DIFFERENCES BETWEEN A-LEVEL AND UNDERGRADUATE MATHEMATICS QUESTIONS: DOING, REPRODUCING OR PRACTISING MATHEMATICS

Ellie Darlington¹
¹Cambridge Assessment, Cambridge, UK, ²University of Oxford, Oxford, UK

In university mathematics departments in England, lecturers are concerned that A-levels do not adequately prepare students for undergraduate mathematics courses. A-level reforms seek to address any issues regarding their structure and content, which is pertinent in a subject such as mathematics. Secondary mathematics and tertiary mathematics are very different, with the focus changing from "What is the result?" to "Is it true that..?" (Dreyfus, 1999).

This research investigated how well A-level Mathematics and Further Mathematics prepare students for mathematics degrees. In particular, the types of examination questions posed, and skills required at the secondary and tertiary levels, were explored.

The Mathematical Assessment Task Hierarchy (MATH; Smith et al., 1996) was developed in part as an alternative to Bloom’s Taxonomy of Educational Objectives (Bloom et al., 1956) for the advanced mathematics context. It enables different types of examination question to be categorised and can be used to ensure tests cover a range of skills.

The MATH taxonomy was applied to A-level Mathematics and Further Mathematics papers from four different examination boards, as well as to fourteen first-year pure mathematics papers from a Russell Group university. The papers were analysed with a view to comparing the proportion of questions posed in each group in the MATH taxonomy: Group A (factual recall and computation); Group B (application of familiar skills in new situations); and Group C (conjecturing, interpreting, justifying). Subgroups within the main groups were also explored such as ‘comprehension’, ‘factual knowledge and fact systems’ and ‘routine use of procedures’ in Group A. The papers were analysed question-by-question by a mathematics researcher. Samples of analysis were verified by: an undergraduate mathematician; a professor of mathematics education; a mathematics teacher; and a mathematics academic.

The differences in question types between A-level Mathematics and Further Mathematics were small. However, a significant difference between A-level and the undergraduate mathematics papers was found. Undergraduate papers comprised mainly Group C questions, whereas A-level papers comprised mainly Group A questions. Nonetheless, a significant minority of marks were available for Group A questions at undergraduate level, specifically in questions entailing factual recall. Conversely, Group A questions at A-level comprised mainly ‘routine use of procedures’. Surprisingly, it was found that all of the papers analysed could have been passed solely by using factual recall, a skill which requires no mathematical understanding. The findings support the need for A-level reforms, and raise questions regarding the nature of tertiary level assessment.