This report is reproduced with kind permission from the Commonwealth of Learning and the Asian Development Bank.

THE COST EFFECTIVENESS OF DISTANCE EDUCATION FOR PRIMARY TEACHER TRAINING

A paper prepared for the Commonwealth of Learning and the Asian Development Bank

Contents paragraph

Hilary Perraton
International Research Foundation for Open Learning
Cambridge

September 1996

Executive Summary

The purpose of the paper is to guide the planning of distance education programmes for teacher training. Many teacher-training programmes have sought a balance between general education, teaching in relation to specific subjects, classroom methods, and teaching about children, education and pedagogy. The balance between these different elements has varied according to the target audience and programme aims. A number of different models have been developed for integrating the supervision and assessment of classroom practice with other elements.

Distance education has been used for both pre-service and in-service education, and at most levels of education. Programmes have often used correspondence as a staple medium of instruction and many have combined this with other media such as radio and, less often, television, and with classroom practice.

Cost studies have been carried out in many parts of the world which examine the comparative cost of using distance education or conventional methods for teacher training. Some have looked at the cost per learning hour of using a particular medium, others at the comparative cost of conventional and distance-education programmes. The studies have faced a number of difficulties because of the quality of the data, the difficulty of making precise comparisons between different methods when audiences also often differ, and the scarcity of data on successful completion rates. Despite the difficulties, it is possible to draw some robust conclusions reasonably.

The evidence confirms that there are circumstances in which distance education is at an economic advantage as compared with conventional education. This is not invariably so and some programmes have operated on too small a scale to yield economies. A major economic advantage of distance education is that it does not require lengthy full-time residence at a college. There are, however, limits to the economies that can be obtained if quality and effectiveness are to be assured by student support and the supervision of classroom practice. In some cases, the favourable economic evidence on distance education reflects the relatively high cost of conventional teacher education.

The major factors affecting the cost of distance education are the number of students and options within the programme, the sophistication of the teaching media used, the arrangements for student support and the supervision of classroom practice, and the success rate. Limited data are available on the costs of different media. The choice between one-way and two-way media is of major educational as well as economic importance.

The research that has been undertaken makes it possible to identify four characteristics of a successful programme. These are likely to have obtained a good balance between the various different elements in teacher training and an integration between them. Within that balance, there needs to be an adequate emphasis on teaching practice. Assessment systems need to reward the qualities that are seen as important within the programme. Programmes are likely to benefit from the use of a combination of different teaching media. All four of these features are likely to increase rather than reduce the cost of a programme but, by raising its effectiveness, may be justified on educational and economic grounds.

Costing techniques have been developed that can be used both by planners and managers. In carrying out cost analysis it is necessary to identify all costs, annualise capital costs and

reduce any cost to a single constant currency where necessary. On this basis it is then possible to calculate unit costs and derive a cost function which makes it possible to see the effect of increasing or reducing enrolment. A thorough economic examination of a programme needs to consider how it should be financed and the role that student fees, if charged, should play in this.

Some data are available on the costs of print, of radio and television, of audio and video cassettes, and of computer conferencing. In each case it is useful to analyse costs in terms of initiation, production, reproduction, distribution and reception. In this analysis, too, one needs to ask where the costs will fall: they may fall on the distance education institution, or on another public or semi-public body, or on the student.

The conclusion of the paper is that the evidence on the use of distance education for teacher training is positive both economically and educationally. Further research would be useful on the integration of distance education with other ways of supporting teachers, ways of maximising quality through the most appropriate mix of media, and on the changing costs and availability of different communication media.

THE COST EFFECTIVENESS OF DISTANCE EDUCATION FOR PRIMARY TEACHER TRAINING

1. The purpose of this paper is to help decision-makers who are considering or planning the use of distance education[1] for teacher training by summarising evidence on its cost effectiveness and showing how this can be calculated. In order to do this, we examine in turn the nature and purpose of teacher training, the evidence on costs, and the techniques used to examine them.

The context

2. If teachers are to be more than custodians, and to do more than teach as they were themselves taught, they need to follow an appropriate programme of teacher education or training[2]. A recent American review suggests that this should comprise:

> a broad grounding in the liberal arts and sciences; knowledge of the subjects to be taught, of the skills to be developed, and of the curricular arrangements and materials that organise and embody that content; knowledge of general and subject-specific methods for teaching and for evaluating student learning; [and] knowledge of students and human development.
>
> quoted in Lockheed and Verspoor 1991, p.90

3. The emphasis given to different elements in a programme of teacher training varies widely. Where trainees' basic education is limited, the main emphasis may be on their general education. A programme of in-service training may concentrate on the skills needed to manage a classroom or a school or on the teaching of a particular subject. Five areas of teaching competence were identified in the plans for a Postgraduate Certificate in Education recently introduced at the British Open University:

> curriculum/subject planning and evaluation;
> classroom/subject methods;
> classroom management;
> assessment, recording and reporting; and
> the wider role of the teacher.
>
> Moon and Mayes 1995, p.99

In this case the trainees were already graduates so that it was not necessary to see the raising of their general education as a priority. In contrast a programme for teachers run by the University of Nairobi some 25 years ago was deliberately 'not for training teachers in classroom methodology. It was aimed principally at upgrading their basic knowledge and general education although there was always the possibility that teachers' methods would improve as a result of the examples placed before them' (Hawkridge et al. 1982, p.181).

4. The more imaginative programmes of teacher education have tried to integrate their various elements and, in particular, to avoid a dichotomy between theory and practice. Most have, in different proportions, sought to provide elements of general education, teaching about the subject matter that trainees will teach in the classroom, and theoretical and practical teaching in pedagogy and education.

Balancing the elements in a teacher-training programme

5. Decisions about the balance between its different elements are critical in planning a programme of teacher training through distance education[3]. The purpose of the programme, and the background of the students, will affect the weight to be given to the different elements identified above (para. 2-3). In many cases planners have seen training in the skills of teaching, that are practised in the classroom, as an essential part of their programme of teacher training. These skills, that are likely to embrace some questions of subject methods, of assessment, and of management, as well as general classroom methods, probably need to be acquired in the classroom. And so these facets of teacher training present different logistical demands from those of teaching the more academic elements of teacher training. Trainees need to get to the classroom, if they are not already working there and their tutors need to visit them while they are there.

6. Close links between college and classroom are needed if practice and theory are to inform each other, and if teachers are to avoid dismissing anything taught at their college as irrelevantly theoretical. The organisation of teaching practice presents severe problems to conventional colleges of education and these are magnified where students are learning at a distance, often a long way from their tutors. Distance-education programmes have tried to solve the problems in various ways. In Tanzania, head teachers and adult tutors from the country's extensive adult education service were asked to supervise trainees. Microteaching has been used during students' residential courses in some countries. Where travel of this kind is possible, tutors from the students' college or university can visit them in the field. The recent British postgraduate certificate course, already referred to, has taken a radically different approach. It has centred the course around activity in the school where the trainee is based for practical work. Students are each required to find a school in which to base their classroom practice and to work under the guidance of a mentor. The schools participating in the scheme appoint a member of staff as a mentor, who is briefed, supported and paid by the university.

7. In seeking a balance between general and specific education, pedagogy, and classroom practice we need to recognise that,

> the distinction between general education and training is not as obvious as might appear... There is a continuous spectrum stretching from what everyone would agree upon as general education to instruction that is quite clearly professional training. Exactly where the line will be drawn between them depends not only upon the individual making the judgement but also upon the stage of development of the school system and upon the grades at which the trainees in question are going to teach. Knowledge that is quite essential stock-in-trade for the teacher at one level may be thought of rather as part of a teacher's cultural and intellectual background at a different level or in a different setting.
>
> Beeby 1966, p.83

8. Reflecting these differences, programmes have varied in their content and in the relative weight they give to general education, to teaching about the subjects which the trainees will themselves teach, to educational theory and to practical classroom training.

Audiences and purposes

9. Distance-education programmes have been used to train teachers with differing backgrounds, at a variety of different levels and for different purposes. Distance education

has been used most often to train primary school teachers, but there is some experience of its use for secondary and tertiary teachers. Some courses have been aimed at the initial training of teachers who are entering the teaching force, some for initial training of those who have already worked as untrained teachers for some years, while others are for the continuing education of those who are experienced and qualified but want to use distance education as a way of upgrading their qualifications and increasing their skills.

10. Where countries face the most severe shortages of teachers, they have sometimes developed distance-education programmes for new recruits to the teaching force, providing initial training, often to recent school leavers. In both Tanzania and Zimbabwe new recruits to teaching were enrolled on large-scale programmes of teacher training run at a distance and put straight into the schools.

11. More often, programmes have been run for the initial training of teachers who are already in service, and therefore experienced. This kind of programme goes back more than 30 years. Soon after independence, for example, Francistown Teacher Training College ran such a programme in Botswana while a programme in Brazil, Logos II, has addressed a comparable audience since the 1970s. At secondary level, the Open University in Sri Lanka teaches experienced teachers who lack a teaching qualification. There is considerable experience in industrialised countries of offering B.Ed and M.Ed programmes for teachers in secondary and tertiary education. Increasingly, too, distance education is being used for specific groups, and specific purposes, within the education service. The government of Trinidad and Tobago, for example, is considering the introduction of a B.Ed programme for head teachers which concentrates on educational management.

12. At least as important as the level of education for which distance-education programmes have been designed is the educational background of the students themselves. Some programmes have been aimed at students whose own education is limited to primary schooling with no more than three years of secondary schooling. Countries that have achieved universal primary, or junior secondary, education are likely to demand a higher entry standard for those embarking on teacher training, whether through distance education or conventionally. The students' background is likely to affect the balance between the different elements in the programme and, in particular, the extent to which the content is essentially one of general education or one more specifically addressed to the needs of the classroom teacher.

Methods

13 Programmes have varied in their choice of media. Most have used correspondence lessons as a staple, seizing the advantages of a medium which can reach students anywhere - though some students more quickly than others - and gives them a text on which to rely. From early programmes set up in various African countries in the 1960s, and planned even before independence, through the work of the Allama Iqbal Open University in its Primary Teachers' Orientation Course to proposals to upgrade Jamaican teachers in the 1990s, correspondence has been seen as an essential part of the methodology. Exceptions exist: a programme of teacher education in Nepal in the mid-1990s used radio as the main teaching medium while television was used for teacher education alongside school teaching in the Côte d'Ivoire educational television service. But these are very much exceptions and the day-to-day activity of most programmes has been to do with the development and running of correspondence education.

14. Correspondence has seldom been used alone. Many programmes have begun with the intention of using broadcasts or cassettes alongside correspondence. In industrialised countries multimedia approaches have often been sustained so that broadcasts continue to support both specialised and general courses. But some developing-country programmes have come up against insuperable logistical difficulties in using audiovisual media as well as print. In Swaziland, for example, the use of radio was early abandoned by William Pitcher College which was set up to offer distance-education programmes (Young et al. 1980, p.30). In contrast an early programme of teacher education in Indonesia found that it was possible to use radio effectively even before the logistical problems of distributing printed materials had been resolved (Setijadi 1987, p.114).

15. Many programmes have included elements of face-to-face support and provided for the supervision of teaching practice as well as expecting students to work literally at a distance. Large-scale programmes in Tanzania and Zimbabwe, for example, sandwiched periods of face-to-face tuition with study at a distance, undertaken while trainees were working in schools. In Guyana, regular practical sessions were arranged for trainee science teachers on Saturdays in university or school laboratories (Brophy and Dalgety 1980). In many, though not all, cases programmes have arranged for the supervision of trainees' classroom practice.

16. The choice of media is affected both by the available technology and by the purpose of the programme. Where programmes are intended to change classroom practice, or teachers' attitudes, they are likely to emphasise practical classroom work and its supervision: their quality and effectiveness will be affected by the arrangements made to organise and supervise this component. A programme with more restricted aims, such as raising the basic educational level of the students, may require less in the way of supervised classroom work and face-to-face support. Decisions about media also have, of course, an important bearing on the cost of a programme. Some media have higher production costs than others: television is, for example, almost always more costly per hour than radio. Different media may affect the distribution of responsibility for meeting costs: if students are required to buy a cassette player, or to meet the costs of printing materials that are distributed through a computer network, this may reduce expenditure on the part of the teaching organisation but increase the cost falling on the student. Even more important there are critical differences between the behaviour of the costs of different media. The most significant of these differences, to which we return below, is between the costs for face-to-face support and for guiding and assessing classroom practice, which vary with the number of students, and the costs of developing educational materials which are unaffected by student numbers.

Cost studies

17. Questions of cost are almost always relevant to planning. There may, sometimes, be a case for using distance education which has at first sight little to do with its costs: to reach students in a distant part of the country, or to avoid taking them out of the work force, or in the interests of equity. But the planner will always want to know what resources are necessary to run a programme and, most often, to compare the costs of alternative approaches. Even in the three cases suggested it makes sense to ask about the costs and about the comparative cost of the alternatives.

18. Three types of cost study can be distinguished. The term 'cost analysis' is used to refer to any study which analyses the costs of an activity and so makes planning decisions easier or more rational. Cost analysis is a first stage in any economic analysis but is also a valuable

management tool. 'Cost-effectiveness studies', in contrast, always include a comparative element: they answer the question 'how does the cost of achieving a given effect compare with the cost of alternatives?'. Much of this paper is concerned with cost effectiveness, examining the strengths and weaknesses of distance education in order to achieve comparable effects, in terms of training teachers, with alternative methods. Studies of cost effectiveness do not require us to put a monetary value on the effects but simply to express them in a way that makes comparison with alternatives possible. 'Cost-benefit studies' put monetary values on both the inputs and the outputs of an activity: they require us to find a value in money for the effect obtained. In education, for example, a cost-benefit study might try to find a value for the output of a particular course by examining the increased earnings commanded by students who had followed the course.

19. This paper does not examine cost benefit further. Its starting point is that educators are convinced that raising the quality of teacher training brings benefits to society. We will, however, need to keep in mind one of the questions posed by cost-benefit analysis and ask how we can be assured that the outcomes of the courses and programmes examined do in fact produce benefits. Thus, even while we stop at cost effectiveness, we will need to be assured that the effects produced by programmes of distance education are comparable to those produced by conventional training programmes.

Comparative studies and their limitations

20. The pattern of expenditure for distance education differs from that for conventional education, with different relationships between fixed and variable costs. In conventional education, staff costs are generally the largest single item in a budget, sometimes exceeding 90 per cent of the total. Staff costs therefore tend to vary with the number of students and education is a labour-intensive activity. While it is possible to hold down unit costs by putting more children into a classroom, or operating a two-shift system, there are limits even to these measures and the relationship between student numbers and costs remains generally close. In distance education, teaching can be recorded in advance, reproduced, and distributed to large numbers of students. While significant costs have to be incurred in developing the teaching materials, the costs of teaching one additional student may be modest. Distance education is thus more capital intensive than conventional education with higher fixed costs, mainly for the development and production of teaching materials, and lower variable costs, as fewer teaching hours are devoted to the teaching of each student or group of students. Within distance education it is therefore possible to expect some economies of scale, and for the cost per student to drop as the number of students increases.

21. If we want to compare the costs of conventional and distance education, or look at the consequences of expanding or contracting a programme, we cannot therefore simply take annual expenditure for the two modes of study and divide it by the number of students. (In any one year a significant proportion of the costs of distance education may be for the development of teaching materials that are used over a number of years.) Techniques of analysis (discussed below), based on classical microeconomics, have been developed and applied to distance education in order to compare its effects with those of conventional education. Studies have generally sought to produce one of two kinds of comparison. A number of studies, particularly those produced in the late 1970s and early 1980s, have analysed the cost per hour of study for different modes of education. An overview of *The costs of educational media*, for example, concludes by summarising evidence on the costs per student hour of radio and television (Jamison, Klees and Wells, 1978, pp240-2). More

recently studies have tended to look instead at the comparative costs of following a course or obtaining a particular qualification through different methods of study.

22. The available comparative studies make it possible to reach some conclusions about the circumstances in which distance education is at an advantage or disadvantage as compared with alternatives. Many of these have followed a standard methodology. In order to put them in context, however, we need to consider their limitations. A review of the evidence, concentrating on higher education but looking at some of the teacher education studies, noted that the limitations of the data were both practical and conceptual.

> The quality of the data is varied: individuals and institutions have undertaken costings for a variety of purposes and using a variety of techniques. In particular, while post-hoc costings done in the interest of economic analysis have often included an examination of the costs of capital, institutional studies have often looked only at recurrent costs. Similarly, analysis of the costs of conventional education varies in its sophistication.
>
> Comparisons are also difficult because institutions differ widely. There is no one form of distance-teaching institution and different institutions use different mixes of teaching methods. As the cost of a distance-teaching programme is, in part, a function of its choice of teaching media, so it may be misleading to lump together evidence from different teaching systems. Nor can we assume a simple relation between cost and technological simplicity: the National Technological University [of the United States] may have costs that compare favourably with alternatives, especially if opportunity costs are taken into account, despite its reliance on satellite technology (cf. Bih-jen Fwu et al. 1992). Conventional institutions also differ widely in the balance of subjects taught and the comparative emphasis they give to teaching and research. These factors can make a major difference to the cost per student: if half an academic staff member's time is devoted to research then it is illegitimate to attribute all that time to teaching in any attempt to define a cost per student. For their part open universities may make quite different assumptions about their staff members' duties than some conventional universities. Staff at Universitas Terbuka in Indonesia, for example have administrative responsibilities that effectively prevent their undertaking research (Djalil et al. 1994, p. 35).
>
> Even where information is available there are difficulties in comparing costs and effects. We rarely have matched groups of students studying at a distance and conventionally and cannot easily disentangle effects to be attributed to the method of study from effects due to differences between the audiences. Nor can we always match institutions. While on the face of it we should compare the work of an open university, say, with a conventional university, the balance of their work may be quite different. Up to 1993, for example, the Indira Gandhi National Open University had awarded 14 328 qualifications but only 1290 or 9 percent of these were bachelor's or master's degrees. (Kulandai Swamy and Pillai 1993, p.73). It would not be fully appropriate to compare its costs with those of a university whose main activity was to produce graduates with bachelor's degrees.
>
> One further practical weakness of the data is that few studies have quoted graduation rates. British Open University data are available. A number of Australian studies (Sheath 1965, p.44, Jevons 1982 p.127, Hudson Report 1986 pp96-7) quote graduation

> rates between 33% and 69%. Apart from some studies of teacher training we have few other graduation rates.
>
> Perraton 1994, pp20-1

23. We need, therefore, to be careful in interpreting the evidence on cost and not drive our conclusions further than the data will legitimately take us. In doing so we need, too, to be sensitive to questions about who is meeting the cost. Some costs fall upon governments or training institutions; others on students and the success or failure of a programme can depend upon the realism of assumptions about who can pay for what.

Costs and outcomes

24. The evidence from cost-effectiveness studies allows us to draw two kinds of conclusions about the costs of distance-education programmes for teacher training: about the comparative cost of distance and conventional education and about the key variables that influence this cost. Table 1 sets out data on a number of programmes of teacher education and of higher education; for the most part the latter relate to institutions which had teacher training as one of a number of functions. All the data reported come from studies which appear to have followed standard techniques of microeconomic analysis and to be robust enough for one to have confidence in the conclusions[4].

25. In interpreting the cost data it is important to distinguish between cost per student and cost per graduate. A number of studies, especially of open universities, have shown figures for costs per student but without examining graduation rates. As a result, while it is possible to compare the cost per student with that of conventional education, it is not always possible to answer questions about the comparative cost of producing a graduate or of successfully completing a course. Our main concern in this paper is with the cost of successfully completing a course.

26. We can then draw six conclusions from the figures and from the studies on which they are based.

27. The first is that there are circumstances in which distance education is at an economic advantage as compared with conventional education. Where it has been possible to measure effectiveness, teacher training at a distance has been shown to be effective and its costs often tend to be lower than those of conventional education. From the available data it is reasonable to conclude that distance-education programmes can be designed for teachers which will cost between one-third and two-thirds of conventional programmes. To some extent, in Pakistan or Tanzania for example, this is because they have operated at a large scale and often achieved high successful completion rates. Typically these were programmes in which successful completion guaranteed more pay. High completion rates narrowed the gap between the cost per student and the cost per graduate.

28. This finding is consistent with other reported data. In China, for example, where only limited data were available for a comparison between the cost of the Radio and Television Universities and others, Wei and Tong (1994, p.98) suggested that the RTVU system was probably 'saving a third of the cost of producing a conventional graduate'. Although he used a somewhat different methodology from that of most of the studies referred to in this paper, our findings are consistent with a review of teacher upgrading through distance education in

southern Africa (Taylor 1983, p.30). In Britain there is as yet no published cost study of the Open University's Postgraduate Certificate in Education but its costs are understood to be about half of those of the conventional alternative (personal communication).

29. Thus, in a number of the cases where reliable data are available, distance education has been shown to achieve the economies of scale that allow the cost per student to fall below that of alternatives.

30. The second conclusion is that some distance-education projects were probably too small to show economies of scale. Five of the projects shown in table 1 (the two projects in Kenya, the project in Nepal, the University of Lagos COSIT programme and the project in Uganda) did not show dramatic economies as compared with conventional programmes of teacher education. Indeed, it was probably more costly to produce examination passes through the early programme in Kenya than it was in regular schools although the programme was seen as having the benefit of reaching remote teachers who could not be taken out of the classroom for full-time education. There were similar benefits to the recent small-scale project in Uganda. These projects had enrolments in the range 500 to 3000. In contrast, the comparative costs of a number of larger distance-education programmes have been much more favourable.

31. Third, one of the major economic advantages of using distance education is that it does not demand full-time residence or attendance at a college over a period of years. This means that a distance-education programme is likely to result in a number of different savings in public expenditure, including the cost of providing residential colleges and, in some jurisdictions, of paying students a maintenance allowance while they are at college. Students in Ghana, for example, receive a living allowance if they attend university to follow a B.Ed course but do not get an allowance if they are following a parallel distance-education course. The costs of student residence is reduced when students attend a college for face-to-face sessions only occasionally, or for shorter periods than in conventional full-time programmes, and colleges are therefore used more intensively.

32. The savings in the cost of residence, and the economies of scale made possible through the use of communication media, have brought the unit costs of many distance-education programmes below those of alternatives. But, fourth, there are tight limits to the economies of scale that can be expected through the expansion of distance-education programmes where these have a significant pedagogical content focused on classroom teaching. Where extensive support is provided to students, or arrangements made for thorough supervision of their teaching practice, the variable cost of programmes is relatively high; supervision and support costs necessarily rise in proportion to the number of students so that economies of scale are not possible for this element of the programme.

33. Fifth, the comparison between the costs of distance and conventional education in part reflects the high cost of conventional methods of teacher education. Lockheed and Verspoor (1991, p.96), in commenting on the high cost of much teacher education, have suggested that where its content is much the same as that of secondary education, so that the work of teacher-training institutions is largely remedial, it would be cheaper to provide that education through secondary schools which usually have far lower unit costs than teachers' colleges. (There are marked national differences here with the annual cost of teacher training standing at 1.10 and 1.64 times the cost of secondary education in Indonesia and Bangladesh respectively but at 8.51 in China and 25.53 times in Pakistan (ibid. p.97).) The Tanzania teacher training scheme is a striking example of these two points; its costs look dramatically

high for a low-income country and demonstrate both the high degree of face-to-face supervision provided to the distance-education students and the high cost of conventional teachers' colleges.

34. Sixth, there are considerable opportunity costs for students in undertaking part-time study. Some of the costs are social: students spending less time with their children, their spouses or their friends. Some, easier to quantify, are financial. While economists can estimate a shadow cost for students' time, teachers doing a part-time degree in both Kenya and Nigeria reported that they were using time that they could otherwise have spent doing private, paid, tuition (Perraton 1993, p.288).

35. The opportunity costs of various modes of study may fall on students or their employers. One of the attractions for employers of the National Technological University, which feeds teaching into its students' work places, is that it cuts the opportunity cost of attending campus by eliminating travelling time. The conclusion is that, if we want to undertake cost-effectiveness analysis of distance education, we need to consider the value of students' time and to ask who is paying for that time (see also para. 60 below). Comparisons between the cost effectiveness of distance and conventional education may turn on just this issue. Policy decisions may turn on the question of who pays the opportunity cost.

36. To sum up, the cost evidence is consistent in showing that students can obtain teaching qualifications through distance education at costs that compare favourably with alternatives. They will not always do so, and in interpreting the data, we need also to consider the opportunity cost of study and the question of who is meeting this cost. Furthermore, while it is legitimate to compare the costs of obtaining the same qualification through different kinds of programme, in a thorough evaluation we would also need to ask how far there are differences in the way teachers perform in the classroom which relate to the ways they have been trained. This is an area in which more research is needed[5].

Key variables affecting unit costs

37. The behaviour of the costs of distance education reflects the fact, already noted (para. 20), that it is likely to be a more capital-intensive activity than conventional education. For any one programme we can identify five factors that will affect the cost per successful student and the relative cost-effectiveness of a distance-education programme.

38. Two factors affect the fixed cost per student: the number of students and the number of options within a programme. As the number of students grows, for a given programme, so the total fixed cost is shared between a larger number and the cost per student falls. At the same time, if all students follow the same course, with no options, so the cost of course development is minimised. In contrast, the cost of course development rises with each option: the more choice there is, the fewer students there are on any one option. Thus the unit cost will tend to rise as the number of options increases.

39. The third factor, which may affect both fixed and variable costs, concerns the sophistication of the teaching media used. A programme that uses print alone is likely to have lower costs than one that uses a variety of media. Television appears invariably to be more expensive per hour than radio. Computer conferencing requires investment in computer hardware and software and heavy expenditure of tutor time in monitoring computer conferences. Production costs for the various media are fixed, and do not vary with the number of students. Distribution costs for broadcasts are also fixed: it costs no more to

broadcast to 500 000 people within a given area than to 50. Because of these significant fixed costs, it may be possible to use sophisticated media only where enrolments are relatively high. Distribution costs for print, and reproduction costs, however, are likely to vary with the number of students. We examine the implications of these differences in more detail below (para.75-81).

40. The fourth factor has already been mentioned (para. 31): the arrangements for student support and for the organisation, supervision and assessment of classroom practice. Here economies of scale do not apply: as with face-to-face teaching, the costs of supervising classroom practice are likely to be a function of the number of trainee teachers. Where a significant proportion of the total cost of a programme is for this element, then the variable costs will form a relatively high proportion of the total.

41. Figure 1 illustrates the behaviour of these variables for any given course. A course may be at any point in the block diagram. Courses at one extreme - with few students, sophisticated media, and a great deal of face-to-face support - will cluster at the top, back, corner of the block and have relatively high unit costs as compared with those towards the opposite corner.

Figure 1

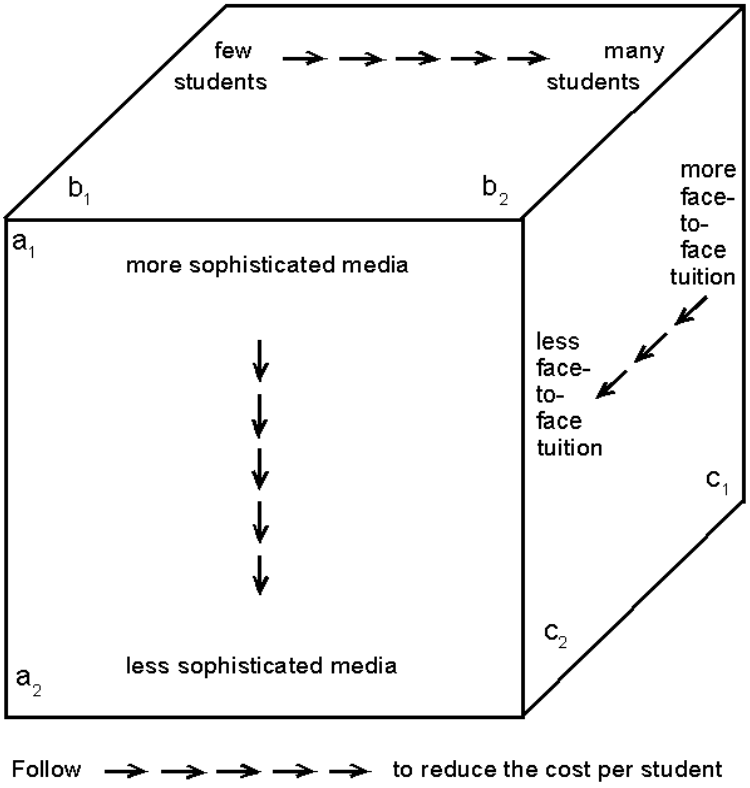

Figure 1: Cost behaviour in a distance-education course

42. Fifth, the cost per successful student is a function of the success rates achieved in the programme. If we want to reduce the cost per successful student - though not the cost per student - one way is to improve the quality of the programme so that the successful completion rate rises. Thus the careful choice of appropriate media and strengthening of

student support may be cost effective, when we measure this in terms of students successfully completing a course or of their effectiveness as teachers.

Comparative costs of different media

43. The programme planner will be faced with educational and economic questions about the third of these factors in choosing the medium, or combination of media, to be used. The educational evidence is reassuring: comparative studies over many years have yielded findings of no significant difference in the effectiveness of different educational media[6.]. This reassuring finding forces us back to make decisions about the choice of medium on the basis of such issues as its convenience for our students, its apparent appropriateness for the educational task concerned, and its cost.

44. Unfortunately it is not possible to draw up a simple chart showing the comparative cost to be expected for each medium. Costs depend heavily on context; the relative costs of particular types of labour, for example, vary widely from one economy to another. There are, too, wide variations within any one medium; the cost of single-colour, newsprint-quality print is quite different from that of multiple-colour printing while a full-scale, broadcast-quality television programme has production costs of a quite different order from those of a two-camera transmission showing a speaker's head together with blackboard notes.

45. A critical distinction affecting the planner's choice is between media that allow one-way interaction and those allowing two-way or multi-way interaction. Broadcast radio and television are, for example, one-way media. Printed materials sent through the post may stimulate two-way interaction if students are provided with assignments to come back to a tutor. There is limited experience, mainly in industrialised countries of providing one-way television with two-way audio signals and offering telephone tutorial sessions to students. The costs of doing so, and the demands on the communication infrastructure, mean that these approaches, and computer conferencing, are at present of limited relevance in the south and there is little experience there of their use. In practical terms, therefore, two-way communication in a teacher education project in Asia is likely to depend on face-to-face contact with students and on correspondence tuition. In both cases the costs will vary with the planned level of interaction and with the number of students; the costs of this element of a programme will not allow for economies of scale.

46. In order to examine the cost of each medium it is useful to ask three sets of questions. First, we need to distinguish between the cost of setting up or initiating work in a particular medium from its running costs. Next, we need to consider how far the running costs are fixed or vary, usually with the number of students. And, third, it is useful to distinguish between the costs of producing teaching material, the costs of reproduction, of distribution and of reception. At each stage the planner is likely to have another practical question: who pays. For some of the costs may fall on the institution, some on national, regional or local government, and some on the individual student. This framework makes it possible to analyse the cost structure of the more important media for distance education. We return to this below (paras.73-9) after examining the costing techniques used.

The quality cost trade-off

47. The discussion so far has put together evidence from both preservice and inservice teacher training. This seems legitimate as the conclusions appear to be common to both forms of training. It has, in fact, been suggested that the division between the two is becoming arbitrary as 'what is pre-service for some [colleges] may be in-service in others. For there is

an increasing tendency to draw college entrants from the ranks of the large pool of untrained teachers since at least these have showed themselves ready and willing to enter the classroom' (Hawes and Stephens 1990, p.106). We do not examine further, here, the economic case for greater or lesser investment in preservice and inservice training respectively. But, while pursuing cost effectiveness, we do need to consider ways of maximising educational quality.

48. The quality and effectiveness of teacher training has been widely criticised and at best it seems that,

> the relationships between teacher training and pupil achievement are 'complex'. Emerging from the research we may ask two important questions:
>
> If training does make a difference generally, why are there significant examples of countries in which teacher education seems to have little effect 'at the chalk face'? Is there therefore an important distinction to be made between good teacher training and poor tertiary level education, masquerading as pre-service instruction?
>
> Hawes and Stephens 1990, p.102

49. Studies in many parts of the world have identified the difficulties faced by teachers' colleges in pursuing quality. In Pakistan, for example, researchers identified as critical difficulties the poor quality of the intake to colleges, lack of motivation among the staff, the abstract nature of the curriculum and a system of evaluation that encouraged rote learning (Avalos 1993, p.75). At the same time distance-education programmes have been widely criticised on educational grounds. In many programmes dropout rates have been much higher than they are in conventional education. As distance-education students are forced to rely on pre-prepared teaching materials there is a danger that learning will lapse into rote memorisation. We have little positive evidence, from the small number of cases where the question has been examined, of the effectiveness of distance education in changing teachers' attitudes (cf. Nielsen and Tatto 1993, p.123). In planning a distance-education programme we need, then, to overcome the problems that have marked both teacher training and distance education.

Four features of effective programmes

50. We can identify four features that are likely to mark successful programmes and consider their cost implications. At the same time we need to recognise that some of the measures needed for effectiveness lie outside the limits of pedagogical design: programmes are likely to be more effective if trainees are highly motivated, if they are drawn from a pool of well-educated entrants, if the teaching profession is one that commands general, better still increasing, public esteem.

51. First, we noted above the need to seek a balance between the various different elements in teacher training (paras. 5 - 8). A consistent criticism has been 'the lack of integration and balance between theory and practice in teacher training' (Dove 1986, p.248) while 'only too frequently the Principles of Education are taught in a .... way amounting to indoctrination. The only saving feature is that they are often confusing and meaningless to trainees' (ibid. p249). The necessary links between general or subject-specific education on the one hand and teaching skills on the other are often not in place. In some cases one element of a course fails to reinforce another: one study found that course materials stressed informal classroom methodologies while the tutors in Saturday sessions taught their trainees in serried rows of desks (Bako and Rumble 1993, p.221). The first feature we should look for, therefore, is a carefully worked out integration between the various elements in a curriculum. This requires

a structure which establishes the links between the various elements of the course, possibly in terms of the competencies to be achieved by students, and the teaching methodologies to be used.

52. Second, an essential part of that framework is teaching practice. 'Unfortunately, though teaching practice is a common feature of teacher training, it is frequently poorly conceived, inadequately organised and under-resourced' (Dove 1986, p.251). It has faced particular difficulties in large, national, programmes of teacher training through distance education where the administrative demands of organising the supervision of classroom practice overwhelmed good intentions (cf. Chivore 1993, p.59, Perraton 1993, p.398). If a distance-education programme is to affect the classroom practice of teachers it seems inescapable that teaching practice needs to be a key component, despite all the complexities of management and administration that this brings in its train. There are a number of different ways in which this can be organised: college of education staff and district education staff have been employed in some programmes to supervise teaching practice. A British programme, and an Albanian one modelled on it, have recruited mentors in school, built the programme around the link between them and the trainee teachers, and provided for the supervision of classroom practice in this way (cf. para. 6 above and Moon and Mayes 1995). The costs vary with the approach adopted as may their location, with a different answer to the question, 'who pays for this element?'.

53. Third, assessment always affects teaching. Just as teachers are tempted to teach mainly in order to get their students through the target examination, so they themselves will be affected by the rewards that follow from their assessment, and by the features in their activity that get the greatest reward. If a balanced curriculum, and the importance of teaching practice are to be stressed, these elements must carry weight in any system of assessment.

54. Fourth, those working in distance education argue that programmes that use a combination of media are likely to be more successful than those using a single medium. The strengths of the different media can then complement each other; where there are difficulties in using one medium another may compensate; if personality differences mean that there are differences in the ease with which individuals learn from a particular medium, there are advantages in offering a combination of media (cf. Moore and Kearsley 1996 p.69; Bates 1982, p.308). We may therefore expect that, while a distance-education programme that uses a variety of media will have higher costs per student than one that uses mainly or exclusively a single medium, it will be at an educational advantage because of the variety.

55. These features are not, of course, the only ones to affect success. General principles of good planning, the use of a systems approach to the design of an educational project, and the achievement of an effective management system, for example, will all have a bearing on the success of a programme of teacher education. But these four seem, from the literature, to be of critical importance. All have management and cost implications.

Implications for management, cost and funding

56. The main management implication is that all four require some emphasis on the management of the educational service at a local level. Local involvement is necessary in the management of teaching practice and of assessment if this is to relate to teaching practice. Given the centrality of these issues, such involvement then needs to extend back into the design of a programme and, to ensure a measure of realism, to affect decisions about educational media.

57. The cost implications are simple: all four features are likely to increase rather than reduce the cost of a programme. As we have seen (para. 40) teaching practice does not allow the economies of scale that are available for some elements of teacher training through distance education. If assessment is to be local, then it, too, will have high variable costs. As there are costs associated with each teaching medium so we can expect costs to rise with each extra medium used.

58. If, however, we shift our focus from overall costs to unit costs and to effectiveness the picture changes. We would expect that, as we increase student support, so the satisfactory completion rate will rise. There is both theoretical and practical evidence to suggest the importance of linking learning from mass media with some opportunities for face-to-face discussion (Katz and Lazarsfeld 1964) which reinforces our arguments for linking face-to-face contact in relation to classroom practice with learning from the media. It is also likely that courses using several media have a higher satisfactory completion rate than those that rely on a single medium. We would, too, expect programmes than included a significant element of classroom practice to have a greater effect on teacher and student performance. Thus, while at least three of the measures proposed are likely to increase overall costs and cost per student, they may at the same time reduce the cost per successful student and achieve a greater improvement in classroom performance for each dollar spent.

59. If, within a fixed budget, we are to find resources for the critical elements of student support and the supervision of classroom practice, which do not allow economies of scale, and to run a programme whose costs do not exceed those of conventional alternatives, we need, as suggested above (paras. 38 - 39) to consider critically the media used and the size of the audience. In doing so, too, we will need to make use of a cost function of the kind discussed below. We can illustrate the point by reference to radio education where one review, whose findings apply as well to distance education, concluded:

> Two essential conditions must exist if radio education is to be less expensive than traditional education.
>
> Staff costs must clearly be lower than those in traditional education systems. This implies at least that the number of hours spent by students and teachers should be greatly reduced...
>
> A sufficient number of students must be recruited to benefit fully from the economies of scale resulting from the use of modern technology ... it should be noted that the only clear example of a multi-media system whose cost is significantly less than that of a traditional system is the Open University where the principal technique ... is print.
>
> Eicher 1980, p.14

60. It is unrealistic to consider costs separately from funding. Funds for teacher education have usually come from one or more of three sources: regular government budgets at central, regional or local level; funding agencies including the development banks; and student fees. Recurrent costs have usually fallen on government budgets and on student fees. Whether or not fees are charged, some costs are likely to fall on the student. In addition to any direct costs, for travel or books for example, students are likely to spend time on study that could otherwise be spent on activities that might be economically rewarding. Where trainee teachers are inservice, policy on funding a training programme will need to take into account

their salary costs, the extent to which training will take them away from the classroom, and the eventual effect on salary budgets if they get increased pay on completion.

61. Policy on student fees has varied. Many programmes of teacher education have charged no fees; indeed, some have paid allowances. There are, however, examples of programmes funded in part by fees; this was the case for teacher upgrading programmes in Indonesia and Sri Lanka. Where teachers are following a degree course from an open university, they have generally been charged fees. Current orthodoxy is to press for the use of fees to recover some of the cost of tertiary education (cf. World Bank 1995, p.72). If fees are charged, the level at which they are set may determine the extent to which a programme can be expanded. If fees are calculated so that they cover all the variable costs of a programme, leaving some or all of the fixed costs to be found from other revenue, then there is no cost limit on the expansion of a programme. Where fees meet only some of the variable costs, then the total cost of a programme is at least in part a function of student numbers.

62. This is, however, a double-edged sword. In Indonesia it was found that 'distance-education trainees begin to lose their incentive to pursue the course once its costs are beyond 16 per cent of their annual earnings, a level found in the case of many trainees' (Nielsen and Tatto 1993, p. 129). Furthermore, where an open university derives a high proportion of its income from student fees it is under pressure from those students to keep fees as low as possible. This in turn encourages the university to hold down its expenditure on the labour-intensive activities of student support, even though these are the very activities that may raise its success rates[7]. The desirability, and realism, of charging student fees will vary so much from one jurisdiction to another that the analysis is not carried further.

63. To sum up, the quality of a distance-education programme is likely to depend on a balance between its different elements, on arrangements for teaching practice and its assessment where it forms part of the curriculum, an appropriate system of assessment for trainees, and the use of a combination of teaching media. A careful analysis of the comparative costs of different media, in relation to the size of the potential audience, is necessary for effective planning. Policy questions will need to be answered about who is to meet the costs or how they are to be shared between various parties.

Basic costing techniques

64. Costing may be undertaken for various different purposes. In some cases it is to answer managers' questions, establishing how to control and manage costs within an institution. In others the aim is to answer questions from planners and managers, seeking the fullest information about the cost of an activity as a step towards cost-effectiveness analysis. While managers may be concerned only about expenditure that falls on their budget, the planner needs a fuller picture of the costs. This section discusses costing for planning and is based on the techniques that have yielded the data discussed earlier. It also examines the costing of individual media

Cost analysis

65. In order to calculate the costs of a programme we need to go through the following stages:

identify all the costs;
annualise the capital costs;
reduce the costs to a single, constant currency where necessary;
calculate unit costs;

derive a cost function.

66. In identifying the costs we often need to make do with best available data, rather than with totally reliable data. It may, for example, be necessary to make estimates of the cost of buildings, or to use a shadow price, such as the probable rent of an alternative building, where actual figures are not readily available. Unesco (1977, p.31) has suggested that, in identifying the costs for an educational media project, it is helpful to seek costs in the following categories:

1. Buildings of a general nature
2 Specialised buildings
    - Studios
    - Other
3. Equipment and materials
4. Consumable furniture and spare parts
5. Labour
6. Other resources
    - Energy by type and mode of transmission
    - Other

67. In order to look at annual costs, and compare costs with those of alternatives, we need to derive an annual cost from any capital cost. In other words, we need to establish the annual cost of using the capital necessary for a project. Unless we do this, the cost in any year where there is significant capital expenditure is distorted. In calculating the annual cost we need to take account both of the capital cost of the building or equipment and of its life. Many economists argue that we need also to take account of the 'interest one could receive on the capital if it were invested in bonds, say, instead of the [equipment bought]. The resulting annualization can reasonably be thought of as the annual rent one would pay if the equipment were leased rather than purchased' (Jamison 1982, p.276). Cost calculations are then sensitive to the interest rate chosen: some studies have used a single rate, often 7.5 per cent, while others have shown the effects of using a range of interest rates such as 0 per cent, 7.5 per cent and 15 per cent[8].

68. Some programmes involve expenditure in more than one currency. In other cases cost data covers a number of years where the value of a currency has changed because of inflation. In order to ensure comparability, it is therefore necessary to use appropriate deflators to express currency in a constant form. In table 1, for example, all costs have been converted to US dollars, using the conversion rate applying at the date of the study, and then converted to constant US dollars for 1992.

69. The next stage is to calculate a unit cost. As noted above (para. 21), some studies have derived a cost per study hour, others a cost per student, others a cost per successful student. Many studies of educational costing are concerned with the cost per student or, to assist comparison between full and part-time study, with the cost per full-time student equivalent. In the case of distance-education projects we are likely to be concerned with more than one unit cost. We may, for example, need to know the cost per radio broadcast, the cost per printed booklet, and the cost for each tutorial session.

70. In calculating unit costs, and deriving a cost function, it is useful to distinguish between the different kinds of activity involved in distance education, some of which are shown in table 2, below, and separate out the costs of:

general administration of the programme, which may include evaluation costs
initiation costs
production costs
reproduction costs
distribution costs
reception costs.

We need at the same time to bear in mind that fact that these costs are likely to fall on different budgets so that information about them may be in a number of different places.

71. A high proportion of the general administration and initiation costs are generally fixed as are some production costs. Many of the reproduction, distribution and reception costs are variable, especially if we regard tutoring as being a reception cost. The development of a cost function allows us to look at the significance of fixed and variable costs for programmes at different levels of activity.

72. The development of a cost function makes it possible for us to compare the costs of a distance-education programme with alternatives and to consider the effect of increasing its scale on the average or unit cost. The simplest cost function has the form,

$$TC(N) = F + VN,$$

where TC is the total cost, N is the number of students, F is the fixed cost and V is the variable cost per student. Thus , for example, a study of the Air-Correspondence High School in Korea found that, in 1976 $$, it had fixed costs of $444 000 and variable costs of $36.90 per student so that the cost function had the values

$$TC(N) = 444\,000 + 36.9N$$

With enrolments around 20 000 it was then possible to calculate an annual cost per student of about US$60 (Kye-Woo Lee et al. 1982, p.156-7).

73. To develop a simple cost function we may, in fact, need to calculate separate functions for each medium, looking at the cost per student by medium. In the same example, costs were calculated separately for four separate elements of costs with the function

$$TC = C_{rm} + C_{rp} + C_{cl} + C_{ae'}$$

'where C_{rm} is the cost of teaching by reading materials, C_{rp} costs of teaching by radio programs, C_{cl} costs of teaching at classrooms, and C_{ae} costs of central administration and evaluation' (ibid.)

74. Cost functions of this kind enable us to consider the implications of enlarging or contracting programmes and of allocating resources between different media. Where spreadsheets have been used to build up a picture of costs, it is possible to use cost data simply in order to look at the cost implications of decisions about teaching. Still following the same example, the variable cost per student of teaching using reading materials was $20, of radio was $0.44, of classroom sessions $16.40 and of administration $0.08. Spreadsheet

simulations would therefore enable one to see the effect on the total cost of the programme not only of doubling the size of the number of students but also of changing the mix of components by, say, increasing the number of classroom sessions.

Costs of individual media

75. This approach makes it possible to analyse the costs of individual media and so to reach some generalisations about their costs.

76. Print is widely, though not quite universally, used in programmes of distance education and often carries the main burden of teaching. There is often a wide range of options open to the planner considering how to use print: it may be possible to print at the distance-teaching institution itself, or at its parent body, or through a government printer or in the private sector. While costs vary widely, an early study found 1978 costs for printing a 20 page A4 publication, excluding the writing and editing costs, were in the range US$0.07 to 0.19 in Bangladesh, the Philippines and Taiwan (equivalent to 1992$0.14 to $0.38) (Perraton 1982a, p.16-17).

Initiation costs depend on decisions to be taken about printing internally or externally.

The main element in the *production* of printed materials is likely to be the necessary academic and editorial staff time. Costs for producing the original document will be increased where translation is necessary and where calligraphy is used to prepare originals, rather than typing, wordprocessing or typesetting.

Some *reproduction* costs are fixed but, especially for large print runs, most of the cost varies with the number of copies being printed, itself a function of the number of students. Thus the price of paper is likely to be the most important variable affecting the cost of print. Until recently the cost per page has fallen sharply as the print run has risen from about 200 to 1000 and then tended to flatten. Changes in print technology have begun to change this so that small print runs are becoming more economic.

Distribution costs vary with the number of points to which materials are distributed. Thus costs to the institution are reduced if materials are distributed to depots from which students have to collect them.

Reception costs are of two kinds. Students may have costs if they have to collect materials. In contrast with other media, there is no cost to students in using printed materials. If the costs of tutoring, in response to printed materials, are included here then there will be a significant reception cost which will vary with the number of students and with the amount of work they and their tutors are required to do.

77. Radio and television have a similar cost structure with high fixed costs and low variable costs. 'For all sizes of operation, the costs for systems using television are from three to ten times higher than for systems using radio' (Eicher 1980, p.14). At the same time there is a wide variation in the costs of television. One study found costs for an hour of television varying from 1980US$175 to $53 800 (equivalent to 1992 $291 to $89 494), with a ratio of 307:1 between the highest and lowest cost (Curran 1990, p.33).

The *initiation* costs of radio or television may include the setting up of a broadcasting system, including transmitters and the provision of sets to the audience. In this case the costs attributable to education are likely to be dramatically higher than those where education can use an existing service. If a programme is going to need a large number of programmes on a continuing basis it may be necessary to build and equip studios, thus, again, involving significant fixed costs.

Production costs for broadcasts are generally higher than they are for print where they require the use of studios and production staff as well as academic staff time.

There are no *reproduction* costs for broadcasting.

Distribution costs will fall into one of four categories: an educational agency may control its own transmitter, meeting the total cost of transmission; it may buy transmission time at the standard market rate; it may have access to transmission time at a favourable rate such as the marginal cost of transmission; it may have access to transmission time free. The costs of distribution may, therefore, rest with the distance-teaching institution or be shared with a broadcasting authority.

In some cases satellite transmission may be a possibility and may compare favourably in cost with terrestrial alternatives. India and Indonesia, for example, have experience through the SITE and Palapa projects of using satellite distribution for education. There are proposals to use direct broadcasting satellites for education in Latin America. Costs for satellite links include the cost of the uplink, from the studio where a programme is initiated, the cost of a transponder or of transponder time, and the cost of the downlink at the point of reception. Except for direct broadcast satellites there are then on-costs for getting the signal from the downlink to the student's individual receiver.

Reception costs will be significant if students have to equip themselves with a television set. If students follow broadcasts together, in a study centre for example, the cost of a receiver may fall on a local agency rather than on the individual or the distance-teaching institutions. The price, and availability, of batteries may be a constraint on the use of radios.

78. Audio and videocassettes offer an alternative way of distributing teaching material in audio or audiovisual form. For relatively small numbers of students it may be cheaper to distribute cassettes than to broadcast. A study at the British Open University found that a television broadcast became cheaper than it would be to lend students videocassettes where there were less than 936 students a year over four years; with less than 527 students it was cheaper to give them the videocassette than to set up a machinery to provide them on loan (Rumble 1988, pp254-5).

There are some *initiation* costs but these may be more modest than for broadcast quality radio and television. Audio cassette masters can be produced using only a high grade tape recorder and a room suitable for use as a studio.

In practice *production* costs for cassettes tend to be lower than for broadcast radio and television as lower technical standards are seen as acceptable.

There are *reproduction* costs for the production of cassettes from a master. The most significant cost element here is the cost of the individual cassettes and is therefore variable. While in principle it may be possible to recoup costs by loaning cassettes and reusing them, this in turn imposes costs for organisation and for carriage.

Distribution costs are involved and vary with the weight and number of cassettes being distributed.

There are likely to be significant *reception* costs as students will need to have, or have access to, a cassette player.

79. Computer links are beginning to be used in distance education. Two kinds of use can be distinguished. In some cases authors have collaborated, using email, so that it is easy for them to work together even if physically separated. The costs in this case are usually a negligible addition to the cost of course development. There is experience of this kind of use within and between developing countries. There is also some experience of the use of

computer conferencing within distance education. Only a limited number of cost studies are available. Early studies of costs found a fivefold increase in actual over planned costs (Eicher 1980, p.15) and that 'the costs of computer-assisted learning schemes are from ten to fifty times higher than those of systems using television' (ibid p.14). A detailed cost study for the British Open University found that the cost per student hour of computer conferencing on a course where it was introduced was £52 in 1988 (1992US$107) (against a planned cost of £24 or $50) and the cost per student/course was £474 ($979) for a total of 1364 students.

Initiation costs depend on the state of development of the computer service within the institution concerned but are in principle relatively high.

Production costs are likely to be high where material is specially produced for computer-based instruction. Where computer conferencing is used principally to enable and encourage interaction among students and tutors, production costs will be more limited.

Reproduction costs are insignificant.

The level of *distribution* costs depends on the access that students and tutors have to a distribution network. Where, as within an institution, they already have access, costs are likely to be borne by the institution so that the individual costs are modest.

Reception costs are relatively high as each student needs access to a computer, a modem and a telephone line. Telephone line charges will be a significant cost in any jurisdiction where a student has to pay more than a local call charge.

80. Table 2 shows how far costs are fixed or variable and where responsibility for meeting them is likely to rest.

81. To conclude, the most important variables for the planner are likely to be the size of the audience and the nature of the face-to-face support and supervision of classroom practice provided within the programme. Where the size of the audience is very large, then media that have relatively high costs may be justified: the cost per study hour of television, for example, may be quite acceptable for an audience measured above 10 000 where it could not be justified for smaller numbers.

Conclusions

82. The world's experience of using distance education for teacher training is yielding a number of consistent conclusions, even while it is defining a new set of research questions. Distance education has been used effectively for many programmes of teacher training, at all levels, and for a variety of different purposes. Programmes have often included a number of different elements, reflecting the various aims of teacher eduction. In this paper we have stressed the importance of classroom activities, and classroom practice, as this has often been the weakest part of such programmes. Integration between the various elements has also been shown to be of critical importance. The careful selection of media is likely to have an effect on quality and will have cost implications.

83. The evidence is consistent that distance education can have economic advantages as compared with other methods of teacher training. In seeking those advantages it is necessary

Table 2: Location and nature of costs for various media

Medium	Features	Location of expenditure		
		Reproduction	Distribution	Reception
Print	Initiation costs can be modest Origination costs fixed; reproduction costs vary with number of copies Level of costs differ widely according to quality of print Can be two-way if assignments included	Instn	Instn	None
TV	Initial installation cost high Production costs fixed Distribution costs fixed for given transmitter coverage Unit cost is likely to be high below 200 000 students then to rise again above 1 million One-way	n/a	Instn but may be shared with broadcast-ing agency	Local institution for group study or student if individual to provide set
Radio	Installation cost relatively high Production costs fixed Distribution costs fixed for given transmitter coverage Cost generally one tenth that of tv One-way	n/a	Instn but may be shared with broadcast-ing agency	Student (e.g. batteries)
Audio/video cassettes	Initial installation cost lower than for radio or tv as no transmitter required Production costs fixed Reproduction and distribution costs vary with numbers One-way	Instn	Instn	Student (e.g. player, batteries)
Computer conferencing	No production cost. Distribution costs dependent on cost of access to telephone network Running costs for institution vary with number of students Multi-way	n/a	Instn/ student	Student

to strike a balance between teaching methods that show economies of scale and those that depend on close interaction between teachers and their tutors or mentors, in which such economies are not possible. Techniques of cost analysis have been developed and widely used which make it possible both to draw up sound plans for teacher education and to calculate the cost per student and cost per successful student. The economic arguments in this paper rest on such cost analysis.

84. There are three major areas in which further research would help to improve practice. The first concerns the ways in which programmes of distance education can most readily be integrated with other activities designed to support classroom teachers and, closely related, the various models for managing, supervising and assessing classroom practice within distance-education programmes (para. 6 and 52 above). Second, there are few studies that have looked at ways to maximise quality, building on what we know both about teacher training and about distance education, and about the relations between alternative educational methodologies and the various competencies which teacher trainees need to develop. We do not know enough about the comparative strengths of different methodologies in changing teacher attitudes and classroom behaviour or in the teaching of particular subjects (para. 36 and 47-8). Third, communication technology is changing rapidly in its availability and its cost. Our planning would be strengthened by fuller information on the transferability and the costs of different communication media (para. 75).

Notes

1. The term 'distance education' is used here as a broad term to embrace programmes, some of which may be described by those running them as 'open learning'. Distance education is defined as 'an educational process in which a significant proportion of the teaching is conducted by someone removed in space and/or time from the learner'. The definition thus includes the many programmes in which there is some face-to-face contact between students and tutors, and work based in and around teaching practice.

2. Following convention the term 'teacher training' is used even though many educators dislike the narrowness implied by the word 'training'. It may often be read as 'teacher education and training'.

3. Part of this section, and certain other parts of the paper, are based on Perraton 1993 by permission of the Commonwealth Secretariat, the copyright holder.

4. It has often been difficult for researchers or practitioners to gather the data needed for rigorous cost analysis. While it would be possible to add to the data sets in table 1, this might be at the expense of the quality of the data. I am not aware of data from less rigorous studies that would contradict the findings set out in this paper.

5. One of the difficulties in such research is to distinguish the effects of particular forms of training from those that relate to longer or shorter periods of classroom experience.

6. A classic review here is Chu and Schramm 1968. A more recent discussion appears in Moore and Kearsley 1996, pp 60-7.

7. A point made to me by the late Dr G Ram Reddy, founding Vice-Chancellor of the Indira Gandhi National Open University

8. The standard formula for annualising costs is in terms of the initial capital cost, *c*, its lifetime in years, *n*, and the discount rate or prevailing rate of interest, *r*. The annualised cost is then given by an annualisation factor, *a(r,n)* multiplied by *c*, where:

$$a(r,n) = [r(1+r)^n]/[(1+r)^n-1].$$

Select annotated bibliography

Asian Development Bank 1987 *Distance education in Asia and the Pacific vols. 1-2* (proceedings of regional seminar on distance education) Manila

Volume 1 has eight general papers including one on finance and cost effectiveness. Volume 2 has five country case studies and twelve country papers including descriptive and statistical data.

Avalos, B 1991 *Approaches to teacher education: initial teacher training*, London: Commonwealth Secretariat

A thoughtful review of world experience prepared as background for the Commonwealth conference of ministers of education in 1990. Includes discussion of the process of teacher training, curriculum, and issues concerning effectiveness and quality.

Avalos, B 1993 *Initial teacher training: South Asian approaches* London: Commonwealth Secretariat

Country papers for Bangladesh, India, Pakistan and Sri Lanka together with an overview

Beeby, C E 1966 *The quality of education in developing countries* Cambridge Mass: Harvard University Press

A classic, well-argued and valuable study of the determinants of quality in education and of the constraints on measures to raise the quality of teacher education

Carnoy, M and Levin, H M 1975 'Evaluation of educational media, some issues' *Instructional Science* 4

A refreshingly sharp and honest account of the difficulties of honest appraisal of projects with a warning against the 'benefit of the doubt bias' that has resulted in over-statements about the power of educational media

Colclough, C and Levin, K 1993 *Educating all the children: strategies for primary schooling in the south* Oxford: Clarendon Press

A study originally prepared for the Jomtien conference of the educational and economic implications of achieving universal basic education

Coombs, P H and Hallak. J 1987 *Cost analysis in education* Baltimore: John S Hopkins University Press

A practical handbook on the techniques of cost analysis, written for educational managers, and based on the experience of the International Institute for Educational Planning and the Economic Development Institute of the World Bank

Dhanarajan, G et al. 1994 *Economics of distance education* Hong Kong: Open Learning Institute Press

The most recent set of papers on the subject, which followed a conference of the Asian Association of Open Universities on the topic. In addition to overview papers there are studies of the economics of various institutions in China, India, Japan and South Korea. Has more about higher education than about other levels.

Dock, A W et al. 1988 *Training teachers through distance methods: an evaluation of a Sri Lankan programme*, Colombo/Stockholm: SIDA

A descriptive and evaluative study of Sri Lankan experience which includes an examination of the effectiveness of the distance-education approahces described.

Dove, L A 1986 *Teachers and teacher education in developing countries* London: Croom Helm

Include discussion both of curriculum and of the planning and management of educational systems. Four of eleven chapters concern teacher education, with discussion of its content and methodology.

Hawes, H and Stephens, D 1990 *Questions of quality: primary education and development* Harlow: Longman

A review of international experience, mainly in Africa and Asia, on practical ways of raising the quality of primary education within the constraints bearing on many educational systems.

Jamison, D T, Klees, S J and Wells, S J 1978 *The costs of educational media* Beverly Hills: Sage

Combines useful and clear accounts of a methodology for costing with costed case studies, mainly of projects using broadcasting, in El Salvador, South Korea, Mexico, Nicaragua and the USA

Lockheed, M E, and Verspoor, A 1991 *Improving primary education in developing countries* Oxford: Oxford University Press

A review of world-wide experience undertaken by World Bank researchers with a wealth of evidence on educational and economic effectiveness based on extensive reviews of the literature. Includes chapters on improving learning achievement and improving the preparation and motivation of teachers.

Mählck, L and Temu, E B 1989 *Distance versus college trained primary school teachers: a case study from Tanzania* Paris: International Institute for Educational Planning

One of the few published comparative studies of alternative methodologies based on Tanzania's experience of running a distance-education training programme for 45 000 teachers

Mingat, A and Jee-Peng Tan 1988 *Analytical tools for sector work in education* Baltimore: Johns Hopkins University Press

A more demanding book than Coombs and Hallak (1987) illustrating the use of economic analysis in educational decision-making. A World Bank publication reflecting its preferred policy options of the late 1980s but providing methods for the tool kit of the education sector analyst.

Moon, B and Mayes, A S 1995 'Frameworks, competencies and quality: Open learning dimensions to initial teacher education and training' in Bines, H and Welton, J M *Managing partnerships in teacher training and development* London: Routledge

Describes the British Open University postgraduate certificate in education, discussing its curriculum, approach to assessment, and structure, with an account of the employment of school-based mentors as a key element in the programme

Nielsen, H D et al. 1991 *The cost-effectiveness of distance education for teacher training* (Bridges research report no. 9) Cambridge Mass: Bridges Publications, Harvard

A comparative study based on research in Indonesia and Sri Lanka and, in each country, looking at costs and outcomes of alternative approaches to teacher training. The report forms the basis of one chapter in Perraton 1993

Orivel, F 1987 'Costs and effectiveness of distance teaching systems: a methodological approach' (mimeo) Dijon: IREDU, Université de Bourgogne
Sets out a framework for the economic analysis of projects using distance education which has formed the basis for much later work

Perraton, H 1982a *The cost of distance education* Cambridge: International Extension College
A short summary of the evidence available at the time on costs, in both industrialised and developing countries, together with some discussion of the methods used

Perraton, H 1993 *Distance education for teacher training* London: Routledge
An international review, commissioned by the Commonwealth Secretariat and the Commonwealth of Learning, with three overview chapters and case studies on work in Australia, Britain, Brazil, Indonesia, Kenya, Nepal, Nigeria, Pakistan, Sri Lanka, Tanzania, and Zimbabwe

Schiefelbein, E and Simmons, J 1981 *Determinants of school achievement: a review of research for developing countries* Ottawa: IDRC
A short summary of the findings of research literature on factors affecting school effectiveness, including discussion of teacher training

Taylor, D C 1983 'The cost effectiveness of teacher upgrading by distance teaching in Southern Africa' *International Journal of Educational Development* 3:1
Examines the data then available on the comparative effectiveness of conventional and distance-education approaches to teacher training with particular reference to Kenya, Lesotho and South Africa

Unesco 1970 *Better teachers,* Paris: Unesco
An early account of Unesco/UNICEF experience of using distance education for teacher training in Palestinian refugee camps

Unesco 1977 *The economics of new educational media (vol.1): Present state of research and trends,* Paris: Unesco
Unesco 1980 *The economics of new educational media (vol.2): Cost and effectiveness,* Paris: Unesco
Unesco 1982 *The economics of new educational media (vol.3): Overview and synthesis*, Paris: Unesco
These three volumes include general discussion of costing methodology, reviews of the evidence on cost in projects using communication technology of various kinds, and summary case study data.

Young, M et al. 1980 *Distance teaching for the third world* London: Routledge (second edition 1991 Cambridge: International Extension College)
A general account of the role and potential of distance education with one chapter on teacher education

Other references in text

Ansari, M M 1993 'Economics of distance education in India' in Asian Association of Open Universities *Economics of distance education* Hong Kong: Open Learning Institute
Bako, C I and Rumble G, 1993 'The National Teachers' Institute, Nigeria′ in Perraton 1993
Bates, T 1982 'Options for delivery media' in Perraton 1982
Bih-jen Fwu et al.1992 'The National Technological University' in ed. Rumble, G and Oliveira, J *Vocational education at a distance* London: Kogan Page
Brophy, M and Dalgety, F 1980 'Training science teachers in Guyana', *Teaching at a distance* 17
Chivore, B R S 1993 'The Zimbabwe Integrated Teacher Education Course' in Perraton 1993
Chu, G C and Schramm, W 1968 *Learning from television: what the research says* Stanford: ERIC
Curran, C 1990 'Factors affecting the costs of media in distance education' in Bates, A W *Media and technology in European distance education* Heerlen: EADTU
Deakin University 1989 *Further investigations into activity costing in a mixed mode institution* Canberra: Department of Employment, Education and Training
Djalil et al. 1994, 'The financing system of the Universitas Terbuka' in Mugridge 1994
Eicher, J-C 1980 'Some thoughts on the economic analysis of new educational media' in Unesco 1980
Harman, E J 1991 *The cost of distance education at Australian Distance Education Centre*s Canberra: Department of Employment, Education and Training
Hawkridge, D et al. 1982: 'In-service teacher education in Kenya' in Perraton 1982
Horlock, J H 1984 'The Open University after 15 years' Paper read to the Manchester Statistical Society, 17 January 1984 (mimeo)
Hudson Report 1986 *Review of efficiency and effectiveness in higher education: report of the committee of enquiry* Canberra: Commonwealth Tertiary Education Commission
Jamison, D T 1982 'An introduction to the methods of cost analysis' in Perraton 1982
Jevons, F R 1982 'How different is the distance student' in ed. Daniel, J S, Stroud, M A and Thompson, J R *Learning at a distance: a world perspective* Edmonton: Athabasca University/ICCE
Robinson, B and Murphy P 1996 'Costs and effectiveness of in-service primary teacher education through distance education: a comparative study' forthcoming
Katz, E and Lazarsfeld, P F 1964 *Personal influence* New York: Free Press
Kulandai Swamy, V C and Pillai, C R 1994 'Indira Gandhi National Open University: a case study' in Mugridge 1994
Moore, M G and Kearsley, G 1996 *Distance education: a systems view* Belmont: Wadsworth
Mugridge, I 1994 *The funding of open universities* Vancouver: Commonwealth of Learning
Muta, H and Sakomoto, T 1989 'The economics of the University of the Air in Japan revisited' *Higher Education* 18:5
Nielsen, H D, and Tatto, M T 1993 'Teacher upgrading in Sri Lanka and Indonesia′ in Perraton 1993
Open University1991 *Review of the Open University: Conducted by the Department of Education and Science and the Open University* Milton Keynes: Open University
Perraton, H 1982 *Alternative routes to formal education: distance teaching for school equivalency* Baltimore: Johns Hopkins University Press
Perraton, H 1994 'Comparative cost of distance teaching in higher education' in Dhanarajan et al. 1994
Robinson, B and Murphy, D 1996 'Costs and effectiveness of in-service primary teacher education through distance education: a comparative study' (forthcoming)

Rumble, G 1989 'On line costs: interactivity at a price' in ed. Mason, R and Kaye, A *Mindweave* Oxford: Pergamon
Rumble, G 1992 'The comparative vulnerability of distance teaching universities' *Open learning* 7:2
Rumble, G 1988 'The costs and costing of distance/open education' in Jenkins, J *Commonwealth cooperation in open learning: background papers* London: Commonwealth Secretariat
Setijadi 1987 'Distance education in Indonesia' in Asian Development Bank 1987
Sheath, H C 1965 *External studies - the first ten years* Armidale: University of New England
Wei Runfang and Tong Yuanhui 1994 *Radio and tv universities: the mainstream of China's adult and distance education* Nanjing: Yilin Press
World Bank 1995 *Priorities and strategies for education: a World Bank review* Washington D.C.

Table 1: Some costs and success rates for teacher training and tertiary-level distance education

Country, institution and date of studies	GNP per capita 1992 US$	Approx annual enrolment	Cost in per student per annum	1992US$ [a] per graduate or successful course completer	Measure of success measures used	rate %	Comparison between distance and conventional education
Australia: Deakin University 1989 [b]	17,483		2,614 [c]				Cost per student 97.5% of cost of on-campus student
Australia: 8 Distance Education Centres 1990 [d]	17,483	2,750 - 9,125 [e]		4,417 - 6,735			Recurrent costs per external student 1-10% lower than internal
Britain: Open University 1989 [f]	17,790	25,000	2,342	15,834 ord BA 22,160 hons BA			Cost per graduate lower than cost at conventional university [g]
Costa Rica: Universidad Estatal a Distancia 1980 [h]	1,960	8,150	1,276				Cost per student lower than at conventional universities; cost per credit comparable with larger conventional universities
India: Indira Gandhi National Open University 1991/2 [i]	310	52,000	116		Graduation rate	22.5	Cost per student between 8% and 40% of costs at conventional universities but comparable performance rates of latter are in range 55-60%
Indonesia: Open University teacher training 1988/89 [j]	670	5,000	678				Cost about 60% of conventional course
Japan: University of the Air 1989 1992 [k]	28,190	3,600	2,101	23,233			Cost per graduate lower than at national university but higher than private or correspondence programme
Kenya: University of Nariobi BEd 1989 [j]	310	151	923				Cost thought to be lower than cost of full-time equivalent
Nigeria: University of Lagos COSIT 1988 [j]	320	2,000	294 [c]	1,098			Cost slightly lower than cost on campus

Pakistan: Allama Iqbal Open University Primary Teachers Orientation Course 1976/86 [j]	420	8,360		91-125	Successful completion rate	37.9	Cost per AIOU graduate 45-70% of conventional
Sri Lanka: National Institute of Education 1974/88 [j]	540	5,000	98				Costs 1/6 to 1/3 of alternative
Tanzania: Teacher training at a distance 1979/84 [j]	110	15,000	1,569	6,162	Successful completion rate	93	Cost about half conventional education
Uganda: Mubende Integrated Teacher Education Project 1991/95 [l]	170	900 [m]	521	4,525	Successful completion rate	34	Cost 17% higher than for conventional institutions
USA: National Technological University 1989/90 [n]	23,240	3,640	3,366		Course completion rate	85	Breakeven point at enrolment 9,000 students on 200 courses

Notes

a Costs based on those in Perraton 1994, where they were in constant 1988 US$, generally converted by using the exchange rate into $ for the year being reported and then converted to 1988$. Costs now converted to 1992$, using the USA GDP deflator shown in World Bank *World Tables.*

b Deakin University 1989

c Recurrent costs only per full-time student equivalent

d Harman 1991. Enrolment and cost figures are for full-time equivalent student units; for conversion purposes they are treated as 1989 data

e Figures appear to be total full-time student equivalent, not annual

f Open University 1991

g Horlock 1984 calculates cost at 62% cost arts degree at conventional university with OU graduation rate of 57%. His calculations give a cost per graduate in 1981/82 of 1992$17,279

h Perraton 1982a pp 30-1 (where fuller references are cited)

i Ansari 1993, taking his reference to perfomance as a graduation rate, and Kulandai Swamy and Pillai 1994

j Perraton 1993 pp 386-7

k Rumble 1992 and Muta and Sakomoto 1989, taking their figures as in 1985 currency

l Robinson and Murphy 1996. I am indebted to the authors for permission to quote from this draft study. These costs converted from 1994 to 1992 $$ using the US CPI index.

m Total enrolment for the single cohort of students over a three-year period was 900.

n. Bih-jen Fwu et al 1992. The cost per student is for a 3-unit course, apparently stated in 1989$ in original

Table 2: Location and nature of costs for various media

Medium	Features	Location of expenditure		
		Reproduction	Distribution	Reception
Print	Initiation costs can be modest Origination costs fixed; reproduction costs vary with number of copies Level of costs differ widely according to quality of print Can be two-way if assignments included	Instn	Instn	None
TV	Initial installation cost high Production costs fixed Distribution costs fixed for given transmitter coverage Unit cost is likely to be high below 200 000 students then to rise again above 1 million One-way	n/a	Instn but may be shared with broadcast-ing agency	Local institution for group study or student if individual to provide set
Radio	Installation cost relatively high Production costs fixed Distribution costs fixed for given transmitter coverage Cost generally one tenth that of tv One-way	n/a	Instn but may be shared with broadcast-ing agency	Student (e.g. batteries)
Audio/video cassettes	Initial installation cost lower than for radio or tv as no transmitter required Production costs fixed Reproduction and distribution costs vary with numbers One-way	Instn	Instn	Student (e.g. player, batteries)
Computer conferencing	No production cost. Distribution costs dependent on cost of access to telephone network Running costs for institution vary with number of students Multi-way	n/a	Instn/ student	Student

Figure 1

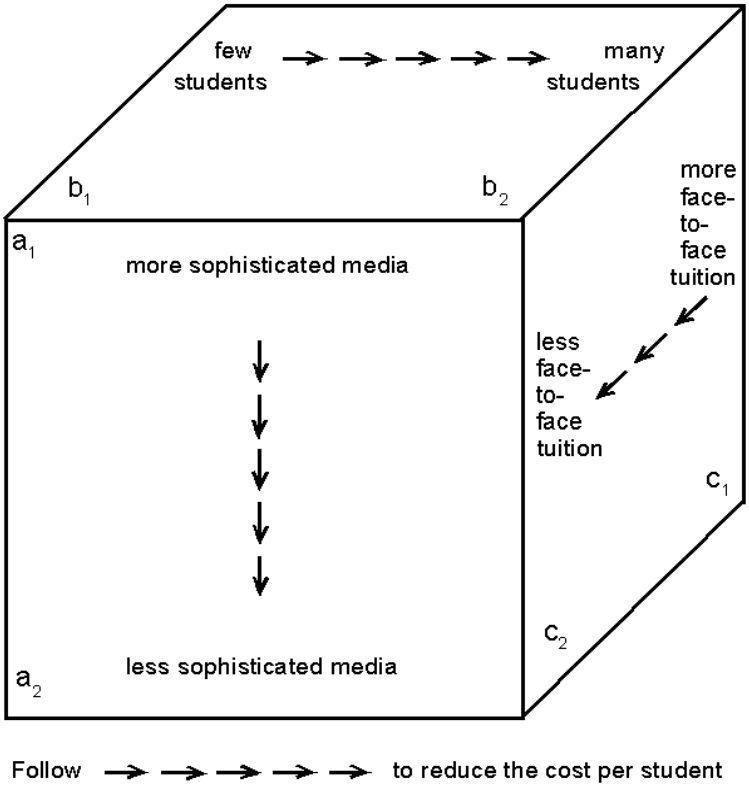

Figure 1: Cost behaviour in a distance-education course