Continuing Professional Education Through Mixed Media in the Distance Learning Mode

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THE NEED

The explosion of knowledge and the consequent rapid obsolescence of technology have created an urgent need in most countries to modernise their traditional education and training systems to cater to the professional developmental needs of the new information age society. The problem can be characterised in the following way :

- The employability of the youth directly out of general education systems is not very high, partly because, as a general rule, the prescribed curricula for most humanities and social sciences, the general sciences, and even for professional courses are broad and often out of tune with societal needs.
- Lack of adequate and sufficiently flexible opportunities for lifelong learning, while in employment, to keep one's knowledge and skills updated to match the demands of the society, often lead to losses for both the employer and the employee.
- Shortages of suitably trained human resources in many key sectors of industry and commerce continue to hamper national progress.

CONTINUING PROFESSIONAL EDUCATION: GENERAL OBJECTIVES

The apparently paradoxical presence of a large number of unemployed and underemployed people, simultaneously with noticeable shortages of suitably qualified professionals in specific areas, is a problem that can be handled quite effectively using the modern tools of educational technology. This involves designing and developing curricula and instructions based on appropriate needs analysis techniques and fundamental principles of learning, as well as delivering and managing instructions using appropriate technological aids.

For educational planners and administrators an important task is to develop a system of lifelong learning which anticipates and most effectively meets the ever changing human resource needs of a country. Creating adequate opportunities for vertical mobility, that is, progression in the same discipline through further specialisation, and horizontal mobility, that is, progression through reorientation to a different discipline, are the twin general objectives of a good continuing education system.

One of the most important features of such a system would be its ability to cater to individual differences among learners. Thus the education system should be highly flexible, in terms of choice of content, learning style, venue, time, and duration. Creating and retaining motivation also play significant roles.

CONTINUING PROFESSIONAL EDUCATION: ACADEMIC FRAMEWORK

Mode of Learning

Research data from around the world confirm the age-old view that the effectiveness of learning by small groups of motivated students under collaborative learning conditions is extremely high (Hillborn 1994). Such motivation is strengthened if a course of study successfully completed in this way leads to a recognised qualification which is useful for career advancement. The value of the qualification naturally depends on its acceptance by the society and the prestige associated with it.

Continuing professional education, designed to benefit a reasonably large population scattered over considerable distances, as in a country like India, will, of necessity, have to be conducted as open and distance learning. If the concept of small group collaborative learning is to be implemented in the open and distance mode, then sufficient

numbers of suitably equipped study centres within easy reach of the target population will also need to be established.

Choice of Media

Rapid developments in information and communication technologies have made the process of coding, storing, transmission, and retrieval of bulk information cheaper, faster, and easier. As a consequence, the use of electronic media for the development of distance education material is expected to become increasingly popular. It is also obvious that the print medium is going to remain in use alongside the electronic media for the foreseeable future. If fine distinctions are made between audio and radio and between video and television, then the possible range of media would include computer assisted instruction and the print medium in addition. However, for most professional education, only audio without video may prove too restrictive. The media choice therefore is reduced to video or television, or both, plus the print medium and computer assisted instruction (a term used in this text to include both computer assisted learning and computer based training). At this point it becomes necessary to assess the relative importance of each of these media in the context of small group collaborative distance education for professionals. The relative advantages of video and television media are considered first.

Video Based Education System

The pioneering work of J. F. Gibbons at Stanford University in California (1977, 1986) begun in the early 1970s, on the use of video course material for distance education as well as the research studies of Harvey Stone (1987) in this field are worth reviewing to get a better insight of the issues involved. The practice of live telecast of engineering courses given on the campus, for the benefit of off-campus students working in industry, has been in existence for many years. At Stanford University, this practice has been known as "instructional television fixed services" (ITFS).

Tutored video instruction (TVI), conceived by Professor Gibbons in the early 1970s was initially meant to cater to small groups of off-campus students residing outside the ITFS broadcast range. Live classes were video recorded and sent by courier service the same day to plant-sites where small groups of students could view and discuss the videotaped lectures in the presence of a local "tutor". The function of the local tutor was to encourage the students to view the tape for about ten minutes at a time and then to help them clarify their doubts through group discussions for about three to five minutes before proceeding on to the next segment of the video lecture.

Both ITFS and TVI students were allowed to register for credit options and could accumulate course credits leading to the Master's degree in engineering from Stanford University. All off-campus and on-campus students had to complete the same assignments and appear in the same examinations to earn the necessary credits.

Based on the analysis of the comparative performances of the on-campus TVI students, the ITFS students and the students in the real class over a variety of courses and over an extended period of time, Gibbons reached a number of important conclusions. The relevant ones are reproduced below .

- TVI students perform at least as well, if not better than the conventional class most of the time.
- The ITFS students perform well, but not as well as the conventional class.
- In the TVI mode, students of all ability levels, as judged by their admission qualification scores, gain more than the students of corresponding ability levels in the actual class; however, the comparative gains of the lower ability level students are markedly higher.
- The performances of all students above a certain ability level are equally high and, very unlike the conventional classroom education, do not depend on their earlier academic records, that is, their admission qualification scores.
- Students with language difficulties, who would normally wish to slow down a lecture, actually gain from attending a course run in this way. There is evidence to suggest that students who can read English but are not comfortable with spoken English are well served by TVI.
- TVI can be used effectively to teach courses in Humanities and Social Sciences also.
- Participation by mature working professionals benefit the course in general by bringing in a variety of well considered intelligent questions which are usually not encountered by a faculty, in a normal class.
- All local tutors eventually become better managers.

- Students enjoy the collaborative group learning mode.

- For video assisted instruction, the optimum group size is between four and eight.

- Presence of a local tutor is positively helpful as long as the tutor is non-invasive. The best tutor is one who does not necessarily have great mastery over the subject, does not answer questions directly, but who tends to draw the students into discussions as the tape is stopped. The local tutor's other role is to ensure that students at study centres receive lecture handouts, assignments, and tutorials in time and any remaining queries that cannot be solved by the students themselves are answered by the original course tutor quickly.

A study of comparative performance by on- and off-campus video based engineering graduate students for courses offered by the University of Massachusetts over the five year period, from 1980 to 1985, and the experience gained through the administration of satellite-broadcast courses available through the National Technological University in the United States led Harvey Stone to come to almost similar conclusions as reported by Gibbons in his Stanford studies (Stone 1987). However, unlike Gibbons, Stone did not find any significant difference made by the presence or absence of local "tutors". Stone's conclusion that "Candid classroom credit instruction is an effective tool in supporting industry's manpower training and educational needs" is supported by the increasing use of video based education, particularly for mature students seeking to earn higher qualification or acquire knowledge and skill in a special area for professional development.

A smaller study carried out at IIT Delhi some years ago by Veena Kumar involving second year students of Computer Science and Engineering and students of Mathematics who were studying computer applications, indicated that video based education could be quite effective, even for undergraduate students, at least in collaborative small group learning situations.

Computer Based Education

Computer aided instruction (CAI), born out of the need to cater to individual differences among learners, is beginning to play an important role in distance education. With rapid developments in multimedia technology, multimedia based CAI packages are likely to become an important part of all interactive teaching learning systems. Recent research studies investigating the effectiveness of group work with computers suggest that although CAI was initially aimed at the individualisation of learning, used in a collaborative small group mode, CAIpackages are usually more effective than when used by a single learner.

Shlechter (1990) using American defence personnel as trainees, examined the relative values of individual computer based training (CBT) and small group CBT, not specifically tailored for collaborative learning, and came to the following conclusions:

- The best group size is four students per computer terminal.

- Small group CAI leads to better retention of information, less time for completion of tasks, makes fewer mistakes, needs less teacher interventions and results in higher educational productivity.

The study by Mevarech et al. (1991) to compare the effectiveness of collaborative CAI, and individual CAI used threestudents per terminal who took turns at the keyboard. The students learning mathematics were positively encouraged to help each other, discuss and find solutions to problems together, and to collaborate rather than compete. The main outcomes were:

- All students who learned through a collaborative group learned more effectively than those who learned individually.

- Low achievers gained even more significantly than high achievers in collaborative CAI.

Studies by Howe et al. (1991), Eraut and Hoyles (1989), and Kendl and Liberman (1989) also led to similar conclusions. An interesting and highly desirable outcome in most of these studies was that not only did collaborative small group learning through CAI lead to better results in the cognitive domain but unexpected gains in the affective domain were frequently reported.

In our own research investigating the relative learning gains of pre-adults in the 17 to 20 year old age group, learning through CAI as well as through print materials, under both individual and small group collaborative learning (Kapoor 1996) show clear advantages for collaborative learning. The effects of variation in group size and changes in group composition in terms of intellectual ability on learning gains were studied. Initial analysis of data does not indicate any marked difference in learning gains among homogenous group sizes of two or three

learners. Collaborative CAI group learning appears to be the most preferred mode. Collaborative CAI group learners also perform better than collaborative learners in the print mode.

Extensive work by Johnson, Johnson, and Stanne (1985) and Johnson and Johnson (1986) on the relative advantages of collaborative and competitive group work suggests the superiority of collaborative group work over competitive work.

CONTINUING PROFESSIONAL EDUCATION SYSTEM: DESIGN GUIDELINES

Based on the research evidence discussed so far, it is possible to draw up a set of design guidelines for establishing an effective continuing education system. These guidelines are :

- Candid classroom type video lectures delivered by experienced faculty with good reputations, both as domain experts and teachers, may be used as the core instructional resource material. Educational productivity is increased with consequent cost reduction when the core video instructional material does not involve any significant amount of special script writing or editing. Extensively edited programmes may be used as an exception rather than the rule. These video lectures need to be supported by suitable supplementary lecture handouts, assignments, and tutorial problems.

- When learning through video, collaborative group learning with not more than eight learners per group would be ideal.

- CAI packages support learning more effectively when used in a collaborative group mode with no more than three learners per group.

- Non-invasive local tutors, more in the role of facilitators and less as domain experts, are highly desirable.

- Reputed academic institutions may offer such courses leading to appropriate qualifications in partnership with industry, keeping strict control on assessment and evaluation before certification.

- Admission to such courses should be more on the basis of results of entry tests requiring a prospective participant to prove adequate competency in meeting well specified prerequisite knowledge and skills and less on formal qualification and grades. Admission rules should be in tune with the principles of open learning and promote horizontal and vertical mobility.

- The courses should be as accessible as possible, requiring the establishment of a sufficient number of study centres, and implementing highly flexible study schedules.

- To increase the responsiveness of the system, all study centres and the academic institutions involved in offering such courses need to establish effective communication channels among themselves using modern technologies.

- Last but not the least, courses should be needs based and the curricula should be designed scientifically. Specific instructional objectives and a specifications matrix should be drawn up, not only to assist teaching, but also for proper summative evaluation.

MODEL IMPLEMENTATION AT THE INDIAN INSTITUTES OF TECHNOLOGY, KHARAGPUR

The Indian Institutes of Technology System in India

In the field of engineering education, the Indian Institutes of Technology (IITs) are the most sought after institutions in India. Established by an act of the Indian Parliament, the IITs have been declared as Institutes of National Importance and occupy the highest level in the hierarchy of engineering education. Competition for admission is, to say the least, extremely fierce, with around 90,000 of the best students of India, from a population of nearly 860 million, competing for less than 1,600 seats in the six IITs for admission to four year engineering degree courses. Until recently there were five IITs, located at Kharagpur, Kanpur, Bombay, Madras, and Delhi. The sixth IIT at Guwahati, Assam, has been established only recently. Academic standards are considered to be comparable to the best in the world.

Indian Institutes of Technology, Kharagpur

Situated in an idyllic, sylvan setting, 116 kilometres from Calcutta, IIT Kharagpur, is the oldest and the largest among the six IITs. It has a 2,000 acre campus and23 departments and research centres, offering a large number of B.Tech., Master's, and doctoral level programmes in engineering, science, social science, and management dis-

ciplines. M.Tech and Ph.D. research scholars constitute nearly 50% of the total student population of around 3,000. The faculty strength is close to 500. The Institute's contribution to the country's industrial activities is considerable. With very large research outputs, major international collaborations, fast-expanding sponsored research and industrial consultancy (SRIC) activities, IIT Kharagpur is among the most vibrant institutions of higher learning in the country.

The Institute has a highly active continuing education cell responsible for organising more than 70 to 80 short term continuing education programmes every year. The Centre for Educational Technology (CET) IIT, Kharagpur has the necessary infrastructure and expertise to design, develop, and implement the model of continuing professional education just described.

Electronically Networked Life Long Learning Programme: Phase One

The Centre for Education Technology, IIT Kharagpur has already begun work on phase one of a sponsored research and industrial consultancy project called "ElNet-3L" or "Electronically Networked Life Long Learning Programme", funded by an external professional agency. Phase one of the project, covering the period July 1996 to June 1998, envisages the design, development, and implementation of two reasonably high level courses in the area of information technology and one covering the area of modern telecommunication systems. Three more courses are scheduled to be taken up around January 1997. The estimated number of participants in the first three courses in phase one is around 8,000, distributed among 30 or more local study centres, which are scattered over the entire country and separated by distances of more than 3,000 kilometres between some of the study centres.

The Centre for Education Technology, IIT Kharagpur will take up all responsibilities related to the design and development of curricula as well as course material, set all academic norms and standards, be responsible for developing appropriate mechanism for interactions with students in remote locations, and also be responsible for the evaluation of all students and the awarding of certificates to those who successfully complete the courses.

Depending on the nature of the course, contact hours can go up to about 150 hours over a 26 week period. High accessibility would be assured by flexible timing and by allowing fresh admissions at reasonably frequent intervals. Approximately 48 hours of candid classroom type video lectures produced by CET, IIT Kharagpur would form the core of the theory classes of most courses. The tutored video instruction mode described earlier would be recommended for theory instructions at study centres established in different cities and towns.

Collaborative group work would be the norm for all computer based activities as well as those tutorials and assignments not used for continuous evaluation. Problems remaining unsolved even after group effort and local tutor support would be answered by the IIT faculty through courier service, e-mail, and telephone networks as convenient, switching more and more to high speed electronic networks in the future. Questions received could be categorised at IIT, Kharagpur, the more important ones could be discussed in a mock studio classroom, and the videotapes of the mock sessions could be distributed to study centres by courier service at regular intervals. Cost permitting, it is also possible to hold live interactive question and answer sessions via satellite, as described earlier. The frequency of these live sessions could increase with time, depending primarily on cost considerations.

A small group of senior faculty members from IIT, Kharagpur would be entrusted with the responsibility of ensuring strict adherence to all norms and standards. Only those course participants who meet the predetermined criteria for successful completion would be awarded appropriate certificates.

The responsibility for conducting a needs survey, establishing and operating the study centres, issuing advertisements, managing admissions, undertaking the replication and distribution of all study material, taking care of legal and financial aspects of the project, and all other administrative activities would be taken up by the external collaborating agency. Some of the privately run training organisations with good reputations and which are already approved by the Department of Electronics, Government of India, for conducting specified training courses and with study centres spread around the country, could join hands with IITKharagpur's external partner in this project. They would, however, have to meet the norms specified by IIT, Kharagpur to join and remain as partners in this project.

The data generated from this large scale project will be continuously monitored and analysed to learn more about a number of factors which decide the quality of such programmes.

Electronically Networked Life Long Learning Programme: Phase Two and Beyond

The possibility of upgrading the programme to earn credits leading to a diploma and or Master's degree in a particular field of specialisation would be looked into more carefully at an appropriate time. If a decision is taken to award an IIT, Kharagpur postgraduate degree allowing off-campus registration, then certain modifications to the ElNet-3L programme structure will be required.

Active collaboration with selected Indian and foreign universities is a strong possibility. Distance education material produced by one could be shared by others. The participation of faculty from one university in another's distance teaching programme could become a reality, particularly when the institutions are fully interconnected by video-computer networks. In the same way, students of one country could learn from the ElNet-3L programmes of another country without leaving their own shores.

One of the objectives of future ElNet-3L programmes would be to offer tailor-made courses for specific sectors of the industry such as coal, steel, power, and petrochemicals. Since most of these industries have characteristic requirements and are usually concentrated in specific regions of every country, the generation and delivery of course material, as well as programme implementation methods could be reorganised for the optimum utilisation of resources.

CONCLUSION

Massive pressure on the education system is bound to force almost every country to use the help of technology to remould their education system. Such changes are sweeping across the world. Standing at the gateway of the twenty-first century, it would be wise to recall the old maxim:

> *Old institutions either change or new ones take their place to meet society's need.*

IIT, Kharagpur has decided not only to change, but also to be counted among the leaders, as it did earlier, by pioneering the entire IIT system in India.

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