

An important concept in the evaluation of assessments and questionnaires is the Alpha. It is required from the assessors and researchers that they estimate this quantity to add validity and accuracy to the interpretation of their data. A low value of alpha can mean a low number of questions and poor interrelatedness between items or heterogeneous constructs. For example, if a low alpha is due to poor correlation between items, then some items should be changed or totally eliminated. If an alpha is too high, it may suggest that some items are repetitive as they evaluate the same questions in a different manner [26]. As observed in the study, the overall alpha is not too high but still considered highly acceptable at all levels.

Table 4 shows the summary of the perception of students on the significant level of different assessments scales. The mean is given with its standard deviation. The highest mean is 4.37 from the Content scale while the lowest is 4.21 from Navigation scale. The *z*-values at $z_{:05}$ = 1:645 makes all the critical values of measurable scale significant using one-tailed critical region. The z-values computed are greater than tabular value at alpha of .05. Based on Likert scale, the mean of each measurable variable is higher than the agreeable level which was successfully correlated by the *z*-test.

Table 5.1 shows a live data extracted from the prototype for 4 weeks using the link http://maballera.byethost7.com/elearning/. For the purpose of illustration, a number of records were selected from the different tables in the database. The table shows that during diagnostic exams, the items correctly answered by students gradually increased. This exam was composed of 30 questions. The questionnaires or items were designed according to the Bloom Taxonomy assessment. The table also reveals that the the number of trial decreases as the weeks of trainings continued. This can be attributed to the familiarity of the students with the assessment structure as they continue doing the process. The number of trials determined the number of time a formative assessment was taken to reach the competency level. For example, formative assessment shown in W1, first row indicates that students had to take this assessment ten times before they obtained a competency score of 7. As observed, only the 6, 7 and 8 scores were recorded in the formative results. Six (6) is the minimum score which is 75% out of 8. The system could load eight random questions during practice exams.

Table 5: Diagnostic, Number of Trials and Formative Assessments

Diagnostic Results				Number of Trials				Formative Results			
W 1	W 2	W 3	W 4	T 1	T 2	T 3	T 4	W 1	W 2	W 3	W 4
5	8	9	11	10	8	6	5	7	8	7	7
7	8	11	12	8	6	5	6	7	7	7	8
8	9	12	14	9	5	4	4	7	7	7	7
8	12	12	16	7	5	4	4	7	8	8	8
9	13	14	21	8	6	5	4	7	8	7	8
9	14	16	22	9	7	4	5	8	8	7	8
7	15	20	25	5	4	6	3	8	8	7	8
6	8	14	17	6	5	7	5	7	8	7	8
8	9	14	18	7	6	4	3	7	8	8	8
6	8	17	19	8	6	4	2	7	8	8	8

5 CONCLUSION

This paper successfully combined 13 question types extracted from 14 publications. It also aligned the 280 questionnaires stored in the Item Bank according to cognitive schema. The cognitive schema was composed of different “verbs” words which served guide in creating questionnaires that support hierarchical cognitive development. The questionnaires were reproduced as part of the e-learning assessment with added interactivity and simulations. The questionnaires stored in the Item bank were measured using internal reliability test and all were at acceptable level. The design factors of the assessment level were statistically significant at all assessment measurement scale. Based on the preliminary results of the study, students improved their academic performance. The number of trials in taking the practice assessment became less as the results increased. The success of the initial testing was attributed to the design of the assessment which allowed the students to review and reload the questionnaires several times thereby making them familiar with the graded assessment. Being interactive, the item or the question was linked to the explanation facilities, specific learning materials and review module. Although the initial results are quite convincing and acceptable, a thorough study is needed to establish the impact of the design in the diagnostic, formative and summative assessment.

6 REFERENCES

[1] American Educational Research Association, American Psychological Association, & National Council on Measurement in Education.. *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association. 1999.

[2] M. Birenbaum, M. New insights into learning and teaching and their implications for assessment. In M. Segers, F. Dochy, & E. Cascallar (Eds.), *Optimising new modes of assessment: In search of qualities and standards.* Dordrecht, The Netherlands: Kluwer. (pp. 13–36). 2003.

[3] K. Scalise & B. Gifford. Computer-Based Assessment in E-Learning: A Framework for Constructing “Intermediate Constraint” Questions and Tasks for Technology Platforms. *Journal of Technology, Learning, and Assessment, 4*(6). 2006.

[4] E. Schreiner.. How to Design Effective Classroom Assessments. Retrieved July, 22, 2014 from http://www.ehow.com/how_7408048_design-classroom-assessments.html

[5] J. Cowan. Designing assessment to enhance student learning. Retrieved June 10, 2014 from http://www.heacademy.ac.uk/assets/ps/documents/practice_guides/practice_guides/

[6] C. G. Parshall, T. Davey & P.J. Pashley. Innovative Item Types for Computerized Testing. In W. Van der Linden, Glas, C. A. W. (Ed.), *Computerized Adaptive Testing: Theory and Practice.* Norwell, MA: Kluwer Academic Publisher. pp. 129–148, 2000.

[7] C. G. Parshall, J. Spray, J. Kalohn, & T. Davey, T. Issues in Innovative Item Types. In *Practical Considerations in Computer-Based Testing.* New York: Springer. pp. 70–91, 2002.

[8] S. Embretson. Generating Abstract Reasoning Items with Cognitive Theory. In S. Irvine, Kyllonen, P. (Ed.), *Item Generation for Test Development.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers. pp. 219–250, 2002.

[9] M.E. McDonald. Developing Multiple-Choice Items. In *Systematic Assessment of Learning Outcomes.* pp. 83–120, 2002.

[10] British Columbia. Examination Booklet. Retrieved July 7, 1014 from http://www.bced.gov.bc.ca/exams/search/grade11/english/sample/exam/0708ss_P.pdf

[1] S. J. Osterlind. *Constructing Test Items: Multiple-Choice, Constructed-Response, Performance, and Other Formats*. Norwell, MA: Kluwer Academic Publisher. 1998.

[12] Society De Actuaries. Construction and Evaluation of Actuarial Models. Retrieved July 8, 2014 from

http://www.soa.org/files/pdf/edu-2009-fall-exam-c-questions.pdf

[13] FunTrivia.com. True or False Trivia. Retrieved August 21, 2014 from http://www.funtrivia.com/quizzes/general/true_or_false.html

[14] EHow.com.. How to Write a Fill In the Blank Questions. Retrieved August 21, 2014 from http://www.ehow.com/how_8233244_write-fill-blank-questions.html

[15] Bloom, B. Mastery learning. New York: Holt, Rinehart, & Winston. 1971.

[16] L. W. Anderson, & D. R. Krathwohl. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. Allyn & Bacon. Boston, MA (Pearson Education Group). 2001. http://epltt.coe.uga.edu/index.php?title=Bloom's_Taxonomy

[17] A. Churches. Bloom's Taxonomy Blooms Digitally. 2008. http://www.techlearning.com/studies-in-ed-tech/0020/blooms-taxonomy-blooms-digitally/44988

[18] M. Rosenberg, M. E-Learning: Strategies for delivering knowledge in the digital. 2000.

[19] R. Thomas.. Interactivity and Simulations. Multi-verse Solutions Ltd. 2001. http://www.jelsim.org/resources/whitepaper.pdf.

[20] R. E. Clark. & T. G. Craig. "Research and Theory on Multimedia Learning Effects." In: M. Giardina (red). "Interactive Multimedia Learning Environments. Human factors and technical considerations on design issues.. NATO ASI Series. s. 19-30. 1992

[21] R. Mayer. The promise of multimedia learning: using the same instructional design methods across different media. Learning and Instruction. Vol. 13. Pp. 125-139. 2003

[22] D. George & P. Mallery,. SPSS for Windows step by step: A simple guide and reference. 11.0 update (4th ed.). Boston: Allyn & Bacon. 2003.

[23] C. Zaiontz. Real Statistics Using Excel: Cronbach Alpha. Retrieved January 21, 2013 from http://www.real-statistics.com/author/

[24] M. Tavakol & R. Dennick. Making sense of Cronbach's alpha. *International Journal of Medical Education*. 2011; 2:53-55 Retrieved June 12, 2014 from http://www.ijme.net/archive/2/cronbachs-alpha.pdf

[25] J. M. Cortina. What is coefficient alpha? An examination of theory and applications" *Journal of Applied Psychology*. *pp*. 98–104. http://psychweb.psy.umt.edu/denis/datadecision/front/cortina_alpha.pdf

[26] D. Streiner. Starting at the beginning: an introduction to coefficient alpha and internal consistency. Journal of personality assessment. 80:99-103. 2003.