ENTRANCE GRADE INFLATION AND ITS EFFECT ON THE FIRST YEAR SYLLABUS

Robin Bradbeer[1]

Abstract *_There is mounting evidence that grade inflation has been taking place at all levels of education over the past decade or more. This has usually been denied by the authorities conducting the assessments. During the past six years the first year students taking Basic Electronic Engineering on both a 3_year Mechatronic Engineering and 3_year Manufacturing Engineering bachelor degrees have been closely monitored. As part of that monitoring students are given a pre_test at the start of their first semester to determine their 'pre_knowledge' of the syllabus. Although the entrance grades of the students have been rising, the scores on this pre_test have been falling. This paper considers the causes of this discrepancy and attempts to determine the effects that this has had on the way that the courses are being taught.*

Index Terms _ Entrance grade inflation, mechatronic engineering,manufacturingengineering

INTRODUCTION

The Department of Electronic Engineering (EE) at City University of Hong Kong runs four courses in Basic Electronics for first year students taking the Mechatronic Engineering (BEMTE) and Manufacturing Engineering (BEME) programmes offered by the Department of Manufacturing Engineering and Engineering Management (MEEM).

The four courses are offered in Semester A and Semester B, two courses per semester, one for each subject. The course material is equivalent, although the teaching style and pedagogy are different. The BEME courses use a more traditional teaching style, based around lectures, tutorials and laboratory, whereas the BEMTE courses are studio based with no clear distinction between the various components [1]-[5]. The entrance qualifications for each programme are also similar.

Since Semester A 1996, and entrance examination has been given to all new students entering the first year of the two programmes. This paper will analyse the entrance qualifications of those students, and then compare these results with those of the entrance examination.

Entrance to bachelor's degree level programmes in Hong Kong is similar to the British system. All school students wishing to enter university take an 'A level' examination (HKALE) in a number of subjects, usually related to their final university study programme. In Hong Kong this is administered by the Hong Kong Examinations Authority (HKEA). Most students taking HKALE will be in their sixth or seventh year of secondary education - around 17 or 18 years' old. They will have taken a more broad-based series of examinations in their fifth year - the Hong Kong Certificate of Education - or 'O levels'. Whilst in the sixth or seventh year they can also take 'AS level' examinations, which are somewhere between 'O' and 'A' level and are usually for more general subjects such as 'Use of English' (UoE) and Chinese Language and Culture (CLC). All bachelor's programme entrants must have at least a 'pass' in these two AS level subjects.

Alternatively, it is possible for students who have graduated from Vocational Training Colleges (VTC) with technical diplomas, to enter the first year of the bachelors' degree programme. The subjects taken by the students at the VTCs are more technically based than for the 'A level' entrants, and are usually very closely related to the university programme.

ENTRANCE QUALIFICATIONS

In the 96-96 and 97-98 cohorts there were significant numbers of non-'A level' entrants - mainly from Vocational Training Colleges. To be consistent, these were eliminated from this analysis, as were any repeat students.

For the 96-97 cohort the grades were reported by the students in answer to a questionnaire, and this did not ask for the specific subject. For the 97-98 cohort the grades were supplied by the university registry, and were letter (coarse) grades only. As with 'A level' grades in the UK, the Hong Kong Examination Authority gives grades from A to E for the Hong Kong A Level Examination. From 1998 onwards the university registry supplied both "coarse" grades as well as "fine" grades, which range from 1 to 10, 1 being the highest. Thus coarse grade A can be either fine grade 1 or 2. The fine grade system allowed better discrimination between students for this exercise as the vast majority - <95% - scored either D or E on the coarse grade scale. The practice of giving fine grades will be discontin-

[1] *Robin Bradbeer, City University of Hong Kong, Hong Kong. eersbrad@cityu.edu.hk*

ued in 2003.

Coarse grades were converted into fine grades using the average equivalent ie grade A was given a fine grade of 1.5, and so on. This assumption was valid as an analysis of the fine grade distribution for each coarse grade showed that they were roughly equal for all cohorts.

As the fine grade system is an inverted scale, the grades were subtracted from 11, so that fine grade 10 had a value of 1, and fine grade 5 had a value of 6, for example. This made the scale roughly equivalent to the normal score for A level letter grading, ie A = 10, B = 8 etc. but with higher discrimination. AS levels were scored at half the value of A level, again in accordance with normal practice.

Figure 1 below shows the A level/AS level total score average for each cohort. A trendline has been added, as shown by the dotted line.

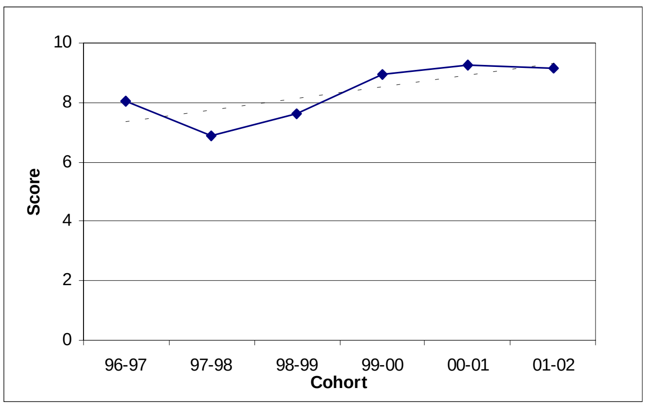

FIGURE 1

A LEVEL SCORES OF EACH COHORT

A comparison was then made between the A level scores of the two groups compared to those of A level examination entrants in general 6]-[11]. This was to determine the 'quality' of students entering the two courses, and their rough position in the overall performance of Hong Kong A level results. Table 1 shows the average number of A and AS level examinations taken by all entrants for each of the years considered. These are based on exam pass numbers for those passing both Chinese Language and Culture and Use of English AS level but do not include those passes. The HKALE averages are based on the total numbers of exam entrants, not just school entrants, as some of the students on the two courses also come from a non-school background but with A levels not vocational qualifications. The number of subjects taken is indicated for the two courses being considered is shown as a comparison for each year.

These results can be plotted as a scattergram, as shown

TABLE 1

AVERAGE NUMBER OF EXAM PASS NUMBERS FOR THOSE PASSING BOTH CLC AND UOE - EXCLUDING UOE AND CLC

Year	HKALE average		Studied courses	
	A level	AS level	A level	AS level
1996	1.97	0.39	2.195	1.325
1997	1.97	0.39	2.27	0.175
1998	1.97	0.39	2.545	0.215
1999	1.95	0.65	2.4	0.285
2000	1.95	0.40	2.255	0.495
2001	1.97	0.41	2.27	0.385

in Figure 2. It is clear from the table above, and the plot below, that entrants to both courses under consideration passed more examinations than the average, although the average grade was much lower than average - see Figure 3.

It can be seen from the results that the level of student

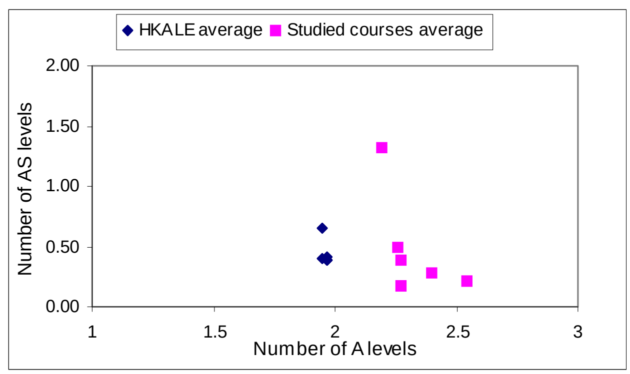

FIGURE 2

SCATTERGRAM OF NUMBER OF AS LEVEL AND A LEVEL EXAMINATIONS PASSED, EXCLUDING UOE AND CLC, FOR THOSE PASSING BOTH UOE AND CLC AS LEVEL.

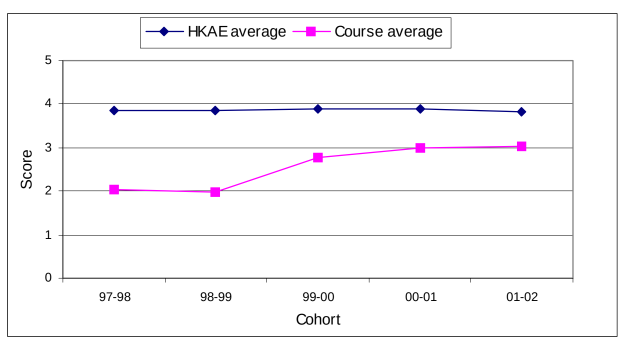

FIGURE 3

AVERAGE SCORE OF STUDENTS COMPARED TO HKALE AVERAGE attainment, as measured by the A level examination results, has, in theory, been rising over the years of the study, as shown by the trend line. However, as can be seen from Figure 3, the average student entering has moved from scoring just 50% of the averagescore to 75% over the period of the study.

This would seem to indicate that the programmes were attracting a 'better class' of students over the years considered, but that these better students were still scoring well below the average for a typical Hong Kong student.

Pre-course Entrance Test

At the beginning of each Semester A, before classes started, each student on the two programmes was given a two-part multiple-choice questionnaire. The first part contained 22 questions relating to their use, understanding and competence with computers, as well as questions concerning the language of study each student preferred. An analysis of this part of the questionnaire is presented elsewhere [12].

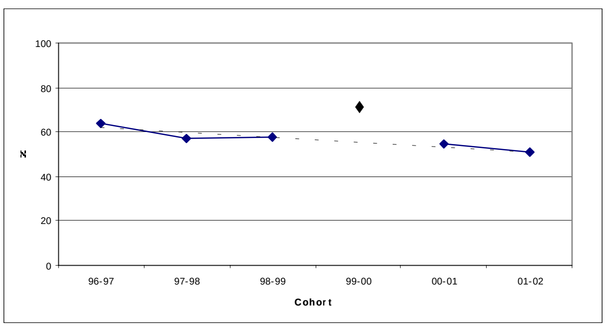

FIGURE 4
Pre-test scores for each cohort

The second part of the questionnaire consisted of 50 questions ranging over the whole field of study that the majority of students had completed previously, i.e. A level maths and at least one physical science at A level, assumed to be Physics, as well as some material that they would be presented with during the electronics courses of their first year.

The test was applied using normal 'examination' conditions, except for cohort 4, which was held under more informal conditions where group responses were allowed. Consequently the results from this cohort, although included in the analysis for reference only, are not included in any discussion of the results, or in any trendline analysis.

The pre-test marks are given in Figure 4. Here it can be seen that the trend line is falling over the years of the study. (The 99-00 mark is indicated for reference only, as mentioned above).

Subjects studied at A level

One aspect which must be considered when trying to analyse the data presented in the previous sections is the number of 'technical' subjects studied, and the respective A and AS level examinations passed and their grades. Figure 5 shows percentage of students in each cohort taking the three main technical subjects - maths, physics and chemistry.

As can be seen this is fairly constant for each subject over the years of the study, although the percentage of students passing Chemistry is falling slightly. Figure 6 shows the average A level scores for each subject for each year, which can be seen to be rising quite consistently.

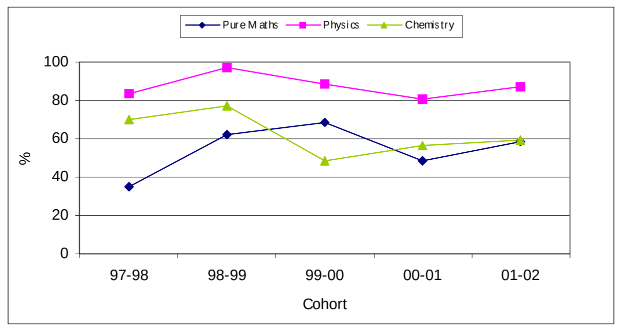

FIGURE 5
Percentage of students for each cohort taking specific A level examinations

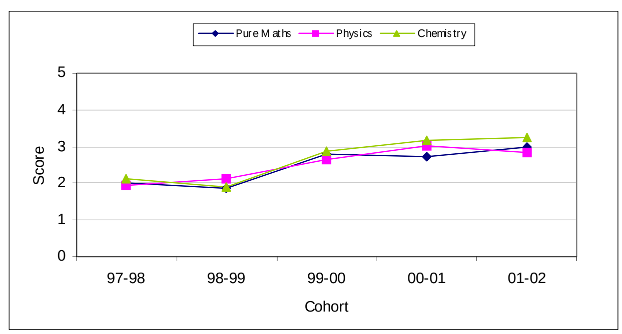

FIGURE 6
Average score for each cohort for specific A level examination

Responses to subject specific questions in pre-test

Another aspect to consider is the responses to the various sections of the pre-test, and to determine if there is any relationship between the falling score for the test, and if one aspect of the test is responsible. The test itself covers four basic areas. The main one is electronics, which is itself made up of several areas, such as basic electrical theory, devices and applications. For this analysis all these have been grouped into a single variable. The other three areas are physics, computing and mathematics. The physics questions were mainly concerned with basic physical phenomena such as electromagnetism, electrostatics and dimensions/units. The computing section was basic binary concepts, whilst the maths was concerned with trigonometric concepts used in electronics.

As can be seen from Figure 7, other than for electronics which remained fairly constant, all the other subject areas showed a decline in correct responses over the period of the study. (Again, the 99-00 cohort marks are shown but not included in the analysis). The surprising decline is in the understanding of basic computing theory, which shows a significant decrease in correct responses. The implications of this are discussed below, as well as investigated more fully in a related paper [12].

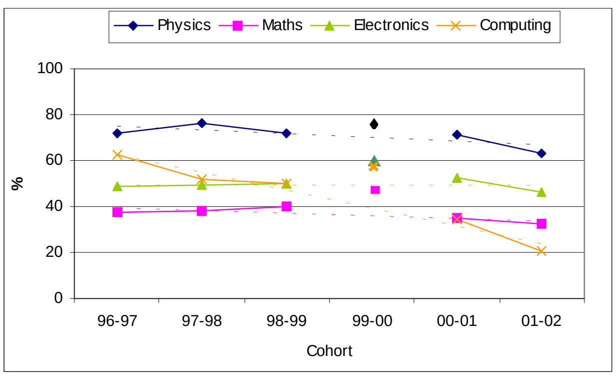

FIGURE 7
PERCENTAGE CORRECT RESPONSES TO THE PRE-TEST BY SUBJECT AREA OF THE QUESTION

IMPLICATIONS FOR COURSE CONTENT

The changing extent of the basic knowledge of new entrants has meant that assumptions made in 1996 cannot be applied in 2002. This has had major implications in the syllabus content of the courses themselves. The amount of time needed to cover basic theory that should have been covered in the A level syllabus and was not - or may have been but was not understood by the students - increased substantially over the period of the study. So much so, that the courses themselves have had to be drastically rewritten to cope with this. From 2002, two completely new courses will replace those taught for the previous 6 years. These will emphasise the design aspects of electronics and not concentrate so fully on analysis.

Also, a more problem-based, student-centred learning approach will be taken, based upon the experiences of using integrated studio teaching for the BEMTE course.

A brief look at the first semester syllabuses for 1996, 2001 and the new 2002 courses will show clearly the changes that have had to be made to accommodate the changing environment.

- 1996: Revision of basic electric and magnetic fields. Inductance, self_inductance, mutual inductance. Transformers; principles of operation and applications. Revision of circuit theorems and laws; Simple dc transient analysis. Revision of ac fundamentals; Phasors and complex numbers. Three phase systems. Revision of basic semiconductor devices; modes of operation. Amplifier circuits. Feedback. Introduction to the operational amplifier. Power amplifiers. The transistor as a switch

- 2001 Basic Magnetic Fields: Revision of basic magnetic laws. Inductance, self_inductance, mutual inductance, Magnetic circuits. Transformers; principles of operation and applications. Basic Electric Fields: Capacitance and capacitors, energy storage in capacitors. DC Circuit Analysis: Revision of circuit theorems and laws. Simple dc transient analysis. AC Circuit Analysis: Revision of ac fundamentals. Phasors and complex numbers; reactance, impedance, power and power factor. Semiconductor Devices: Revision of basic semiconductor devices; pn junction, characteristics of junction diode, diode circuits, bipolar transistors, field effect transistors, modes of operation.

- 2002 Circuit analysis techniques, basic discrete semiconductor devices, integrated circuit fundamentals, the transistor as an amplifier, the transistor as a switch.

It can be seen that by 2001 most of the first semester course had been taken up with basic revision of fundamentals, which were assumed to be generally known by the students in 1996, an assumption which could not be made in 2001. Analysis of tests, quizzes and coursework over the period of the study support these assumptions.

The 'knock-on' effects of having to cover fundamentals in the first semester meant that less coverage could be given to the more design aspects of electronics in the second semester and this itself meant that courses taken in the second and third year were also affected, in most cases adversely. This was especially true of the virtual elimination of power electronics from the syllabus. There was also some criticisms that basic electronics courses, which were designed to support the manufacturing and mechatronics engineering programmes should not become applied physics courses!

Another reason for changing the course structure was the change in the BEME programme to a BEng in Manufacturing and Information Systems Engineering (BEMISE). The basic electronics courses for this new programme would become second year electives, not first year core courses. The BEMTE programme was also revised to become more design mechatronics based, although still keeping the basic electronics courses in the first year core.

This led to complete rethink of what such a basic course in electronics should provide, both as a student learning experience and as a basis for further study in later years. It was decided that most theoretical 'applied-physics' fundamentals should be ignored completely, and that a more systems approach should be taken in teaching the basic electronic circuits. In other words, any design processes should be based around the use of 'black-box' modules, which would correspond roughly to the most popular integrated circuit packages, such as logic gates, operational amplifiers etc.

At the same time, there would be a more 'hands-on' experience with simulation and experiment replacing basic theory. This would seem to be shifting the course more towards the technician engineer pedagogy compared to the more traditional university approach. Also, group based projects would replace more individual learning experiences.

Discussion

It is clear from the data presented above that there has been a gradual decline in the basic knowledge of physical fundamentals, maths and computing over a six year period from 1996, even though the grades achieved have been rising. This may be a consequence of the Hong Kong government's policy of rapidly increasing the number of university places available for 18 year olds, from around 6% of school leavers to today's 18%, starting in the early 1990s. It would also seem to indicate that the Hong Kong Examination Authority has condoned a gradual and sustained inflation in grades over that period of time.

One widely accepted explanation for such grade inflation, and its link to expanded access to university eduaction, is the examination authorities' practice of awarding relative, not absolute, grades, whereby a constant proportion are given each grad. For example, say 10 per cent get an A then if a broader range candidates take examination less able children i.e. lower attaining children will be given similar grades to those given to higher attaining pupils in the past.

Also, even though universities and departments are quite happy to publicise the fact that quality of their student entrants is getting relatively better, in fact this hides the fact that, in absolute, terms they are not.

The implications for syllabus and course design are even more profound, and means that a constant and continuing shift in course content and level is needed to give the students a meaningful learning experience that is suited to their level of knowledge. Unfortunately, programme leaders and course lecturers who just take the raw entrant examination grades as an indication of how to 'pitch' their courses are in danger of getting it wrong, with disastrous consequences, which can be seen in the lack of commitment and energy that students have for their studies.

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