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## **Three generations of technological innovations in distance education**

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Technology and distance education are inextricably linked. This link is evident considering the “use of technical media” is one of the essential characteristics of distance education (Keegan, 1983). This is not surprising, however, since two other essential characteristics suggested by Keegan (1983) are the “separation of teacher and student” and the “provision of two-way communication”. In fact, given this non-contiguity and the need for teacher-student interaction, it is a virtual tautology to say that media are essential in distance education. The essential nature of mediated communication to distance education emphasizes the need to understand the impact that new technologies have had on distance education delivery methods.

Holmberg (1982) has suggested that attempts to create a taxonomy of media in distance education have been in vain. The fact is that few schemes ordering media in distance education have gone beyond a simple listing of media and their attributes. Perhaps what is required is an analysis of media conducted from the perspective of key concepts in distance education. The focus should be on distance education and which technological innovations have caused significant shifts in the assumptions and concepts of distance delivery. By identifying shifts in the conceptualization and delivery of distance education perhaps a structural simplicity and clarity regarding its technological development may be realized.

It will be argued that the development of distance education can be structured into three generations of technological innovation - correspondence, telecommunications, and computers. The technological innovations and resulting paradigm shifts in the delivery of distance education will be analyzed through the concepts of interaction and independence.

p. 235

These concepts in turn will Provide the dimensions for a typology of media consistent with the suggested generational shifts in distance education delivery. Such structures and typologies could assist distance educators to better understand the essential characteristics of distance education and the selection of media for delivery.

### **THREE GENERATIONS**

It is important at the outset to explain the use of the term, generation, in describing the development of distance education technology. Generation is used to suggest the building upon previous capabilities. The development of the generations of distance education represents, in systems terminology, a hierarchical structure with an increasing differentiation of technological capacity for integrating unique delivery systems. In other words, new media can be combined with older media to provide a greater range of choice for the design of effective distance education delivery systems.

#### **Correspondence Generation.**

The first technology of distance education was realized by combining the printed word and the postal system as a medium of two-way communication. Correspondence education represents a significant shift from face-to-face interaction in the delivery of traditional instruction. Although newspaper references to correspondence lessons date back over 250 years, the first advertisement of correspondence education documenting two way instructional activity dates back to 1833 (Bååth, 1985). Correspondence education is still likely the most prevalent form of distance education today.

Correspondence studies provide educational opportunities to vast numbers of people by providing the freedom to choose when and where to study. In addition, this form of mass instruction can be very cost effective. On the down-side, however, two-way communication between the teacher and student is dependent upon the mail and therefore the response rate is potentially slow and ponderous. A slow rate of interaction places added burdens upon the correspondence student. It necessitates the student having a strong desire to complete the course successfully. Considering these disadvantages, it is not surprising that distance education was quick to adopt other means of increasing the rate of interaction between the teacher and student.

### **Telecommunications Generation.**

The term, telecommunications, refers to the "use of wire, radio, optical or other electromagnetic channels to transmit or receive signals for voice, video, and data communications" (Olgren & Parker, 1983: 330). In short, telecommunications refers to the electronic transmission of communica-

p.236

tions over a distance. The use of telecommunications in distance education includes the telephone and teleconferencing (audio, video and computer).

The use of the telephone by a teacher for instructional purposes is perhaps the most personalized use of telecommunications in distance education. However, telephone-mediated interaction between the teacher and student as a prime method of distance delivery carries with it two concerns. Although telephone tutorials with the teacher are very desirable, they violate a distance education characteristic in that they can "be used by great numbers of students" and are a form of mass communication (Holmberg, 1985: 2). More importantly, however, a one-on-one telephone lesson by the teacher is just not very practical. The time constraint placed upon the teacher does not make this a viable method of distance delivery. Another form of telephone tutorial is the use of tutorcounsellors to direct and assist the student in place of the teacher. They can be contacted by phone to assist in academic and personal concerns on an individual and regular basis. This is a very common and effective use of telephone interaction in distance education.

The use of telecommunications to facilitate two-way voice communications among three or more individuals at a distance characterizes audio teleconferencing. Although audio teleconferencing dates back to the thirties (Olgren & Parker, 1983), it has only been since the late sixties that serious efforts were made to use this technology in distance education. The use of audio teleconferencing marked a significant innovation in the delivery of distance education.

With the introduction of teleconferencing technology, the agonizingly slow interaction of correspondence study was overcome dramatically. It did not necessarily mean, however, that the carefully prepared print materials would be redundant. Audio teleconferencing built upon the foundation of correspondence study by enhancing the quality of the interactive process among students and teacher. The ability of the student to receive immediate feedback from the teacher as well as fellow students without a corresponding loss of independence is a significant development in distance education. Although teleconferencing is often organized in local centres which can provide added interaction and support from other students it also means some travel to "class". It must also be realized that opportunities for interaction using audio teleconferencing are usually possible only during scheduled times and therefore are discontinuous.

Increasing the frequency of these teacher/student interactions can be, as has been mentioned, accomplished by using one-on-one telephone tutorials. Another method of avoiding the difficulties of contacting a busy instructor directly is with the use of computer teleconferencing. With the proper hardware, electronic mail can be sent and received at the conven-

p.237

ience of both the student and instructor. The rate of response may be delayed somewhat but the interaction is far more regular.

A third form of teleconferencing is realized by combining two-way audio and video media. The resulting system, video teleconferencing, has not received wide use in distance education due to the cost and various problems linking multiple

locations (Olgren & Parker, 1983). One relatively cost effective system is to use one-way video and two-way audio, although this is not considered a fully interactive video teleconference.

The advantages of video conferencing are obviously the visual component which may be necessary for many courses. Video conferencing can enhance the quality of the interaction but the question is whether it is significant enough to justify the costs. It should also be noted that, due to the special equipment required, it would likely mean fewer locations and considerable travel on the part of the student. Given the limited gain in quality of interaction and the loss in independence, it would seem that considerable justification is required for its use. One way audiographics such as slow-scan television and electronic blackboards can be combined with audio teleconferencing in a much more economical system compared with fully interactive video teleconferencing.

### **Computer generation.**

Dramatic new possibilities are open to distance education through the capabilities of computer assisted learning (CAL). After 25 years of research it has been concluded that CAL can be a more efficient or effective means of instructional delivery than traditional face-to-face instruction; in addition, we "have just scratched the surface of what can be accomplished with computers in education" (Kearsley, Hunter & Seidel, 1983: 90). Significant progress has also been made in the area of "intelligent" CAL courseware that can simulate a patient and understanding teacher in a very sophisticated manner. At the same time, the use of CAL in distance education is still only at the experimental stage. Only in the last few years have serious efforts been made to implement this technology.

With this technology, getting the mix of interaction and independence right may not necessitate combining more of one at the expense of the other. In fact, it is possible to maximize both interaction and independence in the delivery of education at a distance. Through microcomputer-supported CAL it is possible for a student at a distance to maintain virtually complete independence and yet experience quality two-way interaction characterized by learning diagnostics and feedback.

Consideration of CAL's Potential in distance education requires going beyond the restrictive view that interaction is mediated person to person communication. Under this definition, activities such as CAL are not

p.238

considered interactive. Distance educators must appreciate that interaction in CAL "is not *with* the computer so much as *through* the computer" (Jones, 1984: 50). It must also be realized that CAL is designed with great care, usually by a highly-qualified design team. Communication is mediated in ways similar to that of an author through print media but with the tremendous added advantage of the students being given immediate feedback regarding their active responses to the lesson. Intelligent CAL has powerful diagnostic and feedback capabilities rivalling those of a master teacher.

Store and Armstrong (1980: 150) provide a broad definition of feedback as "that process of communication which provides information on how well a task has been performed or an objective has been achieved". This type of feedback is well within the capabilities of good CAL courseware. Five characteristics of good feedback are immediacy, regularity, explanation, conciseness and clarity (Store & Armstrong, 1981). It is clear that these characteristics of good feedback could be provided by CAL effectively and efficiently in many distance education situations. Further, these characteristics represent the essentials of quality interaction with regards to the acquisition of knowledge. Therefore it must be concluded that CAL is capable of effective two-way communication in the delivery of education at a distance.

It would appear, given the apparent capabilities of computers in delivering distance education, that considerable research into the implementation of these systems in distance education is needed. In a discussion of micro-computers, (Daniel (1983: 395) states that "Distance education has scarcely begun to plan for the opportunities and threats that the development of these stand-alone domestic systems present. If we are to understand and take the opportunity that computer-based education is offering, we must broaden our perspective of communication in distance education.

### **Ancillary media.**

Before leaving this discussion of technological innovation in distance education it is important to state why other media are not considered to have significantly altered the delivery of distance education. The main reason is the non-interactiveness of

media such as radio and television broadcasts, audio and video cassettes, laser videodiscs, and audiographics. For this reason, these media are viewed as being in a separate category, since they are incapable of providing two-way communication.

Considering the essential nature of two-way communication to distance education, broadcast media cannot be seen to have radically changed the technology of distance delivery. This is also true of other devices such as audio cassettes, video cassettes, and laser videodiscs. Notwithstanding

p.239

this, however, when a device such, as the laser videodisc is married to a micro-computer an extremely powerful technology is created. The extensive audio and video storage and random access capabilities of laser videodiscs controlled by a micro-computer can provide a fully-interactive quality learning technology. Computer stored and controlled explanations and questions can be combined with audio, photographs, and moving pictures on the videodisc. Such technologies demonstrate the exciting prospects for distance education as we enter the computer generation of distance delivery.

Figure 1 is an attempt to order various distance education media within the context of interaction and independence. Although this can only be considered a general approximation, the inter-relationship of various media along the dimensions of interaction and independence can be determined. The extreme positions from the origin (low interaction/low independence) that correspondence, teleconferencing, and CAL occupy argues for the significant shifts in the technological development of distance education presented in this paper.

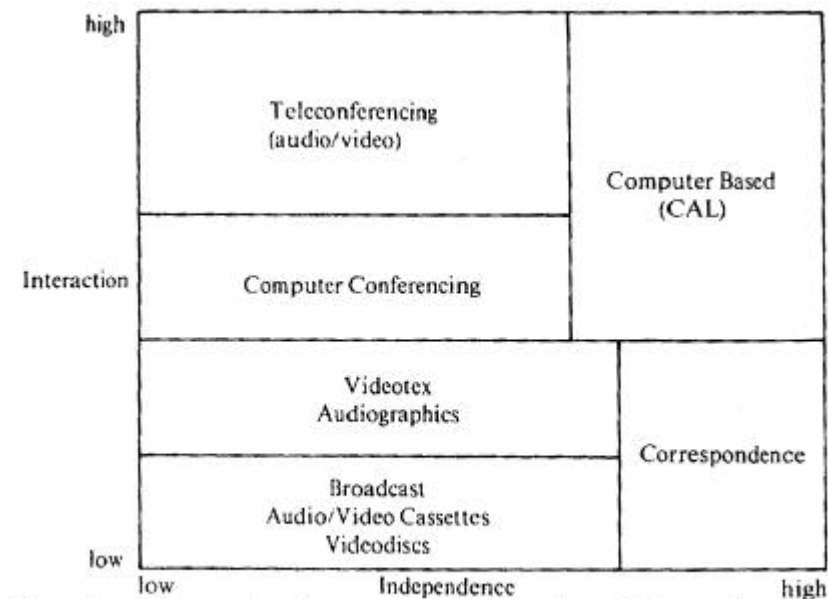


Figure 1. Distance education media as a function of interaction and independence.

**Summary.**

After establishing the premise that media plays an essential role in distance education, the development of this field was analyzed from the perspective of technological innovation. It was suggested that paradigmatic shifts have occurred in distance education particularly with regards to the

p.240

concepts of interaction and independence. The first and seminal conceptual shift in the delivery of instruction occurred when it was realized that educational interaction need not be face-to-face but could be mediated via correspondence. Although there are serious disadvantages in terms of the response rate, it does offer freedom as to when and where to study. With the advent of telecommunications it was seen that person-to-person interaction could be mediated electronically. The marginal loss in independence inherent in telecommunications use was easily offset by the great advantage of immediate feedback; however, it should be noted that the amount or regularity of interaction is often not sufficient or in the control of the learner. Finally, we are currently experiencing a conceptual shift with regards to the simulated structured interaction of computer-based instruction. With this technology we gain a new perspective in that feedback can be immediate and regular without, theoretically, any serious loss of independence.

Resulting from this analysis was the proposition that the development of distance education could be viewed in terms of three generations of technology - correspondence, telecommunications, and computer. A secondary outcome was an ordering of distance education media based upon the concepts of interaction and independence. It is hoped that this analysis and the resulting typologies will provide some assistance in understanding the important characteristics of distance education media.

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