A CONCEPTUAL MODEL OF TEACHING APPLIED ENGINEERING SUBJECTS

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ABSTRACT

This paper presents a conceptual model of teaching, where emphasis is on developing problem solving abilities in students rather than on covering the syllabus by the teacher. It also shows a direction as to how to correlate effective curriculum implementation with the teacher development progrmmes including prepartion of teaching - learning material.

1. INTRODUCTION

A model of teaching is a plan or pattern that can be used to shape curriculum, to design instructional materils, and to guide instruction in the class-room and other settings. Over the years, a large number of teaching models have been developed (2). Models are based on practice, emperical work, theories, and on speculation about the meanings of theories and research work done by others. The purpose of developing a model of teaching applied engineering subjects is to help students learn efficiently and effectively keeping in view the challenges of the world of work where they are going to be employed. Apllied engineering subjects deal with various aspects of Manufacturing, Construction, fabrication, installation, testing etc. as against Basic engineering subjects which deal with principles learnt in the basic subjects are used in practical situations. While expository and explainatory type of lectures coupled with verification type of experimentation under certian ideal condtitions may be considered suitable in dealing with basic engineering subjects, applied engineering subjects require different kind of treatment. Exploratory and hence interactive type of teaching-learning, mainly based on project work, field experimentations, Group learning activities, etc. may form the basis of learning applied engineering subjects.

The model described in this paper basically is an interactive one rather than the traditional expository one.

2. BASIS FOR DESIGNING THE MODEL :

A model for teaching necessarily needs to be based on the following considerations :

i) Target population and psycology of learning.
ii) The general and specific objectives of subjects of study and
iii) Long-term educational objectives (1)

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In developing the conceptual model, the above considerations have been translated in operational terms as:

* Creating relevance of the subjects of study;
* arranging activities in learning;
* promoting group learning activities:
* laying stress on achieving the objectives of the subjects of study rather than on covering the syllabus;
* giving emphasis on mastery learning;
* developing higher order cognitive abilities leading to the ability of open ended problem solving;
* developing learning to learn ability;
* having provision for need based individual guidance;
  and
* evaluating students on their total personality traits rather than their learning of specific subject matter.

3. STRUCTURE OF THE MODEL :

Keeping in view the various learning theories (6) developed by educational psychologists like Gagne', Ausubel and Bruner and taking advantage of the available teaching models(2), and the objectives of teaching a particular subject in a technical college, a model for teaching of applied engineering subjects has been proposed.

The proposed model is described through the following :

I. **Orientation to the Model** : This describes the goals of the model, the theoretical assumptions, and the principles and major concepts underlying the model.

II. **The Model of Teaching** : This gives analysis of the model in terms of four concepts viz. **Syntax, Social System, Principles of Reaction,** and **Support System.** These are explained as follows :

(a) **Syntax** : The syntax or phasing of the model describes the model in action. This specifies in general the kind of activities to be undertaken if teachers are to use the model as the basis for their strategy.

(b) **The Social System** : The social system describes student and teacher roles and relationships and the kind of norms that are encouraged.

(c) **Principles of Reaction** : Principles of reaction tell the teacher how to regard the learner and how to respond to what the learner does.

(d) **Support System** : This describes the additional requirements of the model beyond the usual human skills and capabilities and technical facilities.

4. THE PROPOSED MODEL :

The conceptual teaching model in terms of its orientation and the four concepts viz its Syntx, Social System, Principles of Reaction and Support System is presented in this section.

4.1 Orientation to the model :

This model is based on the idea of developing in students problem solving abilities and their transfer in real life situations. The students are trained in the development of their cognitive

strategies, in productive thinking and in applying knowledge of concepts and principles learned in a variety of problem situations at a gradual increased level of complexity. The basic assumption is that once the students see the relevance and meaningfulness in the subject of their study and are actively engaged in learning by doing and in processing of infomration for problem solving, they would continue to work for achieving the objectives (3, 4, 5). The teacher's role therefore becomes quite different than that of a mere communicator of information and as a lone individual, struggling to cover syllabus with the students having a passive role to play.

The teacher will deliver lectures, arrange demontstrations, field visits, group/individual discussions, project work, seminar etc. depending upon the need felt by the learners. Thus this model envisages a total shift from the teacher centred learning system to a more students participatory learning system, teacher taking the role of a facilitator and a guide. The model draws its theoretical base from the principles of learning and psychology propounded mainly by Bruner, Ausubel, Gagne' and Bigge (5, 6).

4.2 The Syntax i.e. the four phases of the model :

Phase One : Additional Phase

Use of structure of the subject
Use of Advance Organizers*(7)
Showing relevance
Developing Objectives

Phase Two : Preparatory Phase

Arrange for meaningful learning of basic concepts and principles following:

* Inductive mode of instruction, self study, demonstration, and feedback
* Provide variety of examples and non examples
* Test for mastery of basic concepts and principles, arrange for learning of basic skills and evaluate students.

Phase Three : Problem Solving Phase

* Arrange for guided discovery mode of learning through individual and group project activity - projects drawn from the world of work and relevant to the subject of study
* Use gap lectures, industrial visits, discussions, seminars, feedback
* Arrange for practice in a variety of complex problem situations.

Phase Four : Evaluation Phase

* Arrange for evaluation of problem solving abilities, communications skill, etc. through written and practical tests, reports, viva-voce, seminr and group discussion.

The Soical System i.e. the teacher-student relationship, the Principles of Reaction i.e. the feedback system, and the Support Sytem i.e. requirements are explained in the following Section.

(* An Advance Organizer is any device used at the beginning of a learning experience e.g. a lecture by an expert or a television progrmme, that aims to alert the learner to what is to follow and help him organise his expectations so as to learn effectively from it - propounded by David Ausubel).

5. EXPLANATION OF THE MODEL IN TERMS OF THE FOUR CONCEPTS :

5.1 Syntax :

Phase One requires that the teacher presents an "Advance Organiser" preferably in audio-visual mode of presentation which will provide a frame work, a base, an inellectual scaffolding on which the students will further build up thier knowledge. This may be followed or preceded by a visit to application centres so as to actually perceive the relevance. Alternatively, use of modern communication technology may be made to provide a feel of the experience.

The objective of the subject of study can then be developed by the teacher through student participation. This will make the students own these objectives and presumably work for achieving these.

Phase Two requires the learners acquire basic knowledge and skills which are considered as prerequisite to the problem solving phase of learning. Learning of the basic concepts and principles are to be organized and presented meaningfully. Students would learn through questioning, verifying, discussing and clarifying. Use of demostration, discussion, self study, student activity, etc. will be made to reinforce student learning. Too often an idea or a concept will be introduced briefly by the teacher, while the rest of the class time will be spent by students doing independent work.

Phase Three envisges students to be engaged in a variety of project activity. Along with developing cognitive abilities required for problem solving, the students will be trained in effective communication in both verbal and written forms, leadership qualities, team work, cooperativeness, and in building attitudes. Provision of seminars, group discussions, industiral visists, extension lectures, case study presentation, technical report writing, qulity practical work, and continuous feedback for correction are made as integral part of the model.

Phase Four is the evaluation stage where the student is tested for transfer of learning. The achievement of total objectives are tested through problem solving ability test, viva-voce, presentation of report, seminars, etc.

5.2 The Social System :

The social system is cooperative, students participate as equals so far as ideas are concerned. Teacher is a facilitator of individual as well as group activity. Students are active, learning through self study, experiments, group discussion and need based presentation by teacher or experts drawn from industry. Initially teacher's role is to create motivation by establishing relevance of the subject of study and to prepare students with basic knowledge and skill before placing them in problem solving situations. After this, teacher only provides guidance while the students engage themselves in solving complex open ended problems.

5.3 Principles of Reaction :

The most important reactions of the teacher take place in the second and

third phase. During the second phase teacher should help the students acquire mastery of the basic concepts and principles including basic skills by providing additional help, extra assignments, self-study material and individul guidance.

In the third phase although the teacher should proivde guidance, problems are to be solved by students and not by the teacher.

5.4 Support System :

The support system is a problem bank and facilities for project activity. For creating relevance, arrngement is to be made for showing applications in industrial situations and/or for bringing industry in the class-room through modern communication media like video recordings and films. The problem bank is to be created and kept upto date by the curriculum developer/ teacher by having constant interaction with the world of work. Self learning material in the form of experimental kits, CAL packages, training boards, multi media learning packages, monographs, etc. may be procured or prepared to help students learn basic concepts and principles by reading, observing, doing and interacting.

6. IMPLEMENTATION OF THE MODEL :

For implementing the model, the prime requirement is the orientation of the teachers and their initial preparation. Interaction with the world of work is the second requirement. Preparation of instructional material both in print and of nonprint form is the third requirement. Examination reform and certification of students reflecting their abilities in another important requirement.

Impact of much of the efforts now being made in teacher preparation and other developmental projects is not visible because of the fact that the teaching model being practiced by most of the teachers has remained unchanged. The emphasis of such a model throughout has been on covering of syllbus by the teachers through expository mode of teaching(8). The curriculum revision activities at present mostly concentrate on making changes on the course content alone. Teaching thus continues to be the same age old traditional method. Teacher training on pedagogy, industrial material prepration, industry-institute interaction, class-room management, educational technology, student evaluation etc. without bringing in a change in the very design of instructional processes (i.e. the teaching Model) thus remain exercises having very little transfer value.

Implementation of this conceptual model presented in this paper will hopefully bring in meaningfulness of all the teacher training programmes and other related activities and an impact of all these will be visible in the form of better quality of products of technical institutions **

7. CONCLUSION :

The power of any given model is relative to any other model. There is no body of research that compare the

(** The author has performed an experiment using this conceptual model in a technical institute, the details of which will be presented in a seperate paper to be published subsequently).

range of models of teaching with respect to the specturm of educational objectives. The model of teaching proposed in this paper has been conceived keeping in view much of the criticism about the quality of product of our technical institutions and the less visible impact of the Quality Improvement Programmes. The model represented can be modified and adapted so as to increase the likelihood that it will result in better quality output.

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