

On-Line Aptitude Test

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ABSTRACT

This paper reports upon a project aimed at introducing computer-based test techniques into the aptitude test for the entrance examination at UNITEC Institute of Technology (New Zealand). For the purposes of this paper, a computer based and on line delivered testing model is described. The author will discuss the benefits and features of this new testing environment, describe the construction of the test using Macromedia Authorware (and its user interfaces, and address the issues related to the design of question episodes, factors that may influence the system performance as well as distribution and the real time controlling.

1. INTRODUCTION

Students applying for places in either the Certificate in Computing or the Bachelor of Computing Systems must meet three entry criteria - English, Maths and General. For many years, the School of Computing and Information Technology has used a conventional pen and paper based Aptitude Test to assess entry criteria for students who did not have relevant school qualifications. Questions were randomly chosen from a test bank, presented to the test-taker (participant), and manually marked. As applications increased over time, this pen and paper based system became an expensive and time-consuming system to maintain and operate, so alternatives were sought. Research was conducted to evaluate a number of CBT software packages for implementation of computer based testing. Some of the programs examined included Question Mark for Windows(tm), Interactive Assessor(tm), TestMaker(tm), EastTest(tm) and Examine(tm). Unfortunately, none of these packages fulfilled all of the selection criteria

identified during the initial stages of the project. It was therefore decided to build a customised solution. For this development process, Macromedia Authorware version 5.0 was chosen to expedite the process of creating a testing environment, and the whole system was designed and implemented for on-line delivery.

Development of this application included creating and testing the delivery and scoring procedures for tests, as well as establishing a record keeping system. Specific tests can be created based on specified criteria with questions randomly chosen from a bank, and questions can be delivered in testing mode, with scoring and a report of results available afterwards.

This paper discusses the benefits and features of this new testing environment, describes the construction of the test and its user interfaces and addresses the issues related to the design of question episodes. Factors that may influence the system performance as well as distribution and the real time controlling are discussed.

2. ADVANTAGES AND FEATURES

The transition to the On-Line Aptitude Test is part of an overall plan undertaken by the School of Computing and Information Technology in UNITEC to enhance the entrance exams. The On-Line Test offers a number of advantages over the former pen and paper format, including the following:

Cost Effective

Reusable templates for assembling test items with no paper work involved.

For each of the four different test sections, a template can be created using Authorware to assemble relevant media objects - such as diagrams, text content, etc.

All questions and answers can be prepared using a text-editing tool. A typical tool is NotePad.

Questions and answers can be randomly combined to produce a new set of questions for another test.

Saves Time

Fewer staff are needed to organize the test. Faster reporting of test results.

For each test room, only two supervisors are needed, one to control the test process, another to monitor the behaviour of participants during the test.

Most marking is conducted automatically. The word test section is marked manually as this is a type of fill in the blank test and has no standard answers. All test sections can be marked on one tutor's machine, removing the need to sort out the results of the four different sections for each participant. This was very time consuming in the conventional pen and paper based test, therefore the score reporting is faster.

Avoids Cheating

Controlled timing, alternate versions of test

One uniform timer is maintained for each test section, which enables every participant to do the test with exactly the same time limit. At the completion of the given time, tests close down on participants machines.

A different combination of questions or questions presented in a different order are presented to each participant, therefore participants sitting beside each other will have different testing material.

Reliable and Robust Architecture

The system is "hardware fault tolerant", each test room can have two supervisor machines working simultaneously. These two supervisor machines can work interchangeably; if one machine is faulty during the testing process, the other one can continue to function as the supervisor machine.

Along with these benefits come many changes for participants. One obvious change is that participants will do the exams using a computer. Although there is a high PC usage ratio in New Zealand, we are assuming that all participants are familiar with the use of the mouse and keyboard.

We have an introductory tutorial which is specially designed to teach participants how to manually operate the mouse and keyboard. This could be made available to participants prior to the actual test.

In the mean time, the on-line aptitude test has some video clips embedded in the application. These video clips will be shown at the beginning of each test

section to demonstrate the operational procedures for completing the tasks in each test section.

Comments from participants in past field tests indicate that these techniques may enhance the participant's performance and improve their task-focus.

3. CONSTRUCTION OF THE TEST AND USER INTERFACES

The on-line aptitude tests were carried out in the school's computer labs under formal examination conditions. In order to deal with the relatively large number of applicants that took part, several rooms were used simultaneously. It is the administrator's job to determine which test room the applicants are assigned to, at what time they are required to attend and at which workstation they will sit.

Test Formats

The on-line aptitude test takes approximately 11/2 hours and consists of 50 questions in four sections:

1. Section one is to test participants' ability to use English words in sentences (see figure-1).

All participants are given a piece of writing in which 15 words are missing. The participants are expected to type a single word into each space (blank). There are several words that could be used in each space. The participant will choose the most suitable words so that the story reads correctly. In the example shown in Fig-1, a participant could use the word "available" in the first space (blank) or the word "offered". Because of the "free format" feature in this section the marking procedure is manually conducted using a specifically designed template, but the subtotal for this section is automatically calculated.

2. Section two is to test participants' mathematical ability (see figure-2).

All participants will be presented with 10 questions and required to recognise what number results from given calculations - without using a calculator.

On the screen some necessary information - such as current time, total number of questions and the number of questions completed, are shown for participants to easily manage the testing process.

This section, as well as the following sections three and four, are multiple-choice tests. The system provides two navigation buttons for the participant to move along the question sequence. Once an answer is selected, it will be highlighted in yellow.

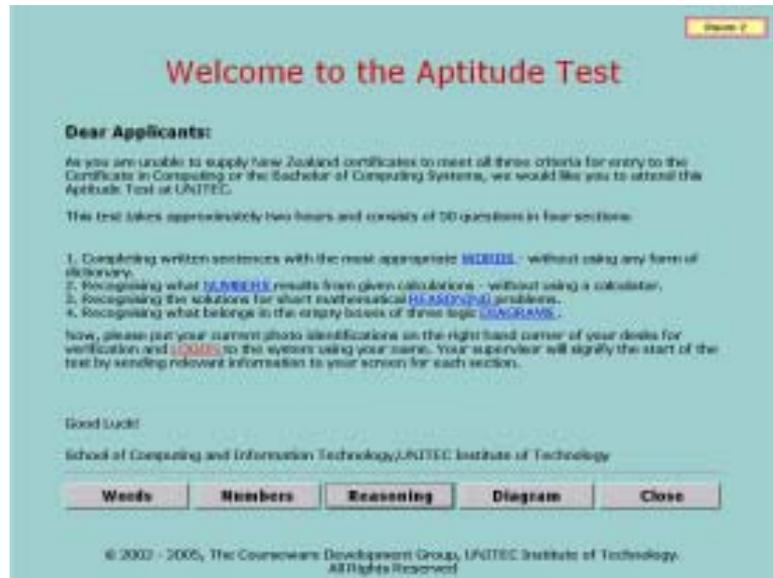


Figure-5: screenshot of supervisor’s control panel



Figure-6: screenshot of score marking

Score marking is carried out after each test is completed. As previously discussed, the examiner must manually mark the word test section, and then the system automatically calculates the total for each participant (see figure-6). Finally the system produces a test result report that is sorted according to the admission criteria for the CC/BCS programmes.

4. SYSTEM EVALUATION AND DESIGN ISSUES

Since the aptitude test is computer based and delivered on-line, it was felt that several areas appear worthy of further discussion and investigation, including issues related to the design of question episodes, factors that may influence the system performance and the real time controlling.

Question episodes

Applying computer technology to the aptitude test gives us the opportunity to measure more than content knowledge. We can also measure how content is applied in problem solving and reasoning. This possibility for creating new test formats and new question types to assess a participant's abilities is partially dependent on the choice of authoring language. Macromedia Authorware(as explored in this project gives us complete control over the test presentation. Each question can contain information in the form of Text, Graphics, Voice, Video or Music files, which could be displayed before the question is answered or after it is answered. The language's highly interactive nature enables us to create a simulated environment in which participants are asked to demonstrate particular abilities, more than can be measured by simply a series of multiple-choice questions.

PERFORMANCE REVIEW

We have conducted field tests both at the UNITEC main campus and the Waitakere campus. Comparisons with the conventional pen-paper based test suggest that the use of this software may improve overall performance, for both participants and supervisors.

The majority of participants felt that using a computer to do the aptitude test was quicker to work through than a conventional testing method. Real-site observation indicates that removing the need to write down answers allowed participants to concentrate and to focus more closely on the questions displayed on the screen.

The screen-recorded demo, which is presented at the beginning of each test section, gives participants a more realistic description of the procedures for completing the test. For example, on the diagram test section, a static diagram (flow chart) with a complex text explanation may require the supervisor to spend 20 - 30 minutes to orally explain how to complete the section in the conventional pen-paper based format. With the advantage of using motion, a multimedia technique, all these explanations can be shortened and presented in new and potentially more intuitive ways.

Distribution consideration

Since the testing modules are accommodated in an intranet environment, the time constraints for the client machines (on the participants side) to access the available testing materials is a critical factor. We

packaged all testing templates in A5R format. Once a participant successfully logs on to the system, all testing materials, including the templates and questions, will be download to the client machine. This is based on the fact that no matter how fast a computer is, getting information to the computer and into memory over a network takes time. The on-line aptitude test is not simply an on-line educational learning and testing software, it simulates a real situation, which requires all participants to start the test immediately after receiving instructions from the supervisor.

Testing Time Control

The on-line aptitude test, like the conventional test, should be carried out under "Fair" conditions. Every participant must complete each of the four test sections in a given time limit. So how we implement an effective timing mechanism is obviously a key factor related to the "fairness" issue.

Technically there are many ways to implement time control systems on the web. The time could be fetched from the local PC client or from the remote server. The on-line aptitude test requires all participants to be totally controlled by one supervisor. Therefore, the timers on all machines should be synchronized with the supervisor's machine. The Microsoft Exchange Service provides a useful function that enables the supervisor's machine to broadcast the current time message to all participants' client machines for display so that the synchronization is realized.

5. CONCLUSION

Computer-based and on-line delivery gives us the ability to "open up the power of testing". The development effort required for the "On-Line Aptitude Test" could be used as an opportunity to illustrate some of the benefits and features that might be associated with this transition.

Much of the material presented within this paper has shown that Macromedia Authorware(as an authoring tool provides many possibilities for creating new test formats and new question types to assess a participant's abilities.

We are presently conducting extensive research to understand the major issues presented by this new testing environment. We want readers to understand why we were motivated to take this evolutionary step, how to prepare for them, and how to evaluate the performance.

Further development involving the design and implementation of the administrative components could allow this application to be used as an



educational shell suitable for the delivery of courseware and modified in such a way as to facilitate further customisation for other subject areas should there be interest in doing so.

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