Historical Study of Correlation between A-Level Grades and Subsequent Performance

Ken Todd ▪ *Department of Electronics* ▪ *University of York*

Abstract

The subject of A-Level mathematics has attracted a great deal of political and academic controversy. Those who represent the academic community in Higher Education have argued for over a decade that the standards of A-Level mathematics have been declining and continue to do so. Elsewhere it has been argued that much of the decline perceived by those who teach in engineering and science departments is more likely to be attributed to the very substantial national decline in entry standards to engineering and science courses rather than any real change in A-Level standards. Using available statistics, a study of the electronics students at York set out to discover whether these questions could be answered and the results were published in a detailed paper [1] of which the following is a summary.

Introduction

Those who argue about mathematics standards or for that matter any other facet of the national assessment system often have very different views as to the purpose of the assessment. Any A-Level can be seen as an award that certifies that a particular curriculum has been satisfactorily completed, or it can be regarded by Universities as a measure of particular skills and knowledge that are essential to further study in the student's chosen subject area.

Using available statistics, a study of the electronics students at York set out to discover whether these questions could be answered:

1. *Given that grades at A-Level are used heavily as a tool for selection do they remain a reliable indicator of ability?*

2. *For the same grades: is a student today any less well prepared to cope with the academic demands of our courses than a decade ago?*

Whether a student passes or fails their first year depends on a number of factors including progression rules, transfer to a different course, personal circumstances etc ("failure" is taken to mean that the student has obtained a year end overall mark of less than 40%). By 1989 in the Department of Electronics at York failure rates had reached alarming proportions, mathematics was identified as a major contributing factor and there were major revisions in teaching provision in 1990, 91 and 92. Finally in 1993 substantial reductions in both the content of the first year course led to corresponding changes in mathematically demanding courses. These steps appeared to have succeeded in 93 and 94 but there has been a steady deterioration up to the present day. Graph 1 shows failures as a percentage of the cohort for two groups of students – those who obtained better than BBB (24 points) at A-Level and those who obtained a grade between BBB and BCC (20 points) inclusive – throughout this period of change.

The dip in the graph at 1995 was the result of the department experimenting unsuccessfully with a radically different approach. The subsequent years of 1996-98 reverted back to similar academic content and standards as those used in 1993-94. Over these five years the failure rate amongst the weaker group (20 to 24 pts) had moved from zero to the unacceptable level of around 25%! Even amongst the best group (better than BBB) the level of failures had escalated from zero in 1993 to 6-13%.

Graph 1: Part 1 Failure
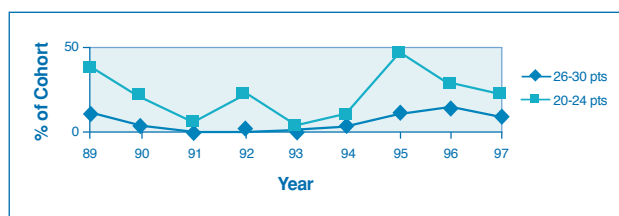
The Entry Test

We are naturally testing the ability of these students against our own assessments in the department. It remains possible that the measured drift in results is an affect of our assessment process and/or teaching performance. We do however have one constant measure of their mathematical ability. In the Electronics department at the University of York, in common with many other Science and Engineering departments, we give first year students a mathematics test on their second day in the department. The purpose of the test is to give us some idea of the "quality" of our latest intake and also to highlight, for the benefit of those of us who teach first year mathematics, any areas of generic weakness that might require attention. The results are made available to supervisors who can utilise them to motivate those whose mathematical knowledge would seem to be inadequate. We have used the same test, administered in the same way for the last 15 years. Consequently, whatever its defects as a test, it does provide a consistent measure against which it might be possible to draw some conclusions.

The test we use was originally devised by the University of Cardiff as part of a project known as the Physics Interface Project (PIP) and was based on the A-Level mathematics syllabus of the early eighties. It was intended primarily as a test of knowledge with 50 multiple-choice questions to be attempted in a two-hour period. None of the questions require anything but the simplest manipulation and students are discouraged from guessing.

The same test has been taken under similar conditions each year and the results can be used to assess the ability of students after A-Level mathematics. However the test is open to obvious criticisms. It does not test the same skills as a conventional mathematics examination, no real insight is required; there is little requirement for complex manipulation and the student is certainly not called upon to pursue the topic through any kind of lengthy analysis. What it does test however is knowledge of a range of key facts. We have found it invaluable in exposing generic weaknesses. We have noticed for instance, over the last few years a declining ability to cope with logarithms and powers. This is clearly identifiable from the PIP test and amply confirmed in further contact with the students.

Graph 2: A-Level Points and PIP Scores
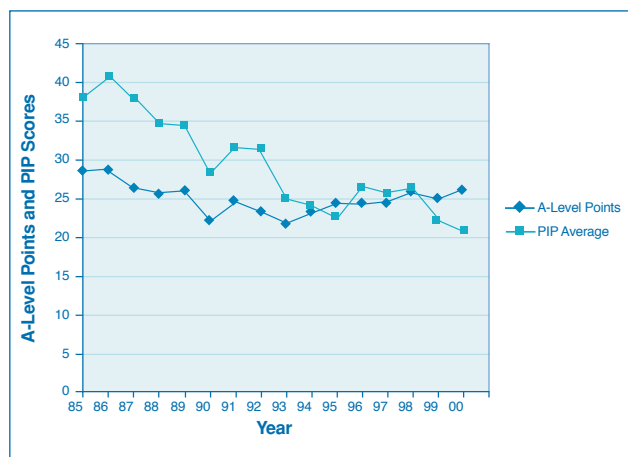
Graph 2 shows the average score for the first year cohort in the PIP test (expressed as a score out of 50) for all the years for which we have records and the average A-Level points score for the cohort. As can be seen the average score on the PIP test declines throughout the period from 39/50 to 21/50. For the first few years in which the test was used it was always assumed that the "worry line" should be drawn at 60% and that any student scoring below 60% should be advised to concentrate on mathematics revision or indeed receive special tuition. Today the bulk of the cohort fall below that line!

Graph 3: PIP Scores by A-Level Grade
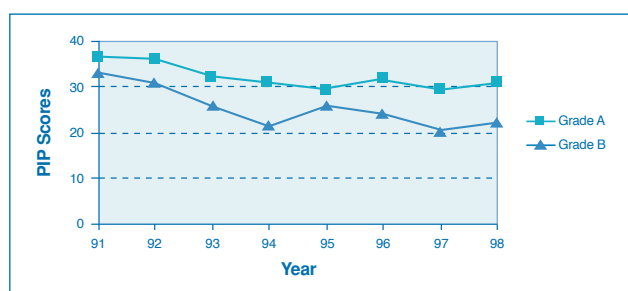
Graph 3 shows average PIP test scores for students who obtained respectively A or B grades in A-Level Mathematics. It can be seen that between 1991 and 1998 the average score of a student with an A at A-Level Maths has declined slightly from a little over 35/50 to 30/50, whereas the scores of students with grade B have declined from around 31/50 to around 20/50. It should also be observed that between 1991 and 1997 the percentage of students taking Mathematics A-Level and obtaining grades A, B, or C increased from 48% to 66% with a similar increase for Physics [3].

The long term picture is very clear. A student with an A at A-Level mathematics today will, on average, obtain a score on our test which would have placed them near the bottom of the cohort fifteen years ago. Part of the decline over the fifteen-year term can be attributed to syllabus changes. Five of the fifty questions on the test demand an acquaintance with topics no longer included as core syllabi in all A-Level maths courses. Two other questions demand a basic grasp of complex numbers, but eight questions required only GCSE mathematics. It is not possible, however, to explain the year-on-year decline throughout the nineties in terms of syllabus changes.

Even if syllabus changes are taken into account it does not change the problem from the perspective of an engineering department. The PIP test was designed as a test of knowledge of a range of key facts that the student needed to know before commencing our courses. That requirement has not changed. It is deeply worrying that an average student with grade B in A-Level mathematics is only able to obtain a score on our test which is marginally better than that which could be obtained by random guessing.

Whether any sensible conclusion can be drawn is debatable but the sharp dip in both plots in 1990 coincides with the first entry of students with GCSE qualifications rather than GCE Ordinary level qualifications. A similar series of results has been published [2] using the same test for new Physics students and these results, including the 1990 dip, are remarkably similar. It is advisable to take some care with these figures. A-Level points score is a crude measure as it can include any A-Level (including General Studies). The PIP test score average includes the entire cohort and therefore, there can be a small number of students who have other qualifications.

References

[1] *An Historical Study of the Correlation between G.C.E Advanced Level Grades and the Subsequent Academic Performance of Well Qualified Students in a University Engineering Department*, Mathematics Today. 37(5), Todd, K. L., October (2001).

[2] Measuring the Mathematics Problem, Engineering Council (2000).

[3] Engineering Council Digest of Engineering Statistics (1998).