

# The SCHOLAR Programme in Scottish Education

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## ABSTRACT

*This paper describes the SCHOLAR Programme [1] based at Heriot-Watt University in Edinburgh. SCHOLAR has delivered electronic resources to thousands of pupils in Scottish secondary education in Biology, Chemistry, Computing, Mathematics and Physics at the level of Scottish Higher and Advanced Higher. At the heart of the SCHOLAR delivery is the automatic assessment system called CUE [2,3]. The assessment engine CUE is the result of 18 years of research in action and a fruitful collaboration between academia and commercial companies. The formative assessment policy for SCHOLAR will be described as will the features of CUE chosen to deliver it.*

## 1: Setting the Scene

The SCHOLAR Programme started at Heriot-Watt University in 1999 as a collaborative venture with four Secondary Education authorities and five Further Education (FE) Colleges around Edinburgh. The initial plan was to deliver electronically the Scottish Qualifications Authority (SQA) Advanced Higher syllabus in five Science subjects. Advanced Higher in Scotland is at a similar level to the A-Level in England. Due to a revision of syllabus academic year 2000/1 was a transition year so SCHOLAR used it as a pilot. At the start, then, forty-four secondary schools in four authorities and five FE Colleges participated in the pilot with 500 pupils and their teachers on-line.

The subjects of Biology, Chemistry, Computing, Mathematics and Physics require a pupil to take three 40 hour units, one per term. The summative assessment is performed in two parts: an internal school test to assess minimum competencies at the end of each unit (taken from the National Assessment Bank, NAB, in each subject) followed by a more traditional examination at the end of the course. In the final examination minimum and extended competencies are tested.

SCHOLAR's written materials have been well-received in schools since the new syllabuses did not have existing resources. The web materials presented the authors with the chance to create more interactive courseware including short animations using Flash, more sophisticated simulations and on-line assessment provided by CUE [2,3]. This paper seeks to review the SCHOLAR

programme with particular reference to its formative assessment policy.

The pilot was so successful that in 2001/2 some 75% of Scottish secondary schools (300 or so) joined in and participation is over 90% next year. The teams of academics, seconded schoolteachers and educational technologists established to create the on-line courses continued TO OPERATE in year 2001/2 and produced similar resources at the level of Scottish Higher in the same five subjects.

## 2: Formative Assessment Policy

The purposes of formative assessment are:

- motivate students through review and consolidation;
- require demonstration of knowledge, understanding and skills;
- inform students on their strengths and weaknesses;
- help students to prepare for summative assessments; and
- maximise their performance in such assessments.

The NAB assessments are taken at the end of a unit and test minimum competence. The course examination tests extended competence across learning outcomes. This practice follows the theoretical underpinning of Bloom [4].

## 3: The Assessment System CUE

The computer aided assessment system chosen to supply the formative assessment policy described above is the CUE system. CUE formed as a collaboration between the CALM Project team for Computer Aided Learning in Mathematics, the University of Cambridge Local Examination Syndicate and the commercial firm EQL. CUE is an internal development of Heriot-Watt University and EQL have their own commercial version I-assess [5].

CALM itself has a long history dating back to the middle 1980s. From the outset CALM recognised the added advantages automatic assessment could offer to students and teachers alike. In formative assessment the students could derive plenty of practice from electronic tests especially if random parameters were introduced

into each question. Moreover, CALM ensured that the testing was more meaningful by prompting for mathematical answers rather than using a multiple choice format. Through a series of educational evaluations CALM [6,7] evolved to more sophisticated testing that included a question split into multiple key parts. Good students could complete a question through the key parts but weaker students needed the extra scaffolding of more steps. By the time the SCHOLAR Programme started CUE had developed into a web delivery XML CAA system with many educational and technical features gathered through a lifetime of experience. For example, the tests could be delivered in a number of ways: Help, Practice and Exam mode. Moreover, answers were gathered incrementally (unlike other systems which take the whole set of answers at the end of a test) to minimise any problems of server failure. In addition, a more varied range of question types was becoming available. CALM had pioneered the use of mathematical expressions as answers in the 1980s but, multiple response (with multiple choice as a sub-set), word and phrase match, multiple hotspot and simple ordering question types now emerged to provide a more varied CAA system. It is possible to add tables, images and diagrams into questions. More recently multi-media elements like sound, video and animation sequences can be included in questions seamlessly. And, all of this was available to the setter of the questions through an editor for composing and modifying questions. The editor incorporated many of the features discovered to be important through earlier evaluations such as the ability to set the length of an answer. In this way it is possible to reflect helpful feedback such as “Your answer is mathematically correct but too long, tidy up your answer” which is the kind of advice a caring teacher might provide.

SCHOLAR sub-divided the SQA units into topics and for example in Mathematics five main topics comprised a 40-hour unit. At the end of each topic on-line tests were created to test the learning outcomes for that topic. The questions in the tests were similar but not identical to those in the National Assessment Banks. However, the feature of CUE to deliver questions with random parameters meant that the pupils could receive plenty of practice since each time they took the test the numbers changed.

In Chemistry Flash animation was extensively used to illustrate an experimental scenario and then questions would be asked in the “What if?” category. In Biology and Computing the use of essay style questions was employed within the learning materials as well as at the end of a unit. CUE developed an essay style question that although not automatically marked did allow the students to submit their answer on-line for their teachers to mark at a later date. In addition, the author of the question could supply a model answer that the students could review next to their own in reveal mode.

A marking scheme could also be given inside such a model answer.

#### 4: Future Plans

The SCHOLAR team is now preparing the AS and A2-Level syllabuses as delivered in other UK schools. The plan is to re-purpose the electronic materials into a different order, plug the gaps and create a set of five courses in Biology, Chemistry, Computing, Mathematics and Physics. It will be necessary to customise the materials by using assessments appropriate to the AS and A2 Level examination papers. There is no equivalent to the NABs in the other systems so a mix of suitable questions is needed to measure both lower order skills and where possible higher order skills as defined by Bloom [4]. It seems possible to use the computer to test lower order skills and at the very least it may be helpful to provide practice of higher order skills in preparation for summative tests. Some research work has already been undertaken in this area, see [8,9], but more remains to be done if CAA is to augment the traditional tools for the measurement of learning.

A further project known as PASS-IT has recently received £ 1M support from the Scottish Office. PASS-IT seeks to deliver, in two pilot phases by the end of 2004, the NABs in Mathematics, Chemistry, Computing and English. PASS-IT brings together the educational agencies SQA, Learning Teaching Scotland, The Scottish FE Unit, the BBC Scotland Education Group and the recently formed Scottish Centre for Research into On-Line Learning and Assessment (SCROLLA). Details of this exciting new project will be available from the SCROLLA website [10].

#### References

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