Chapter 19: Critical Issues in the Distance Teaching of Mathematics and Mathematics Education

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ABSTRACT

Distance modes of teaching and learning have proved to be increasingly popular, worldwide, during the last three decades of this century, especially in the areas of mathematics and mathematics education. This chapter critically examines the distance education phenomenon in relation to several key variables: the nature and purposes of both mathematics and distance teaching; the current and potential roles of computer technology in the flexible delivery process; and the particular implications of these factors in relation to interactions between so-called 'developed' and 'developing' countries. Case studies of current practice are presented to exemplify several of these key issues in relation to course development and delivery. Finally, a framework for future discussion is provided in the form of eight possibly contentious propositions which call for stronger theoretical and practical relationships to be developed between educators in the fields of distance education, mathematics and mathematics education.

1. CHANGING CONCEPTS OF DISTANCE EDUCATION

In the mid-1980's Keegan (1986) defined distance education as a form of education with the following five properties:
1) The physical separation of teacher and learner throughout most of the learning process – although occasional face-to-face meetings between students and tutors may occur;
2) the influence of an educational organisation in the planning and preparation of learning materials for the provision of student support services;
3) the use of media for the delivery of learning content;
4) the provision of two-way communication; and
5) the absence of the learning group so that people are usually taught as individuals and not in groups.

Interestingly, the magnitude and rate of conceptual change in the field of distance education has been sufficiently great that although each of the above five properties is still, to a certain extent, pertinent, taken as a whole, the five properties no longer provide an adequate description of what contemporary distance educators are trying to achieve.

Although the first and the fifth properties emphasise physical separation, taken together the two properties tend to give a wrong impression of where contemporary distance education is moving – because, with advances in interactive videoconferencing the physical separation of learner and teacher is no longer necessarily a feature of distance education. The second property called for a strong curriculum and course design components for distance education programs, but some distance educators – see, for example, Ellerton and Clements, 1990 – eschew hierarchical centre-to-periphery models of distance education which emphasise the need for 'professional' course designers to work with 'expert' course teams at the curriculum design and developmental phases. The third and fourth properties imply the use of transmission modes of learning, supported by teacher/lecturer feedback, but many distance educators are now calling for less teacher-directed, yet more interactionist, forms of distance education.

There are still many educators who think of distance education as a motley collection of 'second-best' correspondence forms of education which are adopted to overcome barriers which restrict educational parity between urban centres and remote communities. However, as Kia (1995) has pointed out:

> As distance learning technologies have evolved, it has become apparent that the audio and visual capabilities and the one-to-one interactivity offered by many of today's state-of-the-art technologies can have a much greater impact on the learning process than any individual teacher can achieve in a traditional classroom. As a result, distance learning is not only viewed as the best method to deliver quality education to rural and remote communities, but the best method to deliver quality education, period.

Kia's statement bears ample testimony to the fact that some educators tend to become excited when they reflect on the potential of harnessing hi-tech multimedia developments to education, and especially to policies and practices in the realm of distance education.

There is no shortage of impressive data, though, to support the contention that the future of education will be with the evolving methods and concepts of distance education. In this Internet age – with communication satellites circling our globe and such ideas as videoconferencing, electronic mail, and virtual campuses no longer in the realm of science fiction – distance education, it seems, presents unparalleled opportunities for making the world a better

place for more people. Never before has it been possible to bring together so many people, in so many parts of the world, so quickly and so easily.

At the tertiary level, for example, there has been a dramatic increase in the use of forms of distance education, so that today, less than thirty years after the establishment of the Open University in the United Kingdom (Perry, 1972), the ten largest universities in the world use distance methods as their major mode of operation. Modern communication systems, assisted by dazzling advances in technology, enable profitable links to be established between students on the same campus, or between students at different locations. It is relatively easy for students to interact, through technology, with other students anywhere in the world. Indeed, the establishment of a global campus, linked by internationalised curricula (Oldham, 1989), is a vision held by an increasing number of educators.

Even a cursory glance at advertisements on the Internet for tertiary education programs will draw attention to the large number of 'paper-free' academic courses which have been developed. Prospective students are being told that all they have to do is to enrol in a course, and they will then be able to qualify for higher degrees without ever having to put pen or pencil to paper (Clements, 1996). The enrolment itself can be completed electronically, course fees can be paid electronically, the syllabuses and text 'books' can be communicated electronically, and all assessment tasks can be submitted electronically. Comments by lecturers who assess students' submissions would be conveyed to the students by electronic means. Throughout the course students would be able to interact with each other, and with their lecturers, electronically.

The high profile which has been accorded by educators and politicians to the hi-tech gadgetry of distance education can be misleading, however. It needs to be remembered that in the mid-1990's most of the world's distance education is still carried out almost totally through the print medium, complemented occasionally by radio, audiotapes and, perhaps video-tapes (Purwanto, 1995). Difficulties of access can be associated with social, cultural as well as geographical factors and some are related to the particular needs of disabled or disadvantaged students. Distance education has a role to play with respect to meeting these needs.

1.1   From Open Universities to Open Schooling

Since early in the 20th century, and probably before then, various forms of distance education have been developed to cope with the needs of school-age pupils living in remote regions (Mukhopadhyay, 1995). However, the development of new multi-modal forms of distance education suggest that the earlier dominance of the print medium is gradually giving way to interactive technologies and learning modalities within an overall framework of multi-

channel learning. The traditional concept of a school as a fairly insular institution where groups of 30 to 40 students are taught by one teacher in one room, for 5 hours a day, is likely to become obsolete – even in large cities.

In 1994 in the State of Victoria (Australia), for example, all government primary and secondary schools were fitted with satellite dishes and decoders to access curriculum delivered by interactive satellite television – a new form of education at a distance. The network, called 'SOF Net', is used to disseminate programs in three categories: curriculum, corporate information, and teacher professional development. It is intended that in Victoria, systems of computers will be installed in all classrooms in government schools (Peck, 1995).

It would be foolish, however, to assume that solutions to education problems in one country or context are appropriate to other countries or contexts. Syarief and Seligman (1995), in commenting on efforts to provide hi-tech answers to the problems of increasing participation in junior secondary education in Indonesia stated:

> Looked at from [the perspective of] a developing country it appears to be a good solution – for somebody else. It is too hi-tech, too expensive and totally inaccessible to the vast majority of children, even if the infrastructure for provision was there.

The same point was made, graphically, by Hareng, Ali, Sadjad and Johari (1995), who described education systems in Eastern Indonesian States:

> In the mid-1980's, a USAID-assisted project called the 'Rural Satellite Project' determined to use an interactive audio-conferencing system together with an interactive graphic system and a dial-up telephone system to assist Eastern Indonesian universities to reach students in more effective ways.

However, according to Hareng et al. (1995):

> The system was totally designed without any involvement of the local technical team. The original designed system consisted of pieces of equipment granted by USAID which turned out to be inappropriate choices for the environment. Thus, in the later phase, we are forced to redesign the system to use full indigenous technology, appropriately. From experience we learned that local equipment... has been more appropriate.

> In fact, the original system lasted for a year only – the graphic system did not function at all – before a local technical team moved to develop new equipment to meet the specific needs of the project.

Clearly, such examples are needed to counter the rhetoric coming from technocrats who believe that schools as we know them will not be needed in the new millennium.

An article published in Malaysia's major national English-language newspaper, the *New Straits Times*, on August 23, 1995, informed readers that sixth-grade school children living in remote parts of Iowa, in the United States of America, were participating in education programs which enabled them, through the use of advanced fibre-optic networks, to provide interactive voice and video links between classrooms and instructors hundreds of kilometres apart. The children were talking directly with NASA rocket scientists and engineers.

Readers were told that this was but an illustration of future trends in education. A technology analyst of Link Resources Corporation was quoted as saying that 'it is the calm before the storm', and that what was beginning to happen in distance learning 'mimics the movements in PCs in schools in the mid-80's'. A Sony Corporation representative was quoted as saying that various companies were determined to cope with the demand, and that despite the massive competition, Sony Corporation expected to sell US$25 million in distance education equipment per year by the year 2000 (up from US$15 million in 1995). Some idea of the scope and pace of expected change could be gained from the fact that although in 1995 only 17 schools in the State of Indiana were 'on line' for fibro-optics programs, it was hoped that within six years over 500 schools in that State would be wired. The cost would range from US$25 000 to US$40 000 per classroom.

Although the anticipated costs were large, school systems in the United States were, the *New Straits Times* article stated, determined to go ahead. This was because they recognised that the new technology would provide students with learning opportunities which previously had not been available. Thus, for example, Spirit Lake High School, in Spirit Lake, Iowa, which, had not offered Russian language classes for two years because of cost considerations, was now once again offering Russian classes – this time with the aid of the fibre-optic network, which enabled Spirit Lake students to tune into a Russian language class being held at Marshalltown High School, 410 km away, in Des Moines.

The *New Straits Times* article made one thing particularly clear: no longer were the startling advances in distance education being confined to tertiary education. Schools in developed countries were also prime targets for ambitious education policy makers keen to display their ability to incorporate the latest expensive hi-tech gadgetry into school systems. In the late 1990's there is an international shortage of teachers qualified to teach senior secondary mathematics classes, and some education makers have already moved to use satellite technology to beam the same standard senior mathematics lessons into schools across a state or a nation (Peck, 1995).