



Letter to the editors

Sophisticated computer-aided assessment is certainly possible, but what are we trying to achieve?

I am writing to you regarding Dr Keady's letter in the July 2009 issue of the *Gazette*, Volume 36 Number 3, p.161. In this letter he mentions the STACK computer-aided assessment (CAA) system which I designed following my experience with the AiM CAA system here at the University of Birmingham.

Computer-aided assessment is another tool which we can use to help our students learn. By using computer algebra to establish the mathematical properties of expressions entered by students, we believe we can create more valid online assessments than are possible with multiple-choice formats. Ultimately, whether such a tool is used effectively is the responsibility of both the teacher and the student.

In my view there are two important strands to mathematical activity.

(1) *The use of routine techniques.*

This includes recognition and the reduction of problems to cases for which a standard algorithm is applicable.

(2) *Problem solving.*

This involves elements of novelty (for the solver at least), which demand creativity and often personal struggle. Sometimes solutions are useful for solving similar problems. In other cases the argument is somehow unique.

The two strands are inseparable. Problem solving may be replaced by memory or research (with a small 'r', i.e. looking up the answer). Without sufficient practice, recognition is impossible and all mathematical questions become problem solving, which is inefficient and causes problems in recording and communicating mathematics. But what is the point of simply being good at technique if we don't apply these techniques to solve problems?

CAA is most effective for only one of these activities, that is, assessing the practice of routine technique. CAA can assess the *answers* to problems, but not the method or reasoning. More advanced, but still standard techniques, such as solving the wave equation on a square domain, require extended calculations. Steps in such calculations are difficult to assess automatically without providing the student with templates for intermediate answers. This is initially helpful when first learning such a technique, but ultimately I would expect my students to work more independently of such structure. The CAA with which I am familiar cannot currently assess logical proof or geometrical reasoning. They cannot assess students' criticism of an incorrect answer. To concede a tool does not do everything is quite different from saying it does nothing useful. We have a responsibility to use the right tool for each task.

Online CAA could certainly be used for high-stakes summative assessments. At the University of Birmingham, UK, we routinely use CAA for weekly problem sheets which are primarily formative, but which contribute a small summative mark to some modules. We have occasionally used CAA for end of module examinations. Such CAA systems are designed to give immediate feedback to students and are hence primarily formative. They are not really designed to evaluate the effectiveness of teaching at university.

Sophisticated computer-aided assessment is certainly possible, but when the standards of teaching are evaluated we need to decide the relative importance attached to the type of procedural practice problems that CAA is most effective at assessing. What are we really trying to achieve? I am nervous about recommending such systems to a Tertiary Educational Quality and Standard Agency. You might just get what you ask for, but that might not be the whole story about what you want.

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