

**Full Title:**

**WHAT HAVE EXAMINATIONS GOT  
TO DO WITH COMPUTERS IN  
EDUCATION?**

**Running Title:**

**EXAMINATIONS AND COMPUTERS IN  
EDUCATION**

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# WHAT HAVE EXAMINATIONS GOT TO DO WITH COMPUTERS IN EDUCATION?

**(Running Title: EXAMINATIONS AND COMPUTERS IN EDUCATION)**

Courseware (computer based learning materials) usually includes some self-assessment for formative assessment. Insufficient attention has been paid to the link between formal assessment and use of courseware: teachers and learners focus on examination syllabuses. Examinations bodies can use only the simplest forms of ICT based assessment (objective or multiple choice tests) until learners are familiar with newer styles. UCLES is addressing this problem on several fronts: launching new ICT styles of tests, developing websites in support of learners and teachers, conducting field trials using computers under examination conditions and commissioning new types of examination questions built around on-line interactive simulations.

## 1. Introduction

The potential for the use of new technologies in education was recognised from the earliest days of interactive computing. Even in the 1960s, when interaction was in practice limited to the typing and reading of text, several pioneering projects attempted to exploit the ability of a computer to adapt to the individual needs of learners, guiding and directing their learning. In the 1980s the focus of attention changed. The arrival of microcomputers and graphics displays at prices retail consumers could afford encouraged an entirely different attitude. These provided new tools that were under the control of the learner and teacher. They were enrichment tools, not supplanting existing classroom methods but enlarging them, for example:

- Real-time graphing tools to enrich and enliven mathematics
- Simulations in sciences
- Multimedia resources for the humanities

These of course were only a few of the possibilities, and the scope of enrichment tools was being greatly enlarged by the arrival of the Internet. Modern courseware (i.e. computer based learning materials) includes all these things and some level of self-assessment and feedback as well. There is a link between courseware and assessment that becomes very plain when we consider the context. Pupils expect to be tested and examined. Schools and teachers are themselves assessed by their pupils' results. Both teachers and learners are therefore under pressure by the education system to teach and learn to the examination. Topics and skills that cannot be conveniently assessed under examination conditions are likely, to say the least, to be given less emphasis. This is where enrichment courseware has a major problem in present day education: its use does not obviously focus on the ultimate goal of passing examinations. On the other hand, examinations cannot evolve to take advantage of new styles of learning until pupils are familiar with these new styles.

The public, political leaders and the educational community have yet to adjust fully to the new era of educational computing and its use to enrich learning. Clearly new styles of learning and teaching must be recognised in the style of assessment, and methods of assessment must change. There are however no simple answers in the complex process of adjustment.

UCLES recognizes that it has a major part to play in developing the roles of ICT in learning and assessment, and has set up the ITAL (Interactive Technologies in Assessment and Learning) Unit. The Unit has several projects to help explore the impact of new technologies on learning and assessment, and intends to encourage public debate on the issues. This paper describes some of our activities.

## **2. UCLES – an international assessment body**

UCLES, despite the ‘local’ in its full name “University of Cambridge Local Examinations Syndicate” is an international assessment body. UCLES is respected throughout the world for the standard and quality of its assessments. UCLES (UCLES, web site) international examinations are taken in well over 150 countries, by around two million students each year.

### **2.1 Oxford Cambridge and RSA Examinations (OCR)**

OCR (OCR, web site), which arose from a merger of the UK business of UCLES with the RSA Examinations Board (RSAEB), conducts all types of examinations and tests in the UK under the regulation of the QCA (the UK’s Qualifications and Curriculum Authority). These include general academic subjects (GCSE and A-Level examinations) and vocational qualifications (NVQ and GNVQ) and a large range of other vocational qualifications including IT and Business Management previously offered through RSAEB. It is one of only two awarding bodies in the UK which offers such a range of qualifications.

### **2.2 Cambridge International Examinations (CIE)**

CIE (CIE, web site) operates internationally and offers a range of Cambridge Awards and services including:

- International GCE Ordinary Level (‘O Level’) and Advanced Level (‘A Level’)
- International General Certificate of Secondary Education (IGCSE)
- Advanced International Certificate of Education (AICE)
- Cambridge Skills Certificates
- Cambridge Careers Awards

CIE’s syllabuses cover a wide range of subjects including over 30 languages, as well as science, mathematics, humanities, arts and employment-related subjects such as information technology and business skills.

### **2.3 Cambridge EFL**

Cambridge EFL (Cambridge EFL, web site) specializes in examinations in English as a Foreign Language. There is a range of English proficiency qualifications suitable for students at all stages from beginner upwards. Cambridge EFL tests are characterized by in-depth testing of comprehension and productive skills (i.e. speaking and writing), especially at higher levels. Although objective tests (multiple choice) are used where appropriate, at higher levels especially greater emphasis is placed on more subtle and deeper types of test. EFL’s tests include:

- Main suite. Five levels of tests from the simplest, level 1 KET (Key English Test), to the highest, level 5 CPE (Certificate of Proficiency in English). The largest entry is for the level 3 FCE (First Certificate in English).
- BULATS (BUbusiness LANGUAGE Testing Service). Used for assessing the language ability of groups of employees or trainees.
- IELTS (International English Language Testing System). IELTS is recognised as an entrance requirement by many universities.
- CommuniCAT – a new computer adaptive testing service providing a quick, accurate and economical assessment of language skills in English, French, German or Spanish.

Language skills are vital in modern business and Cambridge EFL has tests that combine its traditional strength of testing in depth with the need for rapid results. Computer based adaptive tests have been developed that are particularly suitable for rapid determination of a candidate’s language skills (the ALTE proficiency scale is used). See (Cambridge EFL, web site) for details.

## **3. The ITAL Unit**

The aim of the ITAL Unit (Interactive Technologies in Assessment and Learning) (ITAL, web site) is to carry out research and development into computer-based teaching and assessment, and to manage certain projects in this field, often conducted in partnership with external organizations.

Some strands in the work of the ITAL Unit have their origins in Cambridge University's Department of Applied Mathematics and Theoretical Physics (DAMTP). Recent projects in which ITAL staff are or were involved include:

- **“Calculus Connections”** – CD-ROM based multimedia courseware, winner of the European Academic Software Award (EASA) for commercial software, 1996. See (Harding & Quinney, 1995) and (Harding & Quinney, 1998).
- **Millennium Mathematics Project (MMP, 1999-)** addresses public awareness of mathematics and provides a means by which the University of Cambridge Faculty of Mathematics can contribute to the national and international development of mathematical education. The MMP incorporates two Internet magazines: +Plus (formerly PASS Maths) initially funded by British Telecom, one of the UK's largest telecom companies, and NRICH (Mathematical Enrichment Project), funded by UCLES and Cambridge University Press. See (MMP, web site), (+Plus, web site), and (NRICH, web site).

The ITAL Unit is involved in nearly 20 projects altogether covering all subjects. Mathematics is prominent but by no means dominant, and there is significant activity in the sciences and humanities. This paper mentions only a few of our activities.

## **4. Computers in the school examination**

### **4.1 The Enigma Project**

The ITAL Unit in partnership with Aotea Interactive Media (AIM) of Auckland NZ has been conducting trials in Singapore of a new form of assessment for secondary school science that we call an analytical examination. It tests the experimental design and interpretation skills that a practical examination tests, but removing the element of purely manual skill (such as not dropping test tubes). Laboratory skills can be tested separately and more simply and reliably, if required. The Unit would like to acknowledge with thanks the co-operation and encouragement of the Ministry of Education in Singapore.

An analytical examination question is built around an on-line simulation. In trials so far students will not have seen the simulation before the examination but in the future it is envisaged that there might be a wide range of publicly available simulations, used during teaching and for practice just as for laboratory apparatus. The questions themselves and the particular activity that the examiners require of candidates would not be disclosed until the examination begins.

Some of the simulations used and examples of typical questions based on them are now available on CIE's web site (CIE On-line Science Simulations, web site).

### **4.2 MEI Mathematics A-Level**

The ITAL Unit is working with OCR and the MEI Mathematics project to explore issues of ICT and assessment. The project, which attracted initial funding from the Qualifications and Curriculum Authority (QCA), has conducted field trials of two new modules in the MEI Mathematics AS/A Level course. The first examination sessions of the trial were held in June 2000 and it is planned to accept entries from all centres for examination in the June 2002 session onwards.

There are two subjects: Decision and Discrete Mathematics, and Numerical Analysis. The case for using computer software in the examining of these topics is compelling, since software is integral to modern applications. The new modules are examined under standard written examination conditions (i.e. not through open book project work), except that each student has a computer. Written answers are submitted at present. The format could be described as a mathematics practical examination in which students demonstrate their knowledge and skills by solving problems using authentic software tools. In the UK, computers have been used

in skills-based assessment for some time. The new MEI modules, however, represent a significant step into the area of general assessment.

These field trials provide an excellent opportunity for the ITAL Unit, OCR, QCA and the participating centres to develop a model for the integration of ICT into the assessment process. OCR has developed guidelines for the conduct of such examinations, including a code of practice for the preparation of the computers. UCLES Research and Evaluation division has a research programme to monitor the trials.

## **5. On-line Support for Learning**

### **5.1 Pilot On-line Teacher Support Sites**

Many people have pointed the finger at examination boards for not encouraging the use of ICT in the learning and teaching process, for example by not making more demands on its use in assessment. The rationale is that if the examinations demanded more ICT awareness from students, then teachers would include more ICT in their teaching. However, as hinted earlier, boards are caught in the vicious circle that says that one cannot fairly assess students using ICT unless those students are all adept at using such technologies - and they will not become adept until teachers feel the need to use ICT more extensively in their teaching.

In order to break into this circle, ITAL is working with OCR to produce a number of pilot on-line teacher support sites to encourage teachers to see ICT as an integral part of teaching. These sites, which focus on specific OCR specifications, provide resources that help teachers prepare their students for a particular OCR examination. These resources include

- source materials
- schemes of work
- advice from examiners
- Frequently Asked Questions about the examinations
- pointers to relevant websites
- examples of students' work
- reading lists, etc.

Each site also has an associated email discussion list, where teachers can share good practice, seek advice from fellow professionals and involve themselves in issues relating to the teaching of that particular specification.

By providing a focussed 'one stop portal' on the web, which offers truly useful materials for teachers, ITAL/OCR is hoping to encourage teachers to see the web as a natural source of teaching ideas and resources, and by facilitating and supporting the creation of focussed on-line 'virtual communities', ITAL/OCR hopes to foment 'good practice' and a greater awareness of the use of ICT in the classroom.

### **5.2 Cambridge OnLine**

Cambridge OnLine (COL) is another project that provides a bridge between the worlds of teaching and assessment. The project was initiated and managed by SNP Multimedia Pte, based in Singapore, and supported by UCLES. COL Maths is an online learning service for students and adult learners studying mathematics at the level of the GCE 'O' and 'AO' examinations (COL, web site). COL Maths was conceived as enrichment material. It does not replace normal teaching but acts in support. COL Maths covers all topics in the GCE 'O' and 'AO' syllabuses. Materials available include:

- Interesting mathematics-related facts
- Animated tutorial modules
- Past year examination questions
- Additional challenging questions
- Syllabus information, updated as necessary
- Performance tracking data

The first of these emphasises real-life applications of mathematics and aims to show that mathematics plays a vital part in the modern world. The tutorial modules are intended to reinforce initial teaching and are especially useful for revision. Practice is an essential and valuable part of learning, and COL Maths provides access to a

wealth of materials for this purpose. There is a large collection of past year examination questions. The student chooses a question (or may have been directed which to try by a teacher), reads the question on screen, then works out answers. Questions may be chosen by topic (for example, to revise “Equations and Inequalities”) or by year and paper. If help is needed at this stage then a range of hints is available. Answers are then typed in and submitted to COL Maths for checking. The system then displays a worked answer and tells the student whether the student’s answer was correct or not.

### **5.3 CIE’s DELIA project**

For some time CIE has been looking at ways of providing more support for teachers and trainers delivering its qualifications. Developments in educational technology offer opportunities to provide such enhanced support, and CIE has set the DELIA Project (Distributed E-Learning and Internet Assessment) to take advantage of this.

DELIA is essentially a management scheme for use by Teachers in a school/college department that can be used to help a teacher to progress through the delivery of a course of learning leading to a Cambridge assessment. It is based around schemes of work that can be used by teachers to access information on available relevant resources and learning materials. It can also provide access to appropriate intermediate assessments. These provide Formative Assessments with feedback built in ranging from simple scores (immediately) to detailed diagnostic reporting (some time in the future).

## **6. EFL Computer Adaptive Tests (CATs)**

Computer adaptive testing allows the construction of assessment tools that are effective for broad based assessment, efficient, self-contained and easy to administer.

UCLES’ EFL (English as a Foreign Language) Division has produced a family of commercially successful CATs. Developed in collaboration with members of ALTE (Association of Language Testers in Europe), these are CD ROM-based systems that test ability in English and five other European Languages. The tests make full use of multimedia, offering textual, graphical, video and listening items. Students are asked to respond in a variety of ways – for example by selecting from a range of answers, or by typing in free text responses. Candidates’ results are archived by the computer and can be inspected by a supervisor, or exported for further analysis.

Successful development of CATs demands expertise in many areas, especially item banking and Rasch analysis (Rasch, 1960 and 1980). UCLES can draw on a wealth of experience in these areas. UCLES/EFL has extensive experience in the banking and tagging of items and has developed its own item banking system, a comprehensive system for tracking the creation and calibration of items, and for their subsequent storage and retrieval. UCLES has long used Rasch analysis in its work on validation, and UCLES’ Research and Evaluation Division (RED) uses Rasch analysis in a wide range of research projects.

## **7. TEEM: Teachers Evaluating Educational Multimedia**

In the introduction to this paper, it was stressed that ‘new era’ courseware should be seen as enrichment material. This raises the question of how best to use such resources in the real classroom situation, a question that many practising teachers may feel has been neglected in the past. The ITAL Unit is therefore supporting an initiative known as TEEM (Teachers Evaluating Educational Multimedia) (TEEM, web site). TEEM is also sponsored by the DfEE (UK Department for Education and Employment), The Guardian newspaper and BESA (British Educational Suppliers Association).

The TEEM project publishes a web site containing a collection of evaluations and examples of classroom use of a wide range of multimedia resources currently available to schools. Most of these resources are published on CD-ROM, but some are on Web sites. Evaluations and examples of use, called case studies, have been produced by working teachers after using the resources in their school. These teachers are trained TEEM Evaluators. They use the TEEM frameworks to help them write their evaluations and case studies. Each resource is evaluated separately for each age group that the publisher has proposed as suitable. In addition, the publisher produces detailed information about what each resource has to offer.

Evaluations and case studies place a particular emphasis on what the objectives were in using the resource, and how it contributed to and enhanced the learning that resulted. These case studies are designed to inform teachers, in training and practising, on the effective management of these resources in their teaching.

TEEM has received further substantial sponsorship from the DfEE and is now setting a programme for the next 3 years. It is planned to produce approximately 1000 evaluations per year covering topics for all of primary and secondary education.

## **8. Conclusion**

Computer-based learning is clearly set to play an increasingly important role in education. The roles of computer-based learning and computer-based assessment are closely linked and progress in one depends on progress in the other. Support is also needed for teachers and lecturers as they learn how to take advantage of both roles. UCLES is ready to play its part to assist and encourage every part of this process. The ITAL Unit is ready to start new projects and form new partnerships to explore and develop new styles of assessment for new styles of learning. OCR, Cambridge International Examinations and Cambridge EFL will continue to offer assessment services at the forefront of these new technologies.

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