

# Computer-Based Assessment

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## INTRODUCTION

Computer-based assessment (CBA) is gaining popularity in higher learning institutions to replace traditional written tests with computerized versions. Some reasons that have encouraged instructors to develop and adopt CBA include the increased number of students and the corresponding increase in time spent by instructors on assessment. The primary objective of a CBA is to save the instructor time by leaving the computer software to mark and give feedback on the test.

As information technology has become ever more important for teaching engineering, so computers have become an established means of student assessment. CBA is not just an alternative method for delivering

tests; it represents an important qualitative shift away from traditional methods such as paper-based tests. In this paper we describe a computer coach-based assessment model for engineering mechanics dynamics course.

## BACKGROUND

Computers are now regularly used to deliver, mark, and analyze student assessments. A common traditional assessment is where candidates fill in their responses on a paper form, which is fed into a computer optical mark reader. This reads the form, scores the paper, and may even report on test reliability. In general computer-

*Table 1. Taxonomy of applications of computer-based automation*

|                         |                          |  |
|-------------------------|--------------------------|--|
| Summative               | Exam                     | <i>An assessment solely for grading purposes such as an exam at the end of a unit of study (Callear &amp; King, 1997; Zakrzewski &amp; Bull, 1998)</i>                       |
| Formative/<br>Summative | Grading test             | <i>An assessment for grading but which also provides feedback intended to direct future studies such as a small test, or weekly problem sets (Callear &amp; King, 1997)</i>  |
| Formative               | Open access test         | <i>A grading tests where students are allowed to practice before sitting the test (Thelwall, 1998).</i>  |
| Formative               | Self-test                | <i>An assessment designed to provide feedback to students on their progress (Zakrzewski &amp; Bull, 1998)</i>  |
| Formative               | Exercises                | <i>A problem set designed to consolidate learning on a section of a unit of study (Thoennessen &amp; Harrison, 1996; Whiting, 1985)</i>                                      |
| Formative               | Programmed Learning tool | <i>A linear computer-aided learning (CAL) package based upon a question and answer session as pioneered by Skinner (1968)</i>  |
| Formative               | CAL quiz                 | <i>A marked exercise integrated into a CAL package, for example a MCQ presented after a slide show containing new information (Kelly, Maunder, &amp; Cheng, 1996)</i>        |
| Formative               | Adapted CAL quiz         | <i>A marked exercise integrated into a CAL package used to test the students but also used to adapt the teaching of the package to student weaknesses (Laurillard, 1993)</i> |
| Formative               | Diagnostic test          | <i>An assessment of prior learning taken before a unit of study test (Appleby, Samuels, &amp; Treasure-Jones, 1997)</i>  |

based assessment has been used since the 1960s to test knowledge and problem-solving skills. The earliest versions were text-based and typically consisted of factual questions for which they were definite right and wrong answers. However today, computer-based assessment is used in many different contexts, and to perform different functions. There are generally two basic types of assessment, that is, *formative* and *summative* (Thelwall, 2000) as briefly described in Table 1. Formative assessment is designed to help students to gain understanding and to develop their good learning habits. Typically, this type of assessment will be represented by activities integrated into the course and may include:

- Feedback within study materials;
- Self-assessments tests or quizzes;
- Feedback from assignments;
- Dialogue with peers, colleagues, and department; and
- Un-graded tests (“mock exams”).

On the other hand, summative assessment attempts to measure the extent and quality of the students learning through:

- Examinations;
- Course work/assignments/mini projects; and
- Practical demonstrations/oral presentation.

A commonly used format that operationally combines the two is *continuous assessment*, that is, summative assessments are integrated into the course alongside any formative assessment. Such an assessment is beneficial to vocational courses where a written summative assessment may itself be inappropriate. Continuous assessment is easy to manage and provides a source of material that allows dialogue, reflection, and motivation to develop.

## GENERAL PRACTICE

Before looking at ways in which assessments might be implemented using computing software, it might be best to look at the needs and concerns of the students, department, educational, and institutions. Students generally have mixed feelings about assessment. On the one hand, the resulting qualifications are seen as being

highly desirable, often necessary to acquiring a desired job or promotion. Students typically fear the standard summative examination process, often feeling it to be unfair that a whole year’s work can depend upon their performance in the allotted two or three hours (Morgan & O’Reilly, 1999).

For the department, the principle function of formative assessments should clearly be to monitor the learning of the student. The assessment process would provide the instructor with useful feedback about the effectiveness of the course. Summative assessment should then be able to provide an accurate representation of the level achieved by a student. For the educational establishment itself, assessment has two important functions; it allows staff and program performance to be monitored, and allows the achievement of the establishment be known to the public through publications, advertisements, and so forth.

With the rapid expansion of educational opportunities, the number of candidates sitting for a particular test has become very large and this calls for an alternative method for effective assessment. In addition, there is a great demand by the candidates, parents, sponsors, and the university to release the results of the examination as quickly as possible. In order to cope with this scenario, computers are increasingly being used in assessing student’s knowledge. However, the techniques employed for this purpose depends on pertinent factors such as the number of candidates, the number of questions, and the available man-hours to mark the answer sheet to prepare the result sheet on the computer.

In general, there are a variety of commercial computer-based assessment tools available on the market such as Question Mark Designer for Windows, Question Mark, Quiz Please, WinAsk Professional, and EQL Interactive Assessor. On the other hand, authoring tools such as ToolBook II Instructor could be used to design and implement customized CBA tools. The following section describes an innovative in-house developed engineering coach-based CBA tool that not only marks and grades the student but additionally coach the student in solving the problem.

## THE ASSESSMENT MODEL

The assessment model is a dynamic model of the student’s knowledge and capabilities, maintained and constantly updated by the computer-based tool. Its

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