INTERACTIVE TEACHING-LEARNING SYSTEMS FOR TEACHNICAL EDUCATION

*S.K. Bhattacharya **Dr. V.V.Mandke

SYNOPSIS

This paper suggests four alternative teaching-learning models which are interactive in character. In view of the requirement of preparing students to face the fast changing technological scenario in the world of work, these teaching-learning models assume importance. In this paper, the need for introduction of interactive teaching-learning and description of four interactive teaching-learning models have been presented. The models suggested in this paper have been field tested through independent experiments for their validity.

1. INTRODUCTION

Teaching-learning in our technical institutes are, by and large, teacher centred providing limited opportunities to the learner to acquire such skills as are required by the world of work. The design of the system of instruction is such that the learner is to acquire informations and knowledge through listening to the teacher who provides him all the assumed knowledge. Much of the inefficiency in our education that research has exposed, stems from the way most subjects are organised and taught. System of teaching-learning where the teacher tells and the students listens, or the teacher stimilates and the student responds, are basically uncritical and authoritarian systems. In either case, the learner follows directions pasively to accept what he is told, and to believe that education consists of those who know telling those who do not. In contrast to this type of education, interactive teaching-learning enables learner to reflect and to see how knowledge changes, grows and is subject to interpretation and what divergent or lateral thinking is, and how difficult it is to accomplish. The nature of such learning would include pruposively acquired exploratory understandings, insights, principles, relationships, concepts, generalisations, rules, theories or laws and added to it an enhanced scientific outlook. This paper described the design of such interactice teaching-learning systems which may be applied at either degree or diploma level institutions.

2. IMPERATIVES OF MODERN TECHNOLOGY - TRAINING A " LEARNER ENTERPRENEUR"

The unprecedented rate of growth of science and technology in this century has made things complex at all levels, in turn requiring the systems skills of synthesis to face the problem solving situations of tomorrow Further, the problem solving scenario is fraught with probabilistic elements of uncertainty, thus giving the

**Professor & Head, Electrical Encineering Department, T.T.T.I., Chandigarh-160019.
**Professor & Director, School of Enginering, Indira Gandhi National Open University, New Delhi.

content and methods of education essentially the task of preparing students to face the unknown. The requirement of a new look at the method of education is not so much from the point of view of what is taught, but from the view of how the learner learns. For, it is the proces rather than content which will probably have more effect on attitudes, and it is the attitudes that count. The shift that has to take place is from a mere "front-end loading" teaching-learning approach to developing "learning-to-learn" skills or in other words, the need would be to develop learner enterpreneurs. A learner entrepreneur is one who is desirous of learning to learn Thus, objective of education is ought to be seen not as teaching knowledge or information, but method of how to acquire them.

3. EMERGING PEDAGOGIC CONSIDERATIONS

In view of imperatives of the modern technology, the shift that has to take place in the content of teaching is one from emphasis primarily on transmission of specific items of knolwedge which may soon become obsolete, to one with emphasis on the development of problem solving skills that are applicable to a broad and largely unforseen task situations. Thus, the "problem solving" skills need to form the prime essential instructional tool for teaching and learning in the field of engineering subject mater, whether at the degree level or at the diploma level. The aim of education ought to be to develop in the student, from the beginning of his technical education and throughout his educational career, the ability to think-to reason to analyse-to synthesize-to visualise-to hypothecate. These are his kit of essenial mental tools upon which the graduate's ability in using them will determine very largely the degree of success he may expect to achieve in the engineering field, whether as a degree holder or a diploma holder.

4. FUNDAMENTAL DEFICIENCY IN THE EDUCATIONAL PRODUCT

For determining the desired specification of the poly-technic product, large number of seminars and workshops have been conducted. In addition, specific studies have also been conducted on the qualitative aspect of the educational product by receiving response from students, teachers, employers and the planners. What is central to these resposes on the present situation is that the educational products are lacking in their ability for "transfer of learning". Transfer of learning occurs when learning in one situation influences learning and performance in other situations. If there is no transfer value of learning at all, students would be required to be taught specifically every act that they ever would be required to perform in life situations.

This "ability of transfer" needs concretisation, particularly because it talks about long-term learning objective. Even today, though one accepts such need, when it comes to operative stage, all teaching-learning efforts are directly aimed at immediate learning outcome, and it has the support of both parents and teachers. The learner is ambivalent. The only point of disagreement seems to come from the employer, not in words, in the sense that he also seems to say train students for job needs and thereby suggest immediate or short-term learning objective. But when it comes to deeds, employer by definition is looking for learner who can move from task to task, as the rate of change of technology at work place is unequivocally demanding ability for flexible application of knowledge i.e. flexible employment.

5. EDUCATIONAL THERIES PROVIDING BASIS FOR TEACHING - LEARNING SYSTEM DESIGN

Since the seventeenth century, systematic theories of learning have emerged providing sound basis for design of instruction. Earliest among them is the mental descipline theory. Mental discipline theory considers learning consisting of students' mind being disciplined or trained. Educational practices based on the theory of mental discipline stresses the necessity for developing the "muscles of the mind" by rigorous execercises. The basis for transfer of learning consists of trained mental faculties and cultivated intellectual powers.

The second kajor theory of learning which followed mental discipline theory was "Apperception" which emphasise implantation in the minds of students a great mass of facts and ideas that have been organised by someone other than the learner. Apperceptive education resembles a process similar to "filling a storage container". Promotion of transfer of learning is achieved by building up the apperceptive masses of the students. Significant learning theories developed on the basis of experimental studies during the twentieth century are the 'S-R conditioning theories' and 'cognitive field theories'.

Emphasis upon creative aspects of learning is traced to the early work of the Gestalt psychologists. Whereas behaviourists treated learner as passive organisms and studied how they could be manipulated by the environment, Gestalists believed that organisms were innately active in their interactions with the environment. Much behaviour resulted from internal motivation rather than external stimulation.

This work of the early Gestalt psychologists, alongwith their emphasis upon learner as active information processors, was the basis for the development of later cognitive approaches to learning. Cognitive theory views learnign as active restructuring of perceptions and concepts, not passive response to external stimulation and reinforcement.

The primary purpose of referring to learning theories is to critically evaluate these psychological theories and principles from the point of their applicability to class-room practices. However, when this is done, it is sen that whereas certain aspects of respective theories of learning and teaching support one another, some others conflict. Traditionalism is criticised on the ground that it does not permit students enough freedom for intellectual exploration and progressivism on the gropund that it assumes that adequately worthwhile learning will necessarily result if students are given freedom and allowed to plan their own avtivities. Although cognitive-field psychology is not a compromise between the psychologies underlying traditionalism and permissivisom, it does lead to a kind of middle position i.e. a position that permits students considerable amount of freedom, but only within certain confines. Widespread acceptance of cognitive-field psychology would restore an intellectual emphasis in education free of the criticism validly made of the old 'mind training' or 'appreception' approach.

6. METHOD OF INCORPORATING INTERACTIVITY IN THE TEACHING-LEARNING SYSTEM

Each of the learning theories mentioned in the previous section leads to a different level of teaching-learning. Whereas mental discipline theories lead to memory level of teaching-learning, cognitive-field theory leads to reflection or exploratory teaching-learning environment where the learner is situationally and perceptually

interactive and there is purposeful involvement of the learner in the learning tasks.

Open-ended project method is one of the known channel for inducting interactivity in the curriculum and problems chosen from work place are probabilistically appropriate projects for this learning situation. Such projects could form an integral part of the study of subjects in the institutions. An understanding of how to solve open-ended problems, according to principles of scientific reflection, is perhaps the most useful intellectual tool a person can possess. To be able to work on open-ended problems, initial preparation in terms of learning of basic concepts and principles and also an orientation towards problem solving procedure, become essential. While the theory could be covered through explanatory level of teaching, problem solving competence needs to be learned through exploratory method of teaching-learning which is, by definition, interactive. In spite of its high educational value, everyone seems to be against the introduction of interactive processes in the teaching-learning system. The only silver lining or ray of hope can come from the technology development scenario running parallel, which is presenting rates of change never know before, thereby making overnight a master of assimilated knowledge, an illiterate of tomorrows' technology. It is this educational anomally which is to be answered and for this purpose the interactive teaching-learning process have to be made operative and this would inturn demand activity oriented learning situations alongwith various inputs in the curriculum.

7. IMPLICATIONS OF PROJECT METHOD TEACHING-LEARNING

Problem centred or project oriented teaching-learning involves learning in the presence of genuine problems that the students feel the need to solve and for which no readymade answer is available. Through the study, the students and teacher, working cooperatively, develop what is for them a new or more adequate solution. Such a project oriented learning is essentially based upon, and has much in common with a modern scientific outlook and approach. It reflects the conviction that students study and learn best when they are seeking both the intellectual and emotional relevance of their learning to significant aspects of their lives. Education that centers around such exploratory teaching-learning consists of both students and teachers experientially reconstructing their respective 'life spaces' in such a way as to add to their meaning and thereby increase the involved persons' abilities, both individually and collectively, to direct the course and contents of their future life spaces. Identification and helping students to understand problems, formulating and testing of hypothesis, evaluation of students' total personality traits, are some of the challenging activities the teacher has to assume if project oriented student-teacher centred teaching-learning is to be made operative. In such a teaching-learning situation, formulation and testing of hypothesis is to be conducted in an atomosphere that resembles, as far as possible, that of a scientific laboratory. The same open-minded and objective attitude that characterise any scientific investigation should prevail. Thus, the teachers' role becomes analogous to that of a head scientist in a laboratory; the teacher need to help students construct hupothesis and then asist them in testing them out.

Problem centred study is expected to encompass a variety of evidence - seeking activities. It is likely to include the use of individual and group research, home study, market survey, field trips, gap lectures, etc. It may also include considerable expapanation and illustration on the part of the teacher. An informal lecture may be highly useful tool both for providing data for students consideration and for instigating and promoting further reflection.

All these involve extra work and cognitive abilities of the highest order on the part of the teacher and, as such, the whole of teacher community, although appreciative of the educational value of the project oriented teaching-learning, seems to be against it. At the same time, the parental illitracy also militates against the project method, as for parents, it means a living exercise in experiencing the evolution of a child in child's own image and consistent with child's own abilities rather than in parents' own image and along the framework of artificial abilities as perceived by them.

The above reactions and feelings ultimately go to suggest that project method of teahcing-learning is good but it is too idealistic and also teacher intensive. However, it is argued that what is idealistic is the only 'practical' education and the most teacher intensive situation is also most interactive, requiring continuous learner participation and effort for learning for transfer. Teacher intensive learning situation like project oriented method of teaching-learning demands more work from the teacher, but it is not the physical or motor work, instead it is the constant thought analysis and synthesis, constant decision making in uncertainty, constant management with minimum information, that is involved. This kind of work is interactive where the teacher and the student together working cooperatively are arriving at answers to open-ended problems. The teacher is like a scientist leader and therefore is leading a learner team in a constantly unfolding situation, where, every second, fog recedes revealing still wider region of possibilities to choose from, thereby simultaneously presenting the mind with excitement of choosing from the multitude as also the worries of facing too vast a canvas. This is the interactivity that has got to be present in every learning situation, come what may, if training is to be for transfer and this requires constant 'adaptation' in the learning cycle where even 'accomodation' sounds to be a big achievement, with the whole system of education aiming only at 'assimilation'.

8. ALTERNATIVE DESIGN OF INTERACTIVE TEACHING-LEARNING SYSTEMS

Alternative design of interactive teaching-learning systems can be achieved through two mechanisms namely,

(i) introducing education-work linkage as an integral part of curriculum design; and

(ii) introducing transfer of learning objective in the teaching-learning process.

This paper describes in brief four alternative teaching-learning models based on the above two mechanisms as follows:

Model I: Institutional training followed by student-teacher involvement in industry.

This model follows the practice-school model where the institutional training is offered through class-room and laboratory experiences for learning of the given course content to be followed by attachment of students and teachers in industries on problem solving assignments, the problems

being of interest to the host industries. The industrial experts work as consultant to the team thereby establishing a meaningful interactive relationship between the students, teachers, and industrial experts. Evaluation of students are done against certain criterion which are considered the requirements in real life situations. A feedback system provides opportunities to students to reflect on their strong and week areas and thereby help themselves develop. This model is different from the sandwich model in the sense thatthe teacher is also placed in industries along with a group of students to guide them in the project activities. Thus, a part of the institutional training requirement in terms of giving students opportunities for application of knowledge and skill is now shifted to industries (Figure 1 a).

Model II. Project activity as an integral part of the institutional training.

This model envisages curriculum offering around certain project activities, the projects being sponsored by industries. The students study the basic concepts and principles as pre-requisite knowledge to project work through class-room inter-actions with the teacher. This is followed by open-ended project work at the institute but by having interactions with industries. To increase the efficiency and effectiveness for student learning of basic concepts and principles, instructional material in the form of self learning activity package, demonstration models, reference study material, practicals, periodical tests and feedback, etc. are arranged. To help students work on project work, extention lectures, group discussions, gap lectures, etc. are organised by involving experts from industries. The teacher and the industrial expert thus form a team of project guide for the students. Evaluation of students has to be done for judging their problem solving abilities through multiple evaluation instruments and feednback provided (Figure 1 b).

Model III. Use of teacher made open-ended problems for developing problem solving competence.

This model envisages conversion of the whole course content into a series of graded problems to be used as class-room exercises. Students while working on the exercises will proceed at their own pace of learning an will have the access to the teacher for consultation. Group discussion, enrichment lectures are to be organised to clarify doubts and to provide additional informations. Students are to be evaluated through periodical tests, viva-voce, assignments, and day-today observations. Students are also to be evaluated on their problem solving abilities by experts drawn from industry (Figure 1 c).

Model IV: Study of functional curriculum and internship in industry

This model envisages acquisition of basic knowledge and skills of a functional curriculum (in preference to a generalised curriculum) through institutional training followed by attachment of students in different functional areas in relevant industries to work as interns under the guidance of industrial supervisors to gain problem solving competence (like in medical profession). Related learning material are to be provided to help students understand the subjects of learning while assisting the supervisor in his tasks. Evaluation of students is to be done using multiple evaluation instruments by the industry in association with the visiting faculty (Figure 1 d).

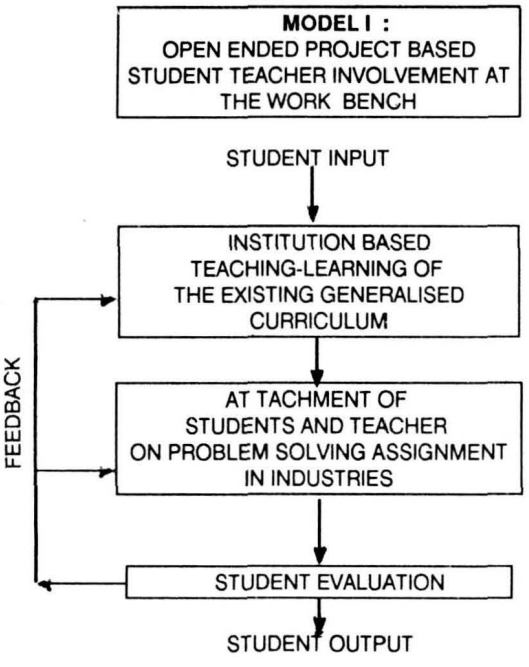

FIGURE. 1a MODEL ON PROJECT BASED STUDENT TEACHER INVOLVEMENT AT THE WORK BENCH

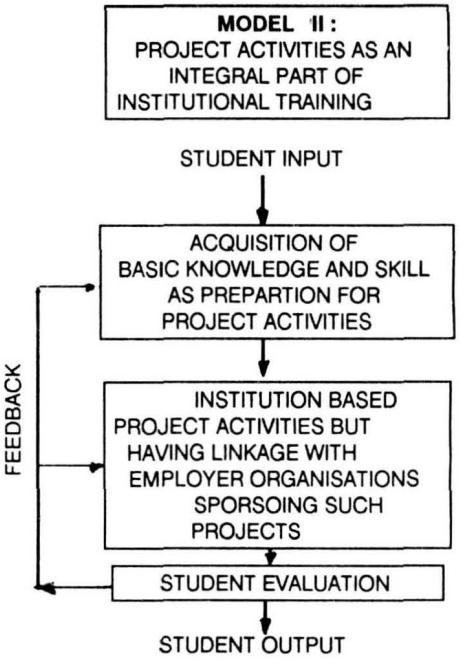

FIGURE. 1b MODEL ON PROJECT ACTIVITES AS AN INTEGRAL PART OF INSTITUTION BASED TEACHING-LEARNING

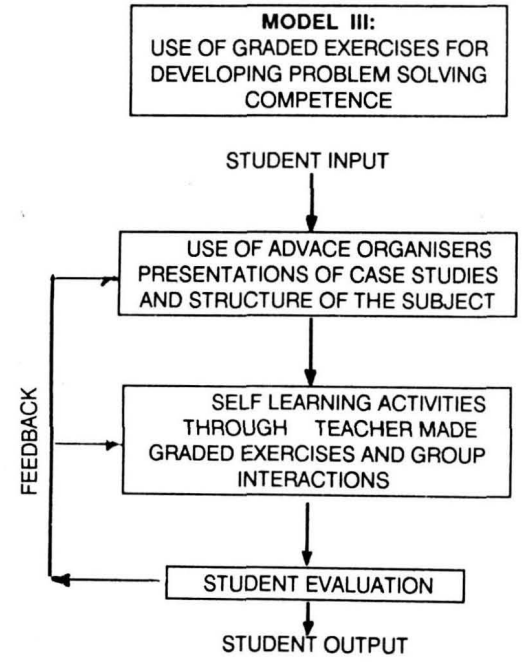

FIG. 1.c MODEL ON GRADED EXERCISES FOR DEVELOPING PROBLEM SOLVING COMPETENCE

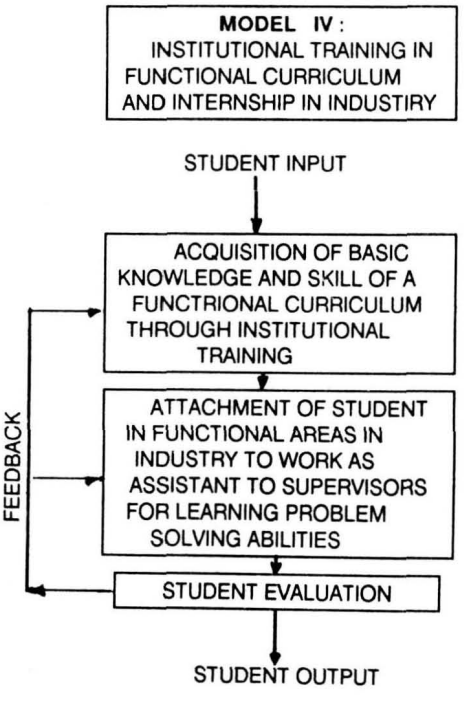

FIG. 1.d MODEL ON INSTITUTIONAL TRAINING IN FUNCTIONAL CURRICULUM AND INTERSHIP IN INDUSTRY

9. COMPARISON OF THE INTERACTIVE TEACHING-LEARNING SYSTEM MODELS

All the four models described in the earlier section aim at providing students with experiential learning by confornting them with open-ended problem situations, as also providing need based various inputs.

Model I and Model II are basically similar with the exception that in Model I problem solving activities take place at the work-bench with the teacher-student team working cooperatively in consultation with the industries experts whereas, in Model II similar activities but with the involvement of experts from industries. In Model II, the problems on which the students work are formulated by the teacher according to his perceptions of the field requirements and these are assaigned by the teacher as graded exercises.

In Model IV students are placed in real life situation to work as assistant to the supervisors where learning of problem solving takes place through direct experience but under the guidance of an expert exactly similar to interns of medical profession. Such learning experience is enriched through self study of related concepts and principles, constant interaction with the supervisor and fellow students, and the visiting faculty. Evaluation of students performance is done, in all these models, agains the criterion of students' attaining all such abilities which are required by the world of work.

10. CONCLUSION

Any improvement on the teacher centred teaching-learning system would bring only marginal benefits to the students for their acquiring of abilities that are required in the actual life situation like indepedent thinking, analysing and finding solutions to open-ended problems, communication abilities, leadership qualities, ability to work cooperatively in groups, acquiring learning to learn abilities, etc. The change that has to be brought in the method of course offering is that from teacher centred class-room lecture based teaching-learning to student centred purposeful experiental learning. Project method of teaching is one of the known ways of creating such learning opportunity. Often, project method of teaching-learning have failed to produce the desired result because the projects chosen were stereotyped and were not really open-ended. The projects used did not create enough psychological tension in students to solve them.

This paper has given four alternate models for incorporating project acitivity as an integral part of course offering. It is suggested that specific experiments may be conducted on the basis of any of the suggested models and evaluate the models against their benefits and requirements before large scale implementation (experiments conducted on a limited scale using each of these models have shown encouraging results).

Institutions have also the option of electically selecting components from the models and design a suitable model keeping in view their constraints like situational advantages or disadvantages, availability of resources, management support, etc. What is required is to make a concious effort to introduce change in the existing teaching-learning system to provide opportunities to the learner to acquire the desired competencies.

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