UNIVERSITY COST EFFECTIVENESS

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Summary

Reference : Not listed

This project was undertaken to discover how much it cost to educate an under-graduate in each year of his course, what were the different components that contributed to the cost, and how the overall cost might be reduced.

A technique known as output budgeting was used in this study which revealed interesting data on the under-utilisation of teaching resources, buildings, equipment and facilities.

The report suggests that larger university departments, a building design and timing more closely related to academic plans are some of the ways of reducing cost.

Report

The United Kingdom's Department of Education and Science and the Organisation for Economic Co-operation and Development in Paris have recently financed a study of cost-effectiveness at the University of Bradford.[1]

The objective was to discover how much it cost to educate each under-graduate in each year of his course, what the different components of this cost were, and how they might be reduced. The technique employed is known as output budgeting. It is part of what the Americans call planning programming budgeting systems (PPBS).

Any approach to attributing costs to individual students on particular courses is unavoidably complicated and open to criticism at every stage. In practice virtually every resource used by the university contributes to more than one course and nearly all costs are, in one way or another, joint costs. Academic staff teach and pursue research; technical staff service teaching and research laboratories; classrooms, laboratories and items of equipment are used by students on different courses; materials are purchased on behalf of Schools of Studies and it is difficult to find the course for which they are ultimately used and so on.

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[1] See, John Dunworth, R.K. Khanna, R.M. Dasey, M. Pickford, R.E. Cooley, C. Barton, Aiden Duggan and Anthony Bottomley, Studies in Institutional Management in Higher Education - Costs and Potential Economies (Paris: Centre for Educational Research and Innovation, Organisation for Economic Co-operation and Development, 1972).

Nevertheless, we have tried to discover how each of these components contributes to the expense of producing each student in each discipline at the University of Bradford and to enumerate the potential economies which we believe are revealed.

I Components of cost per students

Table 1 below illustrates the way in which various courses at Bradford were divided between the three classes of cost components: (1) capital and maintenance (2) teaching costs and (3) administrative, library, student facility, general and miscellaneous costs.

Capital and maintenance costs represent an imputed rent for the use of classrooms, laboratories, libraries, offices and student facility space, such as refectories and social facilities. The rent comprises annual interest at 7 per cent and amortisation payments [1] over 50 years on the insured value of buildings and non-teaching equipment, together with maintenance costs. The total annual cost of each building in the University is then allocated to the different kinds of room (classrooms, laboratories, offices, etc.) in proportion to the area that each type constitutes of the total usable area of the building, but with a weighting factor to allow for the greater cost of constructing laboratory space.

The annual cost of laboratories and classrooms was distributed over different under-graduates following different courses in proportion to their use by each of these students. This involved a detailed study of the timetable of teaching rooms, and took full account of the use of space in one School of Studies by students from other Schools.

The cost of academic staff offices was distributed in direct proportion to the relative amounts of time devoted to various activities by members of staff. The division of staff time between under-graduate teaching and other activities, such as post-graduate teaching and personal research, was based on the results of a survey carried out in 1968 in which staff kept a diary of their activities for a term-time week. [2] The subsequent division between courses courses was based on a study of teaching timetables.

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[1] Interest is charged only on the land upon which the building stands as it is assumed that it will not depreciate in value.

[2] The allocation of staff vacation time was based upon the relevant section of the Robbin's Report, see Committee on Higher Education, Higher Education, Appx. III (London: H.M.S.O., 1963), pp. 60-61.

Table 1: Total Cost per Student at the University of Bradford (1969-1970)

	Capital and Maintenance Costs		Teaching Costs		Administrative, Library, Student Facility, General & Misc. Expendit.		Total Cost Per Student
	£	% of Total	£	% of Total	£	% of Total	£
Laboratory-based Courses							
Chemical Engineering	908	35	1089	43	560	22	2557
Civil Engineering	1030	41	956	38	523	21	2509
Electrical Engineering	1278	36	1769	49	556	15	3603
Mechanical Engineering	1768	44	1679	42	544	14	3991
Applied Biology	849	27	1639	53	622	20	3110
Pharmacy	1446	44	1329	40	519	16	3294
Chemistry	1915	49	1332	34	627	17	3874
Colour Chemistry	1888	48	1517	39	513	13	3918
Materials Science	1134	31	1874	51	672	18	3680
Ophthalmic Optics	1011	34	1484	49	504	17	2999
Applied Physics	1375	36	1635	46	672	18	3682
Textile Science	1245	40	1290	41	621	19	3156
Classroom-based Courses							
Business Studies	710	34	693	32	711	34	2114
Modern Languages	818	34	748	32	820	34	2386
Social Sciences	548	34	475	30	609	36	1632
Applied Social Studies	676	36	419	22	812	42	1907
Mathematics	907	39	744	33	656	28	2307
Statistics	563	31	613	35	599	34	1775

The cost of administrative offices and student facility space was divided equally over all students, except those on "thin-sandwich" courses [1] who were weighted one half. The cost of library space was also divided equally over all students, but with post-graduates weighted two.

Teaching costs comprised academic and technical staff salaries, superannuation and insurance, the annual value of teaching equipment, and expenditure on materials used in teaching. The cost of academic staff was divided in the way already described. The cost of technical staff was attributed

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[1] A "thin-sandwich" course is one with two entries of students per year, arranged so that at any one tome only half the students are present in the university, the remainder receiving practical training in industry.

to different courses in proportion to the relative areas of teaching and research laboratories, and of their use by different courses, since it was found that their number correlated more closely with laboratory area per discipline than with numbers of academic staff.

Similar techniques were employed with respect to the cost per student of staff, stock and equipment in the university administration, library, students' union and so on.[1]

The results of the foregoing calculations for the academic year 1969-70 varied widely between different courses at the University of Bradford. Laboratory-based courses in science and engineering were considerably more expensive than classroom-based courses in social sciences (see Table 1). The cost of educating an under-graduate to first degree level in science or engineering ranged from £2,509 in the lowest-cost discipline to £3,991 in the highest, as against £1,632 to £2,386 in different social science displines.

Annual capital and maintenance costs varied between 27 and 49 per cent of the cost of educating a student to first degree level, depending upon the course involved. Teaching costs were between 22 and 53 per cent of the total, while residual and miscellaneous expenditures ranged from 13 to 22 per cent of costs per student for laboratory-based courses, and 28 to 42 per cent for classroom-based courses.

II Potential economies in existing costs per student

It was evident that some reductions in cost per student could be achieved at the expense of possibly undesirable measures, such as a worsening of the staff/student ratio.

With this in mind, we made detailed studies of the teaching structure of nine under-graduate courses. This involved analysing for each course:

a) the annual contact hours; i.e. the number of hours teaching that a student received each year

b) the number of optional subjects embodied in the course, from which students may select a limited number

c) the size of teaching groups regarded as educationally acceptable by the School of Study

d) the relative balance of lectures, classes, laboratory sessions and tutorials within the total contact hours

From this data, we estimated the total number of teaching meetings that would have to be provided as the values of these parameters were varied. From the number of teaching meetings we calculated the number, and therefore the cost, of academic staff required, and the consequent effect on total cost-per-student.

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[1] For a detailed description of this methodology as applied to the earlier academic session of 1966-67, see: R.K. Khanna and Anthony Bottomley, "Costs and Returns on Graduates of the University of Bradford, "Accounting and Business Research (No.1, Winter 1970).
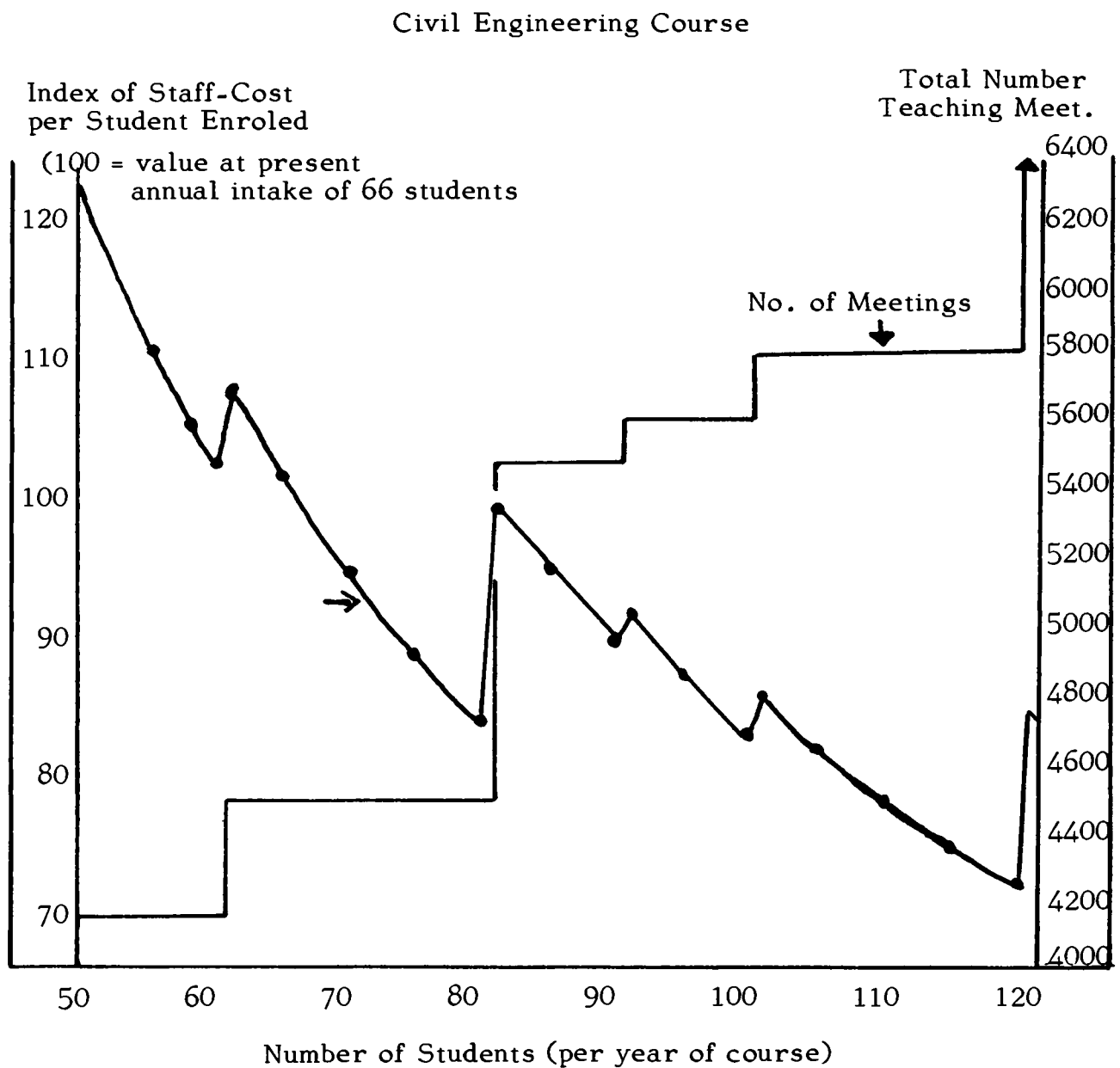
Taking the nine courses together, the following results were obtained. A 20 per cent reduction in contact hours per student caused average cost reductions per graduate of 5.1 per cent. A reduction by two in the range of optional courses of lectures offered per degree course saved between 1 and 4.8 per cent of per graduate cost. Yet increasing the maximum size of teaching groups by 60 per cent did not reduce per student costs by more than 1.7 per cent on any but one of the courses examined. Similarly, replacement of small tutorials by lectures and classes produced an average saving of only 2.7 per cent.

III Economies of scale

Once buildings have been constructed, staff employed, libraries stocked and so forth, there could appear to be very few opportunities for effecting significant economies. We therefore continued our analysis of the teaching structure of nine courses, postulating successive increases in enrolment, by one student at a time, up to more than twice the present number. We calculated the number of teaching meetings that must be provided at each level of enrolment on each course, if the appropriate professor's maxima regarding student numbers per type of meeting were observed. Assuming a constant staff teaching load, the number of academic staff required and therefore the total academic staff cost of the course was thus directly related to the number of meetings. We next divided the number of meetings at each level of enrolment by the number of students to obtain the number of meetings provided per student and therefore the academic staff cost per student.

Figure 1 shows the proportionate change in academic staff per student as enrolment increases on the Civil Engineering course from its present annual intake of sixty-six. For convenience it is expressed in index form with the value at the present enrolment equal to 100. We term this the Staff Cost Index.

Figure 1: Academic staff cost per student

Civil Engineering Course

Index of Staff-Cost
per Student Enroled

(100 = value at present
annual intake of 66 students

Total Number
Teaching Meet.

No. of Meetings

Number of Students (per year of course)

For all the nine courses studied the Staff Cost Index exhibits the same form - falling as enrolment increases, but with periodic upward jumps corresponding to those levels of enrolment at which a series of teaching meetings must be duplicated because a laboratory class, seminar or tutorial reaches the maxima designated by the prefessors involved. The rate of fall, the points at which the jumps occur and the size of the jumps, vary from course to course, but the pattern is similar. The moral is clear - if expansion is to occur it should be to a level of enrolment corresponding to a "trough" rather than a "peak" on the Staff Cost Index.

It seems that, for nine courses examined, the per student cost of providing teaching staff falls by a minimum of 18 per cent and a maximum of 48 per cent when enrolment is increased to the "trough" nearest to twice the present number. This saving in staff cost may be achieved without increasing the number of hours per week which each staff member teaches, or reducing the number of hours of instruction which each student receives. This may be done in spite of the fact that the size of seminars, tutorials and laboratory classes are held at a level which professors or their represent-atives think reasonable. In other words, these economies arise from expanding numbers in lectures where direct student-teacher exchanges do not normally take place. The average saving in total cost per student achieved by a carefully chosen approximate doubling of numbers, whilst maintaining existing course structures, is 7.7 per cent through savings in staff costs alone. This is a considerably greater figure than the savings obtained by any "reasonable" alteration of course structures at the present level of enrolment. It implies that the overall U.K. weighted staff: student ratio could fall from its recent level of 1: 11 to 1: 16 without any apparent increase in teaching duties per staff member or deterioration in quality of instruction if the situation at Bradford is representative.

We believe that serious study should be given to assessing the staff requirements for the proposed increase in student numbers on the basis of the number of additional teaching meetings generated, instead of by using a staff: student ratio. It would appear from our research that expansion accompanied by a constant staff: student ratio and unchanged course structures would mean a reduction in the average weekly teaching load of staff.

There also appears to have been a good deal of overbuilding at the University of Bradford in recent years. The current situation in the courses we examined is that teaching is taking place in laboratories for only 41 per cent of a thirty-two hour basic teaching week, and classrooms are in use for only 52 per cent of the time. Furthermore, in most Schools of Study the teaching week consists of only thirty-three weeks a year.

In the majority of the Schools studied, an increase in enrolment sufficient to bring laboratory use up to 80 per cent of a thirty-two hour week would reduce total costs per student by between 7 and 19 per cent. If this 80 per cent utilisation were extended to a 60 hour week, the total cost per student could be reduced by 10 to 34 per cent of the present cost.

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[1] These conclusions are supported by the fact that teaching costs per student are inversely correlated with student numbers on existing courses at the University of Bradford.

Table 2 shows the reduction in cost per student with successive increases in laboratory utilisation in each of five course investigated.

Table 2: Reduction in Total Cost-per-Student in Relation to Increased Laboratory Utilisation

% Laboratory Utilisation and length of teaching week	Pharmacy		Colour Chemistry		Electrical Eng.		Applied Biology		Applied Physics	
	Total Cost per Student	% of Existing Cost	£	%	£	%	£	%	£	%
EXISTING	£3294		3918		3603		3110		3682	
60% @ 32 hrs.	2957	90	2802	71	3151	87	2999	96	3275	89
70% @ 32 hrs.	2777	84	2737	70	3054	85	2917	94	3215	87
80% @ 32 hrs.	2671	81	2694	69	2994	83	2885	93	3131	85
80% @ 40 hrs.	2593	79	2649	68	2938	81	2837	91	3083	84
80% @ 50 hrs.	2536	77	2613	67	2898	80	2816	90	3039	82
80% @ 60 hrs.	2497	76	2586	66	2878	80	2801	90	3023	82

However, there are a good many practical problems involved in timetabling, setting up experiments and inducing academic staff to work outside the normal working week, even though the objections of the latter might be met by some supplement to salary provided out of productivity savings. Furthermore, the increases in student numbers required to achieve such levels of utilisation are considerably in excess of anything at present envisaged for the University of Bradford.

But in spite of the above reservations with regard to enrolment, we went on to analyse the use of classrooms and lecture theatres in the so-called Main Building of the University. This building is our largest and the level of its utilisation is greater than for the University's buildings as a whole. Nevertheless, its classrooms and lecture theatres were only occupied on average for 55.3 per cent of a 32 hour week. Even when its rooms were in use, only 52.0 per cent of available seats were occupied.

It is evident that considerable economies in cost per student year could be obtained if building design and timing were more closely related to academic plans.

Conclusions

It seems probable that the level of resource utilisation at the University of Bradford is not greatly different from that of the British University system as a whole. There is therefore considerable potential for cost economies of scale in the University sector of higher education. Other countries may learn from this situation. One large university

department can be a good deal more economic than several small ones, and building plans should be co-ordinated with academic plans to that the available space fits student numbers and requirements more like a glove than a sack.

We will do our best to share our experience in these matters with anyone who cares to contact us.