A Hybrid Testing System for ICT Skills Assessment of Students

P. M. K. Alahakoon, A. I. Thilakasiri, P. S. R. Peiris

Information Technology Center
University of Peradeniya
Sri Lanka

   Abstract- Assessment and testing of skills achieve during a course is a prime requirement of the educators. Out of the many teaching and training programs, prime attention goes to ICT teaching programs which have gained an unprecedented demand in all levels of educational institutes today. Assessment of computer related skills are done in several different modes. However, the authors believe that the ideal testing mechanism must provide the students with the facility of using a computer rather than answering on their memory of using a computer.

   The testing mechanism described herein was designed and implemented at the main ICT training facility in the University of Peradeniya, the Information Technology Center (IT Center), in order to address this need and also to facilitate conducting tests amidst numerous technical and logistical challenges.

   The comparative analysis shows that the hybrid test system which involves students answering a printed MCQ type paper while attempting the relevant software based tasks on a computer is capable of delivering higher testable course outcomes as well as topics under cash category. The same can be easily improved to be a fully computer based test depending on the ability of the skills of beginners in handling a computer for multiple tasks.

   Index Terms- Computer based testing, ICT skills assessment, On-line assessment.

I. INTRODUCTION

Conducting ICT related courses has been a very common practice in almost all university academic environments today. The need to impart the basic ICT skills needed by students for efficient learning and conduct of other academic exercises has become an essential part of the curriculum in many faculties in the University of Peradeniya as well. Some these courses are built into the regular undergraduate curriculum, and delivered in first or second year of the study program, while some faculties have adopted the approach of having them as preliminary training programs, offered during vacation periods or preferably, prior to start of a certain predetermined stage of their academic program.

   Since the courses are geared towards imparting various skills related to using a computer together with MS Office package, it is essential that the final assessment measures the skill levels achieved by the students. This, undoubtedly, is a difficult task to implement in a regular practical based examination system especially when the number per batch is many hundreds.

   The approach adopted so far by the IT Center is to design a fully practical test where students are asked to perform different tasks using MS Windows, and other software included in the MS Office package, save their output for evaluation by the teacher concerned. The paper consisted of questions targeting each software package, and the students were given access to a computer during the time of the test.

   The other approach adopted by some of the training institutes is to test their knowledge though an MCQ type question paper in an ordinary examination hall [1]. This testing method obviously was not geared for assessing the skill level but the memory related to the use of each package or software component. Even though this test method is adopted by some institutes, when MCQ type questions are used, the usual practice is such that either the test is completely a paper based MCQ type or, even if it is computer based MCQ, no provision is made for the students to attempt the task before answering. It is seen that many such institutes revert to the above approach of giving a practical examination in testing higher level skills. The IT Center has experienced the following technical as well as logistical problems in conducting these practical examinations, which warranted venturing into the new hybrid approach presented herein.

Preparation of examinations:
   The questions need to be prepared for each batch, and if teachers change in between, the respective teacher must be contacted for questions. The style of questions is dependent on the teacher concerned, and this adds a variability factor and personal dependence which is best be avoided.

Conduct of examinations:
   Since the tests are completely practical demonstrations of one's ability in reproducing what is given in the form of the question, he/she must be given a computer with a working copy of MS Office. The work done must be saved either on the computer, or on a

specific location on the server. However, due to technical difficulties and less know-how of students, it is recommended that they save the files thus created on the machine itself. The mode of operation is, that after each examination session, the Center staff would manually copy all the files created by each and every student into separate folders, and move all these folders to a predefined place on the server, which is an essential step that must be done within a very short time due to the sheer number of students using the limited facilities available. In addition, power outages worsened by malfunctioning UPS systems pose technical problems at several different levels, all causing disruption of present work of a student or saving the work. Besides, the mental agony an inexperienced student goes through due to the loss of his / her work in the middle of the examination can neither be estimated nor compensated.

Such situations have become very commonplace with the computers and UPSs getting older and passing their reliable usage times. The situation is aggravated by the diminishing number of computers since the students cannot be given extra / standby computers when theirs encounter technical problems. Even if the computer is changed midway during the examination, Center staff must to keep track of the location of students and the computers used by them in order to compile all their output files into one folder for final evaluation.

Another essential aspect of the present fully practical examination system is the need for a student to enter data and type a significant amount of text before the actual task prescribed in the question is performed. This undoubtedly places the student at a disadvantageous position if he / she is not a skilled typist. In most situations, the students, especially beginners, are very poor in typing speed, and this hinders them heavily in attempting the question since typing a significant amount of text is a must before the actions prescribed in the question are performed.

Coverage and scope of tested content:

Since the mode of testing was to get the students to generate a certain output and save it as a file, the items testable were automatically limited to the items and features that can produce an observable output. While most of the formatting and styles could be used for testing some of the other more technically important features in the Office package, which are essential for more efficient use, these could not be tested as questions could not be prepared to generate an outcome based on the said feature, that can be evaluated solely by observing the final output file.

Evaluation:

The examiners then take their time and go through the files created by each and every student in response to the question relevant to each teacher. The marks are assigned to each question based on the amount of accomplishment by each student. It is obvious that there is human judgmental error involved in this operation even though every effort is taken to minimize this by preparing detail marking schemes. Besides, the Center staff have to account for disruptions reported during the examination time in evaluating one's work, which is an added burden as well as a possible occasion where inconsistent marking may happen.

III. RELATED CONCEPTS AND WORK

This is an era where modern computer based approaches are engulfing the whole world, and almost all activities done by human beings. All these are categorized to be e-approaches in short, and utilize ICT based systems that range from individual computers to World Wide Web based systems.

ICT Training techniques and systems:

Ever since the trend of using ICT for education started, carrying out computer based assessments has also gained significant attention. What is identified today as e-assessment is the use of information technology for any assessment-related activity. Even though ICT based teaching as well as assessment systems are in use for many subject areas, only the techniques pertaining to ICT skills assessment are discussed in this paper. The activities pertaining to e-assessment of ICT skills could range from the use of a word processor or any other individual software to produce a required output as proof of the skills, to on-screen testing. Other types of e-assessment include computerized adaptive testing and computerized classification testing [2].

Various terms are used to describe the use of a computer for assessment purposes. These include:
- Computer-Assisted Assessment or Computer-Aided Assessment (CAA)
- Computer-Mediated Assessment (CMA)
- Computer-Based Assessment (CBA)
- Online assessment [2]

Although these terms are commonly used interchangeably, they have distinct meanings. Out of the above, the mode adapted in this effort is the Computer-Assisted or Computer-Mediated assessment mechanism as the students are given the opportunity to use the relevant computer software in answering, but assessment is not fully computerized. However, by adapting the approach presented in this paper, it is quite possible to extend the assessment technique to make it fully computer based. In addition, the hybrid testing approach presented herein, can easily be adapted for testing other subject areas as well, with the use of a computer in an appropriate manner.

ICT Skills assessment methods:

The essential steps that must be fulfilled in an examination are; create the examination, keep the contents secure until the examination starts, supervise the entry of students into the examination environment, identify them if necessary, ensure that they do not have prohibited materials or communication devices, make sure they do not communicate with each other, collect the examination papers at the end of the examination period, and mark the answers [3]. Any examination system should facilitate the above in order for it to be successful.

Fully automated testing and assessment systems:

One fully automated computerized testing system which is even integrated with personnel recruitment and promotions is described as ICE (Integrated Computerized Examination) of Pennsylvania, USA. Their system however, is not on ICT skills alone, but is capable of running a large number of simultaneous tests that are accessed by individuals from different testing sites across the state [4].

A very comprehensive and standard testing system for assessing the ICT skill has been deployed by the ETS (Educational Testing Service), one of the most recognized testing organizations in the world. ETS's iSkills assessment is an Internet-delivered assessment that measures students' abilities to research, organize, and communicate information using technology [4].

Computer based manual systems:

Fluck et al. [5] also describe a computer assisted testing mechanism employed in a case study of computer based examinations systems, where they highlight the issues related to power failures, and reliability of computer systems, which is one of the major concerns of the authors of this article.

Even though fully online or fully automated testing systems do have a useful role to play in skill level assessment in many fields, it requires a very reliable, sophisticated hardware infrastructure and dedicated software platforms to operate on. Therefore, the hybrid approach described herein has a great potential in conducting tests in low technology environments, to meet the need to assess the actual ICT skill.

IV. OBJECTIVE

As a means of finding a practical solution to the above issues, and to be able to conduct ICT skill assessment examination with increased reliability, a new approach of conducting examination by combining the MCQ question based technique and practical hands-on work was developed and implemented, which is presented hereby as a hybrid testing system.

The main objective of the new testing mechanism is to be able to assess the ICT skill level of students without having to depend on the technical reliability of the computer systems, while providing higher reliability, confidentiality of the questions as well as answers. The new system ensured that it is difficult for the test takers to copy the questions for transmission to others or copy the answers from the subordinates. This also provided a very convenient and fast marking, which especially helps in handling large numbers.

V. THE HYBRID TESTING SYSTEM

It was hypothesized that a paper based question and answering mechanism would remove the heavy dependence on the computer for generating the answers, save, and subsequently, evaluate. Therefore, it was decided to base the test on printed MCQ style question papers. However, in order to assess the actual skill level rather than the recall abilities, it was decided to conduct the test in a computer laboratory where each students is given a computer during the test, and design the question in such a way that students would be forced or encouraged to answer the questions after attempting the prescribed exercise on the computer.

Advantages:

The benefits of this new system are many. One of the major advantages is that the students are not required to depend on the computer and its reliability for generating and saving the answer, even though the question directly tests his ability of actually performing the intended task on the computer. Therefore, the whole examination is not affected by intermittent technical problems which may arise in a long test, conducted with old UPSs and computers, operated by inexperienced students.

Besides, since the question paper is printed and the student is required to answer on the question paper itself, there is no opportunity to remove the question paper without permission from the examination hall, thus protecting its confidentiality and security, which is difficult to achieve in a computer based paper especially due to electronic means of copying of transmitting. Further, the questions on the paper could be printed in several different sequences and be given to neighboring students preventing direct copying of answers from the neighbor's answer script.

Another convenience experienced by the authors is in planning any given paper to cater to different audiences. The IT Center has already developed a question bank consisting of over 200 questions. The Center also employs a test paper making system [6] which is capable of generating a paper based on several different criteria stipulated by the teachers. These criteria are:

1. The number of questions of each difficulty level
2. The number of questions from each topic

This system and the questions bank that has a large collection of test questions tagged with three levels of difficulty and corresponding marks and times allocated for each level, make it possible to generate a question paper for any audience with any level of difficulty within a short time. In addition, this also allows mixing the right number of questions from each section and difficulty level to match the time period, and the total marks allocated for the paper. A sample planning exercise is described below in Table 1 where it shows how the sample paper is planned to have total marks of 100. The length of the examination is set for 2 hours. The three levels of questions are given 1, 2, and 3 minutes per question and the marks allocated are 1, 2, and 3 respectively for each level.

Table 1: Question paper planning table

Topic	Word			Excel			PowerPoint			Internet			Windows		
Dificult level	E	M	D	E	M	D	E	M	D	E	M	D	E	M	D
Time/ Question (Min)	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
No. of Questions	10	9	4	10	9	4	4	4	1	4	4	1	3	2	1
Time needed/(Min)	10	18	12	10	18	12	4	8	3	4	8	3	3	4	3
No. of Questions															
Easy	10			10			4			4			3		
Moderate		9			9			4			4			2	
Difficult			4			4			1			1			1
Total No. of Questions	**70**														
Time for Paper/(Min)															
Easy	10			10			4			4			3		
Moderate		18			18			8			8			4	
Difficult			12			12			3			3			3
Total Time for Paper/(Min)	**120**														

E: Easy   M: Moderate   D: Difficult

As an example, the authors have decided to generate a question paper that contains question on MS Word as follows: 10 in Easy category, 9 in Moderate, and 4 in Difficult. The difficulty level combinations under Excel, Power Point, Internet and Windows sections are: 10, 9, 4; 4, 4, 1; 4, 4, 1; and 3, 2, 1 respectively, as can be seen in the above table, amounting to a total of 70 questions. The time allocated for each question category can then be adjusted to make the total time for the paper to 2 hours (120 minutes) in a very convenient manner.

Therefore, the new system of preparing a MCQ paper was found to be very convenient and flexible in terms of adjusting its level of difficulty, length, and the subject coverage compared to the previous practice of having several individual practical questions.

VI. RESULTS AND DISCUSSION

In order to comparatively evaluate the advantages and disadvantages of the two test systems, several analyses were performed. The MCQ questioning style adopted in this effort made it possible to include a large range of features in the Office package that are useful for a learner to know but do not produce a visible final output, and therefore, cannot be tested in the previous fully practical testing system. These include the use of many menus and sub menus, procedures of performing certain tasks, and general knowledge on the package and whereabouts of various features. Therefore, it could be seen that the new approach is very powerful in testing much larger scope, covering a larger number of specific course outcomes, which are given in comparison to the number of testable outcomes in the previous 'fully practical' testing system (Table 2).

However, it could be observed that the question papers prepared under this scheme take much larger space as those should include images of screenshots and other graphics in the question as well as in the answers. Therefore, printing of the question papers consumed larger number of papers, which could be identified as the only major disadvantage of the new scheme. Even though a completely computer-based paper could be produced and used, the low level of computer skill of the student cohort concerned prevented us from doing so.

Table 2: Testable outcomes of the examination systems

Subject Component	Hybrid Examination	Fully Practical Examination
Windows	4	6
MS Word	5	23
MS Excel	11	23
PowerPoint	6	9
Internet and Email	1	8

Another analysis was performed by marking the topics that are covered in the two tests given under the previous test system and the proposed new hybrid approach as can be seen in the table 3 below.

Table 3: The course topics tested by each test system

Tested sub topics	Practical Test	Hybrid Test
Basics in IT		
1.Describe the term hardware, 2.Describe the term software, 3.Information Technology, 4.Mainframe computers, 5.Minicomputer, 6.Supercomputer, 7.Personal computer, 8.Laptop and palmtop computers, 9.Main parts of a computer, 10.Input devices, 11.Output devices, 12.Storage devices, 13.System software, 14.Application software, 15.Utility software, 16.Operating systems, 17.Windows environment, 18.Basic mouse actions, 19.Keyboard shortcuts, 20.Desktop, 21.Start button, 22.Customizing the windows background, 23.Control panel, 24.Print screen, 25.Copying and moving, 26.Help functions, 27.Working with desktop icons, 28.Taskbar, 29.Parts of a window, 30.Windows accessories, 31.File storage in a computer, 32.Types of files, 33.Windows explorer, 34.Directories/folders, 35.Working with files, 36.Folder options, 37.Searching, 38.Compressing, 39.Data backup, 40.Computer viruses	18, 24, 25, 30, 31, 32, 34, 35, 36	2, 5, 8, 9, 13, 14, 15, 16, 19, 21, 23, 33, 34, 35
MS Word		
1.menus, 2.Office button, 3.Quick access toolbar, 4.Ribbon, 5.Inserting pictures, 6.Find & replace, 7.Page breaks, 8.Equations, 9.Symbols, 10.Text formatting, 11.Paragraph formatting, 12.Tabs, 13.Borders and shading, 14.Columns, 15.Bullets and numbering, 16.Styles, 17.Tables, 18.Page numbers, 19.Header & footer, 20.Captions, 21.Cross references, 22.Indexes and tables of contents, 23.Page setup, 24.Printing, 25.Mail Merge, 26.Spelling and grammar	1, 2, 4, 10, 11, 13, 17, 25	1, 2, 3, 4, 6, 7, 10, 11, 12, 15, 16, 17, 19, 25, 26
MS Excel		
1.Excel environment, 2.Data entry, 3.Objects, 4.Cell formatting, 5.Formulae & functions, 6.Cell references, 7.Paste special, 8.Series, 9.Sorting, 10.Filtering, 11.Conditional formatting, 12.Forms and validation, 13.Charts, 14.Printing, 15.Mcros	2, 4, 5, 6, 9, 11, 13	1,2,3, 4, 5, 6, 7, 8,10,11, 12, 13
PowerPoint		
1.Usage of PowerPoint, 2.Design techniques, 3.Views, 4.Create a new presentation, 5.Notes related to slides, 6.Inserting a new slide, 7.Changing the slide layout, 8.Inserting duplicate slides, 9.Formatting slides, 10.Inserting objects, 11.Animation, 12.Transition, 13.Slide show, 14.Hyperlinks, 15.Action buttons, 16.Hiding slides, 17.Custom shows, 18.Save/publish, 19.Slide master, 20.Printing	4, 6, 9, 10, 11, 12, 14, 15	1, 3, 9, 11, 13, 14, 16, 17, 18, 19
Internet & Email		
1.Internet , 2.IP addresses and hostnames, 3.domain name service, 4.World wide web, 5.Email, 6.Telnet, 7.FTP, 8.Web navigation, 9.Web browser, 10.Searching the web, 11.Save/print, 12.Password protection	1, 4, 8, 9, 10, 11	1, 2, 4, 5, 8, 9, 10, 12

VII.   CONCLUSIONS

It is very clear that the new hybrid approach of conducting ICT examinations provide a means of testing the skills achieved in very intricate detail. It is possible to test the familiarity of the menus, as well as the student's skill in mastering the software. Furthermore, this testing system provides an advantage to the students who are skilled to learn 'on the go' since anyone is able to attempt the operation pertaining to each question and find the correct answer even if that candidate has no prior experience in using the specific operation in question, which in turn measures the actual skill in using a certain application software.

In addition, the advantages on the examiner's side are the conveniences in planning a question paper, customizing to different trainee levels, different times, and also in minimizing possible copying during examinations, in addition the ease of marking.

Based on the above positive outcomes it could be concluded that the new hybrid testing system is very effective compared to the traditional fully practical method of testing ICT skills.

REFERENCES

[1]   UCSC: University of Colombo School of Computing. (2009). Year 1: Semester 1 Syllabi (Effective from 01 st October 2009). (http://www.bit.lk/index.php?option=com_content&task=view&id=378&Itemid=177).
[2]   Wikipedia. (2011). E-assessment. (http://en.wikipedia.org/wiki/E-assessment).
[3]   WWW.1729.com. (2011). Internet based examination system. (http://www.1729.com/blog/InternetBasedExamSystem.html), downloaded on 2011-09-03.
[4]   ETS: Educational Testing Service. (2011). Testing Information Literacy in Digital Environments: ETS's iSkills Assessment. (http://otrans.3cdn.net/58e07c3cb23a5bb4c9_fsm6by595.pdf), Downloaded on 2011-06-19.
[5]   Fluck, A., Pullen, D. and Harper, C. (2009). Case study of a computer based examination system - University of Tasmania, Australasian Journal of Educational Technology, 25(4), 509-523.
[6]   Weragama, D. S. and Alahakoon P. M. K.. (2011). Development of an online assessment system. Proceedings of the Peradeniya University Research Sessions, Vol. 16, University of Peradeniya, Peradeniya 20400.

AUTHORS

First Author – P. M. K. Alahakoon (B.Sc. (Electrical & Electronic Eng.), MS, Ph.D (Ag.ric. Eng.)
Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka.
mahindaalahakoon@yahoo.com, pmka@pdn.ac.lk

Second Author – A. I. Thilakasiri (B.Sc., MS (Computer Science)
Information Technology Center, University of Pradeniya, Perdadeniya 20400, Sri Lanka
indika75@gmail.com

Third Author – P. S. R. Peiris (B.Sc. (Electrical & Electronic Eng.), MS (Computer Science)
Information Technology Center, University of Pradeniya, Perdadeniya 20400, Sri Lanka
sama_ran@yahoo.com

Correspondence Author – P. M. K. Alahakoon (B.Sc. (Electrical & Electronic Eng.), MS, Ph.D (Ag.ric. Eng.)
Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka.
Visiting Postdoctoral Fellow, Sultan Qaboos University, 123 Al-Khoudh, PO Box 34, Sultanate of Oman.
mahindaalahakoon@yahoo.com, pmka@pdn.ac.lk