SUMMER SCHOOL
(ISTE Sponsored)

METHODOLOGY OF TEACHING AND TRAINING

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LECTURE NOTES
(Volume–1)

Sri Jayachamarajendra College of Engineering
Mysore–570 006

and

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-: O B J E C T I V E :-

A typical young engineering teacher is competent in his subject but his graduate programme in engineering does not include work in education. While teaching with no professional knowledge of pedagogy, Philosophy of education or psychology of learning, he has to face a number of problems. Experience in some of the Colleges of Engineering which conducted summer- schools on Engineering teaching, to familiarise fresh engineering graduates with the methods and principles of teaching and learning, has produced results in bringing excellence in Engineering Education.

It is with this purpose that a short orientation programme has been developed for the benefit of Engineering College teachers to provide opportunities for on the job training with emphasis on pedagogical aspects of Engineering Education.

Such a programme should open up new frontiers and concepts for everyone interested in this vital task of improving engineering & education in this country. The programme will stimulate and inspire the novice as well as experienced engineering teachers who wish to mature and improve teaching.

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C O N T E N T S

Some of the important features of the Summer School on Methodology of Teaching and Training for Teachers in Engineering Colleges.

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The Summer School on Methodology of Teaching and Training for Engineering College Teachers has been sponsored by the Indian Society for Technical Education and organised jointly by the JCE and the RCEM with the primary objective of acquainting the Engineering teachers with the pedagogical aspects of Engineering Education. A typical young engineering teacher is quite competent in his subject but his graduate programme in engineering does not include work in education. As a consequence of the absence of relevant professional knowledge of pedagogy, philosophy and sociology of education and psychology of learning, he has to face a number of problems in his teaching and in his dealings with the students. Experience in the area of familiarizing fresh engineering teachers with the methods and principles of teaching and learning has produced encouraging results in bringing about qualitative improvement of engineering education. It is with the purpose of providing such an orientation to pedagogy that the JCE and the RCEM have come together in organising this Summer School.

The programme has been drawn up keeping in view the objectives, the needs of the Engineering teacher, the expertise available and the duration of the course. The task has proved to be a challenging one in view of the fact that there are no reliable guide-posts to go by in the field of pedagogical orientation of Engineering teachers. It is only recently that the idea of imparting pedagogical training to teachers in institutions of higher learning and professional fields like Engineering is gaining ground while 'Education' has taken giant strides during recent times with numerous developments in the fields of philosophy, sociology, psychology and technology of education. The Course has been designed with the following questions in view:

i) What are the pedagogical needs of an Engineering Teacher?

ii) What areas in Education would have immediate relevance to a teacher in an Engineering College?

iii) What developments in Educational Technology will have bearing in improving Engineering Education?

iv) What kind of an over-all perspective and philosophy of engineering education does an engineering teacher require?

Broadly speaking the programme comprises of six logical divisions: Perspective and Philosophy, knowledge of the learner and the learning process, planning and organization of learning, communication techniques and strategies, tools and techniques of evaluation, human relationships and class-room management.

To start with an overall perspective of engineering education in India and a sound philosophy of education is a fundamental requirement for the engineering teacher. Panel discussion on What is Engineering, Seminar on objectives of Engineering Education in India involving faculty from diverse fields of activity and lecture-cum-discussion on Engineering Education in emerging India, Liberal Education for an Engineer and concepts of Equality, merit and excellence in Engineering Education are provided with a view to fulfill this purpose.

The second aspect of the programme focusses on the understanding of the Engineering student: his developmental characteristics, motivational factors, learning theories, creativity and sociological background. Such an understanding again is basic for the teacher for without it he would be far from effective as a teacher however knowledgeable he might be in

With the perspective made clear and the nature of the learner and the learning process understood, attention should turn to the "Content" of education or the curriculum. A basic principle of curriculum - a principle that concerns both 'What is to be taught?' and 'How is it to be taught?' - is that it should be based on sound objectives. What are educational objectives? Why are they important? What are their different domains? How do we identify objectives? and such other crucial questions are sought to be answered and necessary experiences in skill development provided in the discussions on Educational objectives. Alongside, it is important also to understand principles of curriculum planning, identification of objectives and planning and organising appropriate learning experiences and activities and develop related practical skills.

The fourth aspect of the programme deals with the 'How' of teaching. While there may be no universally acceptable definition of good teaching (learning, of course, question-begging definitions) it cannot be denied that developments in the fields of philosophy, sociology and psychology do point to certain important features and principles underlying effective teaching. Seminar on Principles of Good Teaching and a lecture-cum-discussion on the same topic are designed to make explicit these features. Also sessions have been provided on Models of Teaching, Techniques of Effective Communication, lecture, speech, group discussion, project work, laboratory instruction, management and utilization of learning resources. A whole gamut of teaching resources and strategies has been made possible with the developments in the field of educational technology for example programmed learning, modular instruction and micro-teaching. An understanding of these various strategies and skill development in the practice of them might open up interesting possibilities for engineering educator.

The cycle of teaching which begins with the selection of content and passes on to planning and execution is not complete till the process and outcome of teaching is evaluated. The areas of educational evaluation covering principles and procedures, tools and techniques including marking, grading and internal assessment comprises of the most problematic areas in education and lecture, discussion and work sessions on these various aspects are intended to provide understanding of sound principles of evaluation and practice with the various tools and techniques.

One of the secrets of a successful educational enterprise is sound human relationships. What constitutes good inter-personal relationships and how can they be developed? What causes unrest among students and how is student indiscipline to be tackled? What are the problems peculiar to an engineering teacher and how can they be overcome? How can an engineering teacher develop himself professionally? are questions that perceptive teachers invariably have to contend with in their professional life. Panel discussion and lecture-cum-discussions seek to provide the necessary knowledge and understanding on these various aspects.

The four-week long programme employs various techniques and strategies; lecture-cum-discussion, panel discussion, seminar, film shows, work session and field trip. We hope that the programme will stimulate and inspire engineering teachers and all others interested in the improvement of engineering education in the country.

LIBERAL EDUCATION FOR AN ENGINEER

- an exploration by -
N.R.Ranganatha Rao

Dear Participants:

It gives me great pleasure to discuss with you and share with you the problem of liberal education for us. In a world that is so utterly confused and violent, where there is every form of revolt, may be in the office, home, or field work, it is really important to understand the whole problem of liking, the strain and strife which is there in all our relationships with the outer world and within us. Man is the only creature who is aware of himself and of the vast energies lying within him. At the same time, he is also keenly aware of a sense of limitation within himself; he struggles to overcome this limitation. Striving for fulfilment, the urge for integrality and wholeness, to live peacefully with others, in an atmosphere of freedom, to live absolutely fearlessly without any insecurity feeling, expressing love and joy always are in the pulse of every human being. All science is the search for unity which is the centre of joy. Man reaches the summit in life, if he finds this unity, not verbally but as fact of experience. Can we do that? Then you are free from the bondage. That is Liberal Education.

The values cherished by us spring from this unity experience. These values reach their maximum when the knowledge that is sought and imparted is of the highest kind, knowledge of unity and therefore love in which there is psychological security and fearlessness because there is no division in that - finds its consummation in realization. An inquiry into all this is Liberal Education. In simple terms what liberation can mean to you? We have to seek systematically and explore the skills and disciplines of our humanistic culture. The skills of liberal education are learning, reading and writing, and thinking. The great areas of liberal learning are:

The Arts
The Science
Society
Philosophy and Religion

Let us see how the values express themselves in a simple and superb way in the area of humanities, in the initial stages.

Engineering education is a broad field and naturaly it has many divisions and disciplines. The basic requirement of an engineering

o create a harmonius whole out of somewhat dissimilar disciplines. his ability to see the whole of things is the central function of the hilosophy. He must be prepared to answer the demands of the people ho work with him and for him: that their work contribute to the eaning of their lives, without some awareness of the possibilities or meaning the human life he is not equipped for this central job of anaging people, mostly students. That awareness is a direct function f the philosophy.

All will agree, I hope, that the most valuable commodity in ngineering education is 'ideas'. Yet those disciplines which explore deas for their own sake, which treat ideas as having life and interction of their own (Ex: philosophy) have been set off by many ngineers as 'impracticable'. Now that the range is widening for = ngineering education, we shall do well to demand that the liberation ducation disciplines become a part of education for engineers. The reater this range of resource for the minds of engineering teachers, he more and better will be the ideas that emerge. The Indian nstitutes of Technology are moving in this Direction.

The fullest kind of training for this ability can actually be iven by exposing the engineering students and teachers to psychology educational and social), philosophy, literature and art. In his unction the teacher or the executive must do pretty much what a hilosopher or a critic of literature must do. i.e. seize upon the ey, the theme of the situation, and the symbolic structure that ives it life. He must develop insight of an analytic, subjective ind, something he will never get in terms of pure science or Technology, or people and things in College situations just will not behave ehmselves with the regularity and predictability of water in pipes n the hydraulic laboratory.

In such situations creative mind is necessary and the creative lement is developed by the disciplined imagination of a mind working n the widest range of dimensions possible. The talks of J.Krishnamurti, he world famous philosopher, one of the greatest thinkers of the Oth Century, as expressed in the books 'Education and the Significance f Life', 'Commentaries on Living', 'The Urgency of Change', 'The nly revolution', 'Freedom from the known' etc. may be mentioned in his connection. Swami Ranganathananda, the great exponent of the deas of our ancient culture, beautifully discusses some of these deas in his book 'Eternal Values for a Changing Society'.

The first question a good teacher must ask himself is: "What

He must remember that he does not deal with physical matter. He deals exclusively with ideas and with men. He is a skilled and practical humanist. He has to operate in terms of values. Defining the situation always requires a decision on objectives, that is on values and their relationships i.e. meanings and value judgements on all levels and coordinated in a framework of fact, intellect, emotion and social values.

Certainly, a teacher can do more than teaching. Do they produce clarifications of value judgements in their students? Are they driven to see situations as a whole and to analyze them with all these elements in their experience including moral values? Engineering teachers may please note that society's standards for education are not merely technical or specialized. If they see this, it will have to affect educational policy also. There are ways of working out plans that will tap the liberating qualities of study of these things which will not interfere with technical training. They should be investigated. Liberal Education must be capable at once of taking on many different forms and yet of representing in all its forms the common knowledge and the common values on which a free society depends and that is wisdom. We have to unfold this faculty in human beings through liberal education. To our great store of technical knowledge, we need the added quality of wisdom. Really speaking wisdom is inseparable from knowledge. I hope you are with me; It is knowledge plus a quality which is with in the human being, without it knowledge is dry, almost unfit for human consumption and dangerous in application. Not that we don't have it, but a little more is wel-come. Wisdom adds flavour, order, and decision making element.

The spirit and traditions of technology and humanities are different. Our problem in our search for wisdom is to blend these two traditions in the minds of individual men and women. Otherwise, there will be the rise of the 'machine' and the fall of the 'man', There will be internal crisis in our civilization and the failure of utilitarian man to fulfil the ends of life.

The inner crisis must be resolved before the outer crisis can be effectively met. The remoulding of the self is an inescapable preliminary. Each one, within his or her own field of action - the home, the neighbourhood, the college, the factory, the office, the temple - must carry on to his immediate day's work a changed attitude towards all his functions and obligations. His collective work can not rise to a higher level than his personal scale of values. Once a change is effected in the person, every group will record and respond

Ausubel's Advance Organiser Model - An approach to Expository Teaching

1. David Ausubel's Theory of Meaningful Reception learning is probably the most pure information - Processing theory of learning that one can come across. Ausubel admits that such a theory has its limitations.

Orientation of the Model

2. Ausubel contends that all academic disciplines have an organised structure of concepts - a conical or pyramidical structure. These concepts are hierarchically organised such that simpler concepts or perceptual data are subsumed (included within) by more inclusive (general) and more abstract concepts at the top of the hierarchy or structure.

3. Ausubel believes that each discipline has its own unique set of such concepts and that this implies that disciplines should be taught separately rather than in an integrated manner.

4. Like Bruner, Ausubel believes that the structural concepts of each discipline can be identified and can be taught to students. These basic or structural concepts become a kind of intellectual map or information processing system which can be used to analyse particular domains and solve problems in them. Eg. In political science or sociology if the structural concepts (general, inclusive ones) are taught it may be possible to analyse political behaviour and solve problems in this area.

5. Many of new curriculums in the United States (new Maths, new Science etc.,) attempt to build their curricula based on these assumptions although in many cases an attempt has been made to integrate the disciplines. Ausubel is critical of this trend.

6. The task of educators according to Ausubel is the identification of the structures of each discipline and foster their acquisition by students. In doing this the major task of teachers is to transmit stable (organised) bodies (quanta) of knowledge in such a way that the learner will meaningfully incorporate them into his or her own cognitive system.

7. Ausubel suggests that the nervous system is an information processing one, which may be analogised to the conceptual structure of an academic discipline. The nervous system is a

system recognises itself to accomodate these new ideas etc. However these new concepts, ideas etc. can only be entertained if they are related to those already available - in other words if there is an ideational base for their reception. Thus if new learning is to be incorporated into the existing cognitive structure and persist or be retained there, it must be ensured that the new material does not conflict too strongly with existing cognitive structures.

8. New structures or concepts once adequately incorporated into an individual's cognitive structure become a part of his information processing system and are ready to receive further related new knowledge, ideas, concepts etc.

The Pedagogical Processing of Information

1. Ausubel conceptualises the information processing system of the discipline and information processing system of the mind as analogous i.e., both organise ideas/concepts hierarchically; where the most inclusive concepts occupy the highest position in the apex of the structure and subsume progressively more differentiated sub-concepts from factual data, new information, knowledge etc. that is received - this process is termed as the Subsumption Process.

2. In attempting to enable a learner to acquire and incorporate the concepts of a discipline, two conditions must be satisfied:

a) Ensure that concepts presented to students are stable (organised, related) with respect to those in his existing structure. An effort should be made to help the learner to incorporate new ideas into his cognitive structure in such a way that the structural ideas of the discipline become stabilised in it; a learner's own information system may tend to absorb new ideas within existing ones and thus in the course of time obliterate their existence as independent entities. Ausubel maintains that by this process of absorption of them, a learner is in a position to make maximal use of the ideas stabilised in his structure.

b) Ensure that the material is meaningful to the learner. The ideas and information of the new learning will be regarded as meaningful if they are relatable to relevant ideas within the learners cognitive structure. To facilitate both stability and meaning one needs to create ideational linkages between the students own cognitive structure and that of the discipline taught.

3. In order to ensure that new ideas and information, meaningfully related to the learners existing cognitive structure, ar implanted into that structure in a stable form, two processes should govern the programming of content in the subject fields the processes of progressive differentiation and integrative reconciliation.

a) Progressive differentiation consists in presenting the most general and inclusive ideas of the discipline first and then differentiating these in terms of details and specificity On the assumption that the learners cognitive structure is also organised in the same hierarchical manner as that of any subject or discipline, Ausubel would suggest that a beginning be made, in teaching it, by introducing its most abstract ide which subsume other material which follows - thus moving progssively from more inclusive levels to lower ones of facts, data etc.,

b) The principle of integrative reconciliation simply implie that new ideas should be consciously reconciled with an integrated with previously learned content. The curriculum requires sequential organisation so that successive learning is carefully related to previous matter.

The application of the above principles should result in the meaningful learning of a discipline (incorporation into a learners cognitive structure). This process must essentially be one of building from the top downwards rather than from th bottom to top.

4. Ausubel makes a distinction between enquiry (discovery) centered learning and reception learning. The latter is that process when learning matter (content) is presented to the learner in the final form in which it is incorporated into hi cognitive structue and then organised so to be made available or functionally reproducible for future use. In enquiry or discovery learning, a learner is required to discover the principal content of what is to be learnt before internalisi it, Ausubel contends that by confining ourselves entirely to discovery methods a waste of time and energy may result because of the possibility of false steps and their necessity to retrace them. Ausubel feels that learning should predominantlybe of reception or expository variety, which must not confused with rote learning, where the incorporation of new learning may take place by employing arbitrary, illogical

5. Ausubel points out that even meaningful reception learning may have its drawbacks. Some times learners may create an appearance of knowing something without having attained a stable cognitive structure as in the case of rote learning. However such pitfalls can be taken care of by the use of adequate evaluation devices.

Theoretical Formulation

1. In order to apply his theoretical principles in classroom teaching Ausubel suggests the use of advance organisers. "Advance organisers consist of introductory material at a higher level of abstraction, generality and inclusiveness than the learning task itself". The purpose of these advance organisers is to provide an ideational base for the stable incorporation of the new learning into the existing cognitive structures.

2. Organisers which prepare the ground for later learning are termed expository organisers. In adopting this strategy it is essential to identify the basic structures or concepts of a discipline.

3. Having presented the most inclusive org general ideas/ concepts of the units/unit of a discipline, a teacher would make use of the processes of progressive differentiation and integrative reconciliation in planned, appropriate steps or sequences. Progressive differentiation would be followed by both intra and inter unit planning - thus an attempt may be made to use each unit to serve as an organiser for the ones that follow.

4. Integrative reconciliation involves the practice of examining the units or ideas as learnt to recognise significant similarities and differences or reconcile inconsistencies.

5. Thus Ausubels Advance organiser technique would involve organising carefully programmed sequences of content so that each segment of learning material is preceded by a conceptual organiser which relates the new material to old learning.

6. An organiser is not to be confused with an overview or summary, which is at the same level of abstraction as the material which is to be learnt. It is a general fairly abstract idea relative to the material which is to be presen-

7. Ausubel provides examples of two types of organisers, expository used with unfamiliar material and comparative when relatively familiar a material is presented. Eg. in presenting a matrix of multiplication facts, the commutative law a x b = b x a may precede the presentation of other implied ideas eg. 3 x 2 = 2 x 3 etc., In presenting the process of long division a comparative organiser may be used as an introduction to establish the role of the quotient, divisor and dividend e.g. $6 \div 2 = 2 \div 6$.

Class Room Applications

The model has been applied in a variety of situations and in a number of disciplines sciences, Social studies etc., Eg. of an organiser in the latter: "Caste system is a form of Social Statification". This statement/concept might provide the basis for a study of roles, effects, history etc., of the Caste System".

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The Laboratory or T-Group Model

The T (Training) group or the laboratory method had its beginnings in 1947, in Bethel, Maine (U.S.A.). Its initiators, Broadford L.P. , Gibb J.R., and Berne K.D, were concerned with aiding an individual to adapt to the rapid personal and social changes taking place in modern society. T-group or laboratory methods are thus essentially techniques of re-education or re-learning directed towards improving social practices in conformity with the spirit of science and democracy.

Changes in Human society in the modern technological age often demand individuals to meet certain, "intellectual" norms at work and opposing contradictory 'emotional' norms at home. Also modern bureaucratic organisations result in a de-personalisation of the individual.

To make better adaptations to social changes, human beings require to integrate better the cognitive and emotional aspects of their lives as well as their personal and social aspects. The founders of the laboratory method contend that the inability of individuals to adjust to changing conditions may be due to a failure to make use of three functions in the field of human relations and behaviour ie., action, research and education; often action programmes fail to make use of research in the behavioural sciences adequately or meaningfully. The training laboratory was designed so that both educators and researchers could value and use the resources of one another.

Orientation of the Model - Definition:

"Laboratory Training is an educational strategy which is based primarily on the experiences generated in the various social encounters by the learners themselves and which aims to influence attitudes and develop competencies in learning about human interaction". A T-group has been defined as "a relatively unstructured group in which individuals participate as learners - The data for learners are not outside these individuals or remote from their immediate experience within the T-group".

1. A T-group normally consists of 10 to 12 individuals who spend anywhere between 8 to 40 hours together in instructional face to face situations, helping each other in their quest for understanding.

2. Learning results from experience obtained by individuals interacting within a group; group behaviour is directed towards making the group a viable, productive organisation. The trainer's role in this process which being present at all times is necessarily a passive one directed not towards intervention but the facilitation of learning, communication and development.

3. Participants are given the vague task of "Constructing agroup which will meet the requirements of all its members for growth". They are given the opportunity of creating a little society - to establish its goals, values and procedures.

4. Initially the T-group training procedures attempt the production of a social vacuum. Any attempt to provide leadership, instructions, agenda etc., is checked or kept to a bare minimum. Such a climate it is asserted generates (a) analytical behaviours by participants, (b) a climate of permisiveness, (c) collaborative relationships for learning and (d) models for collecting data and enquiry.

5) T-group experiences may be designed to focus on one or more of the following areas (a) intra-personal (b) interpersonal (c) group dynamics (d) self-direction.

6) The proponents of T-group methods claim that their techniques result in (a) an increase in awareness in participants feelings about themselves and others; of the complexity of the communication process, of differences in members needs, problems, goals etc., (b) changes in attitudes towards self, others and groups (c) new behaviour in the form of greater diagnostic and social skills.

7) An important feature for the achievement of the desired social climate in a T-group is the stress that is laid on the spirit of enquiry and commitment to democratic processes and choice; direction - prescribed goals (by authority or tradition), organisational structures enforced by authority -all militate against the creation of an appropriate social climate.

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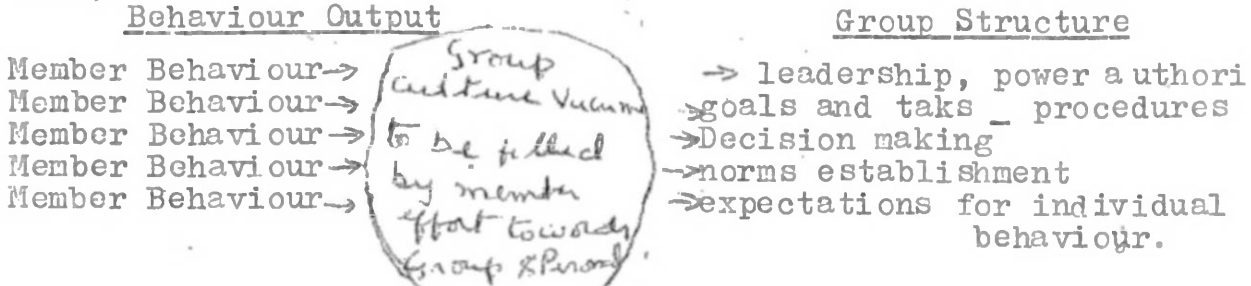
8) Besides the above characteristics, six essential points of difference have been identified between T-groups and other learning groups eg. Theraphy groups. The differences may be listed as : a) the "here and now focus" stress in laboratory training on the experienced behaviour of learners (as opposed to the stress on past history, experiences and behaviour in Theraphy groups). b) feed back (a communication to a group or a person of their effect upon us, communication may be in the form of the spoken word, gesture or action), mechanisoms to afford a recognition of the behavioural experiences and hence afford participants a means of interpreting each others reactions, feelings in an open, descriptive but non-evaluative manner. c) unfreezing or unlearning and hence creating a desire curiosity to learn (re-learn). d) Psychological security - provided by the supportive nature of the environmental group. e) participants play a dual role of observer/participant (observing, acting, diagnosing etc.) f) provide an intellectual framework for emotional experience.

Laboratory Theory

1) Laboratory procedures or T: group training methods have developed a "Dilemna - Invention - Feedback - Generalisation" model to explain the sequence of events which may occur in their group processes of learning (or re-learning/re-education) A dilemna created is the main source of energy for the learning laboratory, bringing together participants without goals, thus setting the stage for the dilemna; tension develops as individuals attempt to structure the situation, conflicts may arise due to lack of support/confirmation of individual perceptions in attempts to structure the situation.

2) Initially attempted solutions to the dilemna may exhibit habitual patterns but when these fail, the need to invent becomes apparent, creating more anxiety; this leads to further analysis, reflections on directions towards the goal. Finally out of the feedback, generalisations may result. Delegates (trainees) and the trainer, theorise together, formulate hypotheses, retest them and recycle them in the next learning phase. These processes may be diagrammatically represented thus;



3. The laboratory training process of Enquiry - data collection, processing, feed back and analysis of results is consistant wit' democratic methodology.

4. Laboratory techniques attempt to find a solution to appropriate role formations in group processes. In groups, roles adopted by members and authorities or by members themselves may be in conflict or lack definition. T-group training seeks to correct this feature. Schematically the outcomes of lab. training may be represented by the following cycles or sequences of learning.

Dilemna or Disconfirming Information → Attitude change (1)
→ New Behaviour (2)
New Information → Increased awareness (2) → Attitude change(2) → New Behaviour (3) → New Information → Increase awareness(3) → Attitude change (3) → Repetition of circle until new information or outside event ~~ex~~ terminates process.

Specific goals of the Laboratory Method

1. Offering individuals the opportunities to improve the quality of their membership in various associations and participation in group activities.
2. To achieve the above objective, lab. training seeks to achieve in individuals a greater awareness of themselves (their needs, motives etc.) and of their environment - - an ability to integrate "inner needs" with outer demands; an increased awareness of and sensitivity to emotional reactions and expressions in himself and others.
3. An attempt, with staff aid, to stimulate the clarification and the development of personal values and goals, consonant with a democratic and scientific approach to problems ~~in~~ of social and personal decision and action.
4. The development of concepts and theoretical insights, based on the findings of the behavioural sciences, to perceive and diagnose human behaviour more acurately in interpersonal and group situations.

Operational Methodology Lab. training consists usually of four major training activities:

1. Self-observation and diagnosis, by the constituted T-group of the groups growth and development.
2. Theory sessions to provide the conceptual framework for group experiences - may include notions of group goals, norms, cohessiveness, power structure, socio-metric structure, role functions etc.,
3. Focusses exercises or activities to achieve group goals eg. role playing, development of listening skills; observation tasks; ways of providing positive feedback etc.,
4. Experimentation with a back-home problem if group shares a common work setting or profession.

Seminars, interviews, discussions are amongst the numerous activities which may supplement T-group training activities.

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Class Room Applications: Elements from Lab training methods can be used in class room situations to develop group relations eg. focussed exercises to develop the receiving and giving of feedback; its uses may be listed as under:

1. Feedback may be constructive or destrictive (eg. punching an individual to show your anger or dissapproval towards him)
2. Feedback enables a person to be aware of the effects of his behaviour on his group.

3. Feedback enables an individual to evaluate his progress towards his goals.

To be useful for a person receiving feedback, the giver should a) be able to describe his own reaction to the behaviour; b) give feedback as soon as possible after the behaviour has occurred; c) give or describe the specific behaviour or incident that evoked the reaction; d) take into consideration the needs of a person receiving feedback. Feedback given in anger or hostility may thus be of no use.

Constructive uses of Feedback

1. Feedback is only destructive if given only to hurt or express hostility to people without any goal of improving communication between people.
2. Feedback may be destrictive if only derogatory or extremely critical statements are given without any balance of positive evaluation.
3. Feedback may be useful to an individual when it describes.

a) What he is doing rather than placing a value - (in behavioural or operational terms) - it is specificrather than general. b) when it is directed toward behaviour which the receiver can do something about c) when it is well tuned d) when it is asked for rather than imposed e) it is checked to ensure clear communication.

In applying the T-group model to educational settings, four basic strategies may be indentified;

1. Provisionof an ambiguous situation in terms of goals, leadership, agenda etc., which will produce and identify stress and ultimately general self-direction
2. Orientation toward group growth and development -i.e., individual learning is the common goal and its realisation

3. The data for analysis are the experiences and feedback of the participants while they are together.

4. Members and trainer should take the roles of observer/ participant which includes collection of data, analysis, experimentation andgeneralisation.

5. A teacher or trainers role is characterised by a participative, non-directive variety of activity but may occassionally involve the role of a counseller; they would provide additional concept and skill building exercises when the occassion demands it.

General applicability of the model :

1. Laboratory models are specifically designed to improve interpersonal relationships and by doing so increase the flexibility and ability to respond to change.

2. In all settings where people work together, interpersonal relations and adjustment to change may be improved with training and hence are amenable to T-Group techniques.

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Q: What are the reasons which lead one to believe that T-group training would benefit organisational groups (teachers, office workers etc.,) in India?

Q: Indicate a problem facing teachers or student groups which may be resolved using T-group techniques. What steps/activities would be necessary for such a procedure?

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Understanding the Engineering Students:

Developmental Characteristics

Introduction:

Everyone has to pass through several stages of development before reaching maturity. It is a long process. Commencing life as a helpless infant, an individual makes his way through carefree childhood and stormy adolescence to reach the destination of responsible adulthood. Educators must be sensitive to the emerging needs of the individual at each stage and relate teaching to the developing needs of the individual.

Broad Stages of Development:

It is really amazing that an unbelievably small speck gets transformed into a full-grown baby in about ten months in the prenatal environment of mother's womb. In the post-natal state, influenced by the physical and social environment, the organism grows, develops, matures and learns to become a full-grown adult in about twenty years. This is indeed a long stretch of time when compared to the animal world. But, this relative immaturity at birth and prolonged period of learning really help the human organism to develop and reach the highest level of development that no other species can ever conceive of. It is not an easy climb as the organism will have to weather many a storm all along the developmental pathway. Certain landmarks are identified by developmental psychologists as follows:

Infancy	:	0 - 2
Early childhood	:	2 - 5
Later childhood	:	5 -12
Adolescence	:	12 -19
Adulthood	:	Beyond -19

The above division is purely arbitrary as it is possible for one stage to merge with another. Yet, these divisions help parents and teachers to identify certain dominant trends and changes in behaviour that are relevant to teaching.

In a college of Engineering we normally come across students who would have crossed the adolescent stages. However, their earlier experiences in life would have left an enduring impression in their personality. While we should be particularly interested in the emerging trends and characteristics of the post-adolescent stage a brief overview of the dominant characteristics of the earlier stages would be not out of place.

Infancy is the most formative period. It is a period of utter dependency. It is a period of immaturity. It is characterised by imitation of parents. Gradually vocabulary enlarges. There is very little of social development. Awareness of other children comes in later. Very little of formal education is given. It is characterized by a good deal of physical growth and therefore nutrition plays a prominent part.

Early Childhood Provides a little more stability than infancy. There is an amazing development in the vocabulary of the child. The child learns to enjoy the company of other children. Weaning takes place and thereby the child gets used to the absence of the mother. Attending nursery classes trains the child to be away from home and delight in playful activities.

Later childhood is period of consolidation of certain characteristics that germinated in the earlier stage. Physical growth is rapid. Active games are preferred. Formal education commences. Communication with friends improves his expression and enlarges his vocabulary. It is called a 'questioning age' as the child tends to raise a number of 'what', 'why', 'where', 'How' questions. A child does not take everything for granted. His curiosity is evident by his probing questions in the classroom. His association with age-mates increases. There is a tendency to spend more time with friends than with parents.

Adolescence marks a transition from the earlier stages by certain abrupt, and radical changes. Muscular and glandular changes bring about secondary sex characteristics resulting in acute self-consciousness. One attains his maximum height and because of the breaking of vocal chords, there is a change in voice. An individual feels more energetic and develops athetic abilities. Pronounced mental changes too take place. Intelligence reaches its peak during this stage. One's capacity to think, argue, grasp, generalise and understand increases appreciably. There is also the emergence of vocational interests. The adolescent visualises the career that he should choose on the basis of his ability and aptitude. He is also given to day-dreaming and fantasy. It helps him to develop aspirations in life. It also helps the individual to retreat for a while from the world of reality. Reality may be sometimes unpleasant and anxiety-arousing and may undermine one's efforts to feel good about one-self and the world. Hence a person may tend to avoid facing this reality by rationalizing, projecting or using other defence machanisms.

By the time an individual joins an Engineering College he might have overcome many of these adolescent tendencies. He is likely

to be thrilled and excited over his choice of studies. There is a great deal of enthusiasm in the first year. It gives him a sense of status and also a vague awareness that he would become an Engineer. He attends classes regularly, conforms to the schedule scrupulously and maintains a respectable record of achievement commensurate with his ability. As time passes there is a regressive trend in his achievement. It may be partly ascribed to the quality of instruction. A highly gifted student is likely to be under motivated by sub-standard teaching. He realizes that he has to be on his own and struggle to understand various subjects.

There is another dimension to this regressive trend. Those who have no aptitude or ability for Engineering studies are likely to slow down the pace of teaching and lower the standards of achievement. Students from affluent families who have joined an Engineering College more for prestige and status are likely to dilute the standards. Consequently even an intelligent student tends to slacken his efforts. In the absence of a proper rapport between the faculty members and the students, engineering education has not been quite fruitful.

Toward the end of his studies, a student becomes very much aware of the vocation into which he should enter. Unless there is a constant liason between the needs of modern industries and the training imparted in Engineering Colleges, there is likely to be demoralization among the students.

The following suggestions are made with a view to cope up with the emerging needs of Engineering Students:-

Since the entrance requirements are farily strict, only students with super normal abilities could gain entry into the college. They would, therefore, need an appropriate standard of instruction suited to their superior mental abilities. To reduce frustration and regression, the faculty of an Engineering College must be of a high order.

Admission has to be regulated whereby each student would have enough facilities to work with others as well as to work by himself. Admission of far too many students would hamper the development of abilities.

There has to be some kind of man-power planning whereby we could check the inflation of educated unemployed. While unemployment of graduates in other areas is a serious issue it becomes all the more tragic in the case of Engineering Graduates. This is likely to demoralise the students who are mid-way in the course.

There has to be a placement section in every College of Engineering so that the outgoing student could be reasonably sure of some suitable job soon after graduation. This system is operating pretty well in all the IITs and there is no reason why other Colleges should not emulate this.

Properly harnessed, students in our engineering College, could perform far better in studies and be fit to fill the positions in the expanding industrial establishments in the country.

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LEARNING THEORIES

Introduction:

Teaching and learning are complementary terms. We can consider teaching as 'giving' and 'learning' as 'receiving'. An organism has to be active while learning though sometimes it can take place indidentally. Learning is intimately related to the maturational level of the organism. Therefore, maturation paves the way for learning. An individual is not passively moulded by the environmental forces. At all times human beings have struggled to resist the natural forces and learn. To be able to build a house or a dam or design an aircraft or weave a garment one has to change and modify the environmental factors. By learning one modifies his behaviour. The modifications may be numerous. To be able to walk, talk, play a game, solve puzzles, reason, imagine - all these are behavioural modifications'. To explain these various changes, psychologists have formulated certain theories. Each theory explains a particular category of learning though fundamentally every theory explains a change in one's behaviour.

The following are some of the prominent theories of learning:

i) Trial and Error learning
ii) Learning by conditioning
iii) Learning by insight or gestalt theory.

Trial and error learning and was propounded by an American Psychologist, named Thorndike. He formulated this on the basis of his experiments on cats using some 'puzzle boxes'. On the basis of his experiment he framed three laws, namely, Law of Exercise, Law of Effect and Law of Readiness. Each one has educational implications in classroom teaching. This theory has been particularly useful in explaining the acquisition of 'skill'.

Learning by conditioning is otherwise known as learning through association. This was the discovery of a Russian Physiologist by name Pavlov. By sheer accident Pavlov found this theory in operation while he was conducting an experiment on a 'dog'. Thereafter he devised certain experimental conditions in the laboratory to induce certain changes. Psychologists call this as classical conditioning in which the organism would be relatively passive.

An American Psychologist by name Skinner introduced certain modification whereby an organism became active to learn. He used a pigeon which learnt to operate a machine to get the reward. He call

machines. This innovation has considerably revolutionised the teaching-learning process, individualized instruction to suit the needs of slow, medium, and fast learners. It has solved many of the problems that were faced by teachers in conventional classrooms.

Learning by insight or Gestalt is the contribution of two German Psychologists namely Kohler and Koffka. It originated in some experiments conducted on 'apes'. To be able to use insight one has to have a good perception of the learning situation, reorganization of the field and reintegration of the experiences. This theory explained learning by discovery, resoning and problem-solving of a higher order.

These broad theories of learning would adequately explain many aspects of classroom learning.

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C R E A T I V I T Y

In order to survive in today's technologically advanced society it is becoming imperative for a country to keep pace with developments that are taking place in the rest of the world. World War II has seen the rapid emergence of colonies as independent states and India is one such example. Merely forming a government of its own is no passport to progress for a country. Self-reliance is an essential pre-requisite for a nation to safeguard against the pressures of other countries, for retaining its identity and maintaining its freedom. This self-reliance, in turn, depends upon the stages of development of the different sectors. If a country has know-how or expertise to offer, it can be encashed for something else that it needs. In the absence of such a situation sole dependence on the charity of more 'developed' nations is an obvious possibility.

To maintain an exchange balance and independence in the various fields, viz., agriculture, industry, Engineering, telecommunications, transportation and defence, India needs her own creative individuals who are not only able to evolve alternative technology when resources are scarce, but also replace the out-dated technology with a more efficient one from time to time and be up and doing continuously in order to meet the needs of a fast developing society. It is the State's responsibility to utilise the talent of its citizens, using it for the benefit of the entire human race in general, and its own people in particular. Developed nations are eternally striving to maintain the tempo of their progress in the different fields. To quote one such instance, the U.S.A. received a jolt, to find that it was lagging behind the Soviet Union when the latter was successfully able to launch the first 'sputnik'. As a result of this awakening, scientists, educationists and psychologists and also those working in related fields began to seek an answer to the question 'Why'?; and in answer to the question 'How'? began an intensive study of the nature of the creative human potential; and consequently, the concerned set about modifying the educational system.

The fate of any country fifty years hence is dependent on the educational system it has today. If the educational system has an in-built mechanism for developing the creative potential of people at different stages, the future is to a certain extent safeguarded, otherwise the nation is likely to fall a victim to neo-colonialism, and this holds good for India, like any other country.

It is now crystal clear that the importance of creative potential cannot be denied. The strategies to enhance creativity need to be planned and incorporated into the educational system. Numerous evidences indicate that creativity, if provided a suitable environment, can be enhanced.

But, what precisely, is implied by creativity?

Creativity Defined:

The definitions of creativity that have been offered are either attempts to list attributes, characteristics, traits of persons who have been characterised as creative, explain the acts or stages by which individuals generally come out with something and that something must satisfy certain criteria before it can be classified as a creative product.

It is generally accepted that a product to be considered as creative must be both novel and useful. The product is judged qualitatively by the degree of its social recognition. Another category of quality of output is number of words, ideas, sentences or other products in generalised psychological forms.

Torrance defines creativity as "the process of sensing gaps or disturbing missing elements, forming ideas or hypotheses concerning them, testing these hypotheses and communicating these results, possibly modifying and retesting the hypotheses".

To Dashiell(1931) the salient characteristics of creative thought are: the sudden unexpected way in which the ideas occur to the creative individual; they occur in a related condition; and sometimes they seem to occur out of nowhere so that the creative individual regards himself as inspired. Creativity does not involve merely waiting for inspiration. Interviews with French poets and novelists indicate that they prepare themselves for their work by enriching and saturating themselves in their subject matter before turning to their work. Novel and fruitful insights occur after a period of absorption. These accounts of the creative process suggest that it may be divided into four stages preparation, incubation, illumination and verification. A brief account of these stages is as follows:

a) Preparation: the stage in which the problem is investigated from all directions;

b) Incubation: The stage during which the individual is not consciously thinking about the

c) Illumination: the stage during which the 'happy idea' occurs together with the psychological factors that immediately preceded and accompanied its appearance;

d) Verification: in which the validity of the idea is tested, and the ideas reduced to exact form.

Whether stages or more general characteristics are used, there is a belief that the characteristics of the creative process are not discreate but overlap and interact with each other.

We have been guided by the belief that virtually every individua regardless of his level of intelligence, school achievement and socio-economic back -ground needs to and can sub-stantially benefit from explicit training in creative thinking; there is an erroneous gap between his usual tasks and the performance he is really capalbe of.

The effort of educators to augment the creative output of these students rests on three assumptions;

i. that every one has some measure of creative ability

ii. That such abilities as the individual possess are capable of being developed by practice and

iii. that such training is a proper function of the school.

Torrance suggests six cardinal principles to be applied by teachers in creative teaching. They are:

i) Treating suggestions with respect
ii) Treating imaginative and unusual ideas with respect
iii) Showing pupils that their ideas have value
iv) Giving opportunities for experimentation without evaluation
v) Encouraging and evaluating self-initiated learning, and
vi) Tie in evaluation with causes and consequences

Development of Creativity:

Creativity can be developed if provided suitable environment. There are various methods designed for the purpose. A few of them are listed below:

1. Brainstorming:

Brainstorming which was developed by Osborn is a procedure designed to separate idea evaluation from idea production. The essentials of brainstorming are as follows:

1. During the brainstorming session no evaluation of any kind is permitted. Osborn reasons that the person whose ideas are questioned will be more concerned with defending his ideas than with thinking up new ones.

2. All participants in the brainstorming group are encouraged to think of unusual or wild ideas.

3. Members of the group are encouraged to generate as many ideas as they can. It is felt that quantity generates quality, a contention supported by research findings.

Research has demonstrated the effectiveness of brainstorming as a means for increasing creative ability. Meadow and Parnes (1959) evaluated the effects of a brainstorming course on the creative abilities of College students. The results of a series of experiments demonstrated that these effects persisted for as long as eight months.

Osborn's assumption that quantity generates quality was supported in two studies by Parnes. Parnes investigated the hypothesis that extended effort in idea production would lead to an increasing proportion of good ideas. Subjects were given the task of listing unusual uses for a wire coat hanger. Responses were rated for quality by judges with respect to uniqueness and unusualness. Results confirmed the hypotheses. In a second experment Parnes(1961) attempted to investigate the quality of idea production in a group of subjects trained in brainstorming techniques. Results of this study supported the hypothesised increased in quality in the latter half of 15 minutes brainstorming periods.

Torrance assessed the effects of instruction in brainstorming on the ability of primary school children to generate creative ideas. One group of children in Torrance's study was instructed and rewarded for producing as many ideas as possible in various classroom sessions. The second group was rewarded for producing quality ideas, but not trained in idea production, Torrance found that special training did improve the ability of subjects with respect to both amount and quality of idea production.

Dunnette, Campbell, and Jastad found that individual brainstorming was superior to group brainstorming. Individuals working alone produced significantly more ideas than individuals working as a group. The effect was greatest when a group brainstorming session preceded individual work.

Brainstorming is especially appropriate for dealing with problems in which there is a direct relationship between problem and solution. Many problems, however, involve situations in which there are several intermediate steps between the initial statement of the problem and the final solution to it. William J.Gordon has devised a procedure called operational creativity, which focuses thought on the processes involved in getting to an appropriate problem rather than on the solution itself.

2. Operational creativity:

Operational creativity was developed by Gordon for use in industrial consulting. The technique is based on the assumption that creative problem solving should begin with the selection of experiences metaphorically realted to the problem to be solved. The problem solution is generated from these metaphors.

The metaphorical thinking described by Gordon differs from the thinking involved in brainstorming, although both make use of divergent prdduction. Brainstorming calls for the generation of many solutions to a problem. Operational creativity calls for the generation of many situations which have something in common with the problem. These situations are used to generate one problem solution. Brainstorming involves deferred judgement, Operational Creativity involves not only deferred judgement, but also deferment of solution generation.

An operational creativity group is composed of a leader and several members whose responsibility is to solve the problem. Only the leader knows the exact nature of the problem. At the beginning of the session he states a general classification under which the problem is included for example, if the problem were to improve ways of grouping children for instructions, it might be presented with this directive; describe ways to categorise objects. In response to such a directive members might consider phylogenetic classification. It might be pointed out that objects can be classified according to their static characteristics or according to their functions. The selection of bases for classifications would depend on the purpose that the classifications were intended to fulfill. There might be some discussion of library cataloging, cross referencing and the like. This might lead to the notion a multiple-classification system

As the group generates ideas the leader provides more and more information about the problem until its exact nature is finally revealed, selectivity and refinement of metaphors occurs with the

By not revelaing the exact nature of the problem initially, the leader forces deferment of solution generation and channells thinking into metaphors that range far beyond the kinds of solutions suggested directly by the problem. In the above example, if the exact problem had been given, discussion would probably have turned immediately to age and ability grouping and some particularly useful metaphors would not have been expressed.

I have given an account of the creativity, its definition and its development in the proceeding section. It is obvious that man power, if properly utilized becomes the wealth of the nation if not it goes waste; original and creative thinking in man are such improtant human abilities that add to his worth. Failure to develop creative thinking ability in students is a loss not only to the individual but to the nation at large. No nation can become great by dwarfing the creativity of the younger gener ration.

Education is an enterprise, in the possession of a society which can, if exploited in the right direction, meet the needs of the society. The development of creative thinking abilities is at the very heart of the achievement of the most fundamental educational objectives. Their development, therefore, can not be left to chances. Infact, the very future of a nation today depends on how it has developed and fostered creativity among its children.

In the light of above discussions, teaching strategies and text material are to be suitably modified to achieve the development of the creative thinking abilities in the learners. This is also necessary to meet the impact of change and to ensure soft landing of the youth in future.

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EXAMINATIONS AND MEASUREMENTS

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Further education of serving teachers has become necessary because of the new programmes in curricular development aspecially in maths and science. The inservice educational activities are to initiate and to prepare the teachers in the new content, methods, materials and also in evaluation. The programme of pre-service preparation of teachers -- mostly in developed countries-are so designed so as to ensure the future entrants to the teaching faculty have the necessary knowledge and skill. (1) The Four Year Integrated Course in Science Education of our RCE, Mysore is an example for such a well designed pre-service teachers' training programme. The expanding educational system is of such a magnitude that there is a constant pressure on inservice programmes to increase the OUT-PUT of the training system by shortening the period of training. (1) The programmes of Summer Institute in Science have been reduced from earlier four weeks to two weeks. The instructional 'Leadership' inservice programmes are designed for those who will fill positions of leadership and key position in institution and training system. They provide leadership to the teaching staff and also co-ordinate their dontribution to the best advantage of their institution. In such leadership programmes most of the innovative approaches are dealt and the different ways in which the instructional courses may be taken up by the teachers and evaluation are discussed.

The concern of test and evaluation is that the examination measurements should indicate how well they serve the purpose. The individualization of education (as done in most of the developed countries) will affect those who are concerned with educational measurement which de-emphasizes group comparison and also grade level norming. The individualization of education shifts our attention from static snapshots of relative positions of individuals in the group to the continuously moving line of each child's development. (2) It should be noted that it is too difficult to judge the educational efforts in terms of change of MEAN in the distribution of test scores as we generally assess achievement of individual child in terms of percentage rank in normal distribution. Evaluation as applied to method of instruction or teaching material

are in a way copied from industrial and technological research where everything is directly measured or translated into money income(2). The changes of individual or units in a curriculum are no consequence beyond their contribution on the mean gain. It may be noted that the changes in test score can not be translated into a measure of Universal Social Benefit. A lower Mean score - which is generally looked down-can be instrumental for further improvement. Sometimes it so happens that a lower MEAN score is actually more beneficial for some 'minority'. The individual instruction for these 'minority' is beneficial but may have to be abandoned for the remaining students. So there is no rational basis for discarding it on the basis of comparing of means when there exists one or more students who are better helped by it. Individual development is influenced by the society in socialisation process at home and environment by educational efforts by parents at home and by educational programmes at school by variety of specialized extra-curricular activities(3). In addition to these extra influences the individual goes through a biological determined development.

Examination and Measurements :

Examinations and tests have two major sociological functions viz (i) various aspects of life and (ii) changes taking place in climates of opinion as well as in socio-economic and political institution (4). They are used to assess the extent to which an individual has benefitted from the education he has received. What does he know ? Has he learned what has been taught? The measurement of attainment or achievement has been received explicit recognition. The system of examination originated due to its necessity. The political power in a society is shared by politicians and officials. It was in order to select the latter, examinations were established. In the beginning of twentieth century when the need to change over to the western styles of education forced both candidate's form of preparation and the style of the test. The test achievement provide goals or incentives for students and they are competitive. Employers and educationsts look at it in a different way. So there is multiplicity purpose. Sharply defined goals may not assure effective examinations and tests but they at least should direct attention to the danger of assuming

that one kind of test or examination will meet effectively multiplicity purposes. This multiplicity purpose and functions imply a variety of techniques. The main categories are written, oral, and practical. Each category includes a number of different types i.e., 'written' may be either essay or objective. The choice of suitable type of examination or test depends on the task it is expected to perform. The professional skills of a doctor, teacher or an engineer are inadequately tested by written work alone. The type of examination which is suitable at the level of University work is not appropriate at the primary school level, etc. even though the stated goal and aim may be the same. Again the acquisation of certain kinds of data can be assessed better by some types of tests than others. What has the candidate learned? Knowledge of facts? The ability to interpret and extrapolate? How to apply the principle? To see relationship? To draw together or synthesize points ? Or How to make value judgements?

When the purpose of an examination or test is known and accepted the choice of type remains a technical problem related to is VALIDITY & RELIABILITY. Examinations discover only a proportion of what the student knows. The adequacy of sampling is of importance in relation to the objectives of the examination. It is reasonable to claim that objective examination, as it includes to 100 more short questions, can sample a field much more comprehensively than an essay paper lasting the same time(6). The number of candidates and frames of reference of different examiners will influence the reliability of marking-essay type of examination. The solution to these problems does not necessarily lie in the objective test. The objective tests are objective based and indicate how the conditions under which the tests are administered, the group to which they are given and the cultureal lines on which they are founded may seriously impair the level of 'objectivity' (8).

Z. Sardi points out that the psychometric tests and inventories are probably the most reliable tools of establishing objective data about a person(7). In the area of vocational guidance, one of the most difficult is to construct tests which will predict success, in a specific occupation and are used more extensively today than over before. It is possible to measure a persons' special traits, his achievement and aptitude, interests and values. A certain method of

selection adopted in vocational stream may be very reliable and efficient. Nepotism, for example, finds little public favour to-day. Interviews for a job or admission to institution are frowned upon. Other techniques of selection have had to be devised. One of the major social purpose of examination is to make certain processes of evaluation and selection APPEAR FAIR. What is just depends on the norms of society and not merely on whether the tests are reliable.

The theories of examinations give us broadly two aspects. Firstly it deals with a certain kind of task: Oral questions about certain matter or to write an essay on certain topics or to translate a passage from one language to another or fill up the blanks in multiple choice question or carry out a certain kind of project over a given period etc.(5). Secondly it deals with performance to be done as well as possible. In every kind of examination some reward is offered either directly or indirectly and it is the reward that encourages the candidate to perform his tasks as well as possible(5). The reward may be monetary or prestige prize or a place in the University or a certificate of competence. But what does this 'as well as possible' mean? The critera for deciding what is good and what is bad performance may be directly defined or may be allowed by tradition. It is essential that both candidates and examiners should know what the criteria are. The degree of success of a candidate is expressed by the examiners sometimes as 'pass' or 'Fail' sometimes in terms of five or six, letter grades, sometimes in terms of percentage of marks. The fact that the students know not only what kind of task they will be asked to perform and they must do it as well as possible, but also when it will have to be done, determines one of the most important characteristics of all examinations, namely that the examination exerts an influence on the behaviour of the candidate in the interval between his deciding to take the examination and the event itself. The kind of practice is the educationally relevant feature of the examination.

In some countries in Polytechnic Institutes each student is assigned a project for some six months. No competitiveness is involved here. He is trying to do his best without necessarilly considering what others do. He wants the reward even though, in order to achieve it, he does not have to do better than anyone else. It is a kind of non-competitive examination(5).

Most of the examinations involve both comparison and competition. It is impossible to ignore others when assessing one candidate. Comparision is one of the main aids to reliable assessment /or grading. The competitive element affects the examinee rather than the examiner. In some examinations its influence is obvious. The effect of competition can be increased or reduced at will by those devising examinations mainly by varying the reward and manner of classifying the successful candidates.

The different methods used in the process of assessing results are known as marking, grading or assessing. Some types of task can only be assessed by the examiners bringing their intuitive judgement to bear while comparing candidate to candidate. On the other hand some tsaks can only be graded by the use of marks. The extreme example is provided by objective tests in which the grade is decided by adding up a large number of independent units. There is no need to compare candidate with candidate in order to fix standards. Yet it has to be remembered that the objective marking can only be graded by resort to statistical procedure which in effect also involves comparison i.e. comparison among all the candidates. A Maths examiner cannot say until he administers the test, whether the questions are easy or difficult. He decides about the 'grading' only when he has assigned arbitrary 'marks' to a large group of answers.

Examinations are continued in all educational and other fields only because they stimulate students to work well in a direction which will lead to their being more useful in some way. Universities have Degree Examinations and without them, students would do little work. What makes a Good Exam? (i) It must not only be conducted fairly but also must be seen by the candidate to be FAIR(5). Why the examinations are not properly developed in the direction which will foster progressive education is because those who are responsible are obsessed by the supposed need for absolute objectivity in assessment. Students know well that there is room for arguments to what constitutes a 'good' essay, etc but that does not mean they want to forego the opportunity of raising their standards in these activities. All they ask is confidence that examiners doing their honest best to assess the work fairly, are impartial and have not made clerical errors. (ii) The difficulty of the tasks set must be neither too greater nor too small (5).

It is not use asking them to solve mathematical problems which are beyond them nor can one expect examiners to become involved in the examination as an educational happening if they know that the tasks to be performed will be child's play to them. (iii) There are other details which might at first glance seem to be unimportant. In sweeden for an essay type question more time is given, first to write a rough copy and later copy the same work neatly. In German Democratic Republic, for oral questionsx they are allowed to see the questions some half an hour earlier(5). In USSR multiple question papers are printedx and given to the students and among them- about 100 in number- student is allowed to pick up one at the time of examination.

Discrepances between the marks awarded by different examiners to the same candidate have been pointed out by a number of educationists. The sources of variation should be distinguished first such as differences in the standard deviations or mean deviations as one examiner is more generous all round or spreads out his marks more widely than the other and secondly differences in rank ordering or relative grading of the candidates.

Any Kind of competence is complex; it is made up of many skills, knowledge of facts and their relations, insights and attitudes (6). The student performance will be according to the question set. In one he may know the facts but unable to tackle a simple reasoning problem. A teacher also may be good in handling Students problems but poor in or slipshod in preparing lessons. A great deal depends on the luck of the question set which happens to suit some and seem to be unduely different to others and a second paper set with different selection of questions on the same topic may result in discrepancies two sets of marks. If the result of several papers are combined as in Universities, the resulting reliability will be much more satisfactory, since the errors due to poor sampling on different papers tend to cancel out. So in most of the competitive examinations people advocate the objective examination as it includes 50 to 100 or more short questions and can sample a field much more comprehensively than an essay paper lasting the same time.

Are the skills or abilities involved in the examination relevant to the general competence with which we are concerned? In most instances scholastic

languages should surely include an oral test while competence in science and technology involves appropriate practical work. Questions may cover knowledge of the syllabus, but a different type of question might better elicit the students' interest, initiative, independent thinking and grasp of applications of the subject (6). Questions may be set such that an examiner may mark them for (a) accuracy of reproduction of detailed facts (b) length of answers, literary style and eligibility and (c) agreement of the examiner's view point or his own pet theories. Many students, it is said, 'fail to do themselves justice' in an examination. They have an OFF day or suffer from examination strain. Variations in performance on different occasions are more likely to arise from variations in questions or in the marking than from variations in mood or health.

Students, in general, dislike and also are suspicious of tests and examinations to which they are subjected. The candidates sit for a week or more, writing essay answers for three hours that too sometime twice a day. There is a cry for Examination reform. The educationsts accept that the end-of-course examinations to be replaced by 'Continous Assessment'. In America the students would be awarded grade or marks during their years of study by each professor on the strength of essays written, assignments, seminar participation, tests answered, demonstration lessons given, contributions made to class-room discussions and so on. Without the once-for-all final comprehensive examination the USA Professors awarded grade. In our set up the UGC, under the examination reform, has suggested the introduction of 'Coninuous assessment'. Under the name of 'Internal assessment', more and more weightage is to be given to this type of evaluation by the authorities. Some beginning has been made and thinking has been made by a number of educationists as how to make it more reliable and effective. The method of continuous assessment by the teachers can be used only if three conditions exist: the percentage of failures is exceedingly small; skills to be evaluated are largely practical; the grades awarded are not important for selection process i.e., admission to higher courses etc. (4).

Administration of tests is not compulsory for the teacher, but are nevertheless, used by almost every teacher in internal assessment. It is always the individual teacher who is responsible for the students' work. A teacher decides

what is to be predicted i.e. how success is to be defined. It is extremely difficult to agree on a definition of what success really is. Evaluation vary opinions change. In colleges success will be in terms of tasks to be completed. The internal assessment should indicate (a) mean marks in several subjects (b) distinctions in academic studies (c) assessment of aptitude for studies (d) technical comprehension (e) logical in deductive aptitude and (f) valid aptitude.

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CONCEPTS OF EQUALITY, MERIT AND EXCELLENCE IN ENGINEERING EDUCATION.

(Paper presented to the Summer School on Methodology of Teaching and Training from 4 - 31 August 1980 in Sri Jayachamarajendra College of Engineering, Mysore.)

In this paper I have explained and analysed the concepts of "EQUALITY" "MERIT" and "EXCELLENCE" with special reference to Engineering Education.

Since time immemorial Education has been considered as a very powerful/omnipotent instrument of Social, Economic and Culture development. If Education is to achieve this supreme end, it should be so planned and designed as to enable every individual in a society to develop his or her capacity and aptitudes to the maximum extent. All our developmental programmes and schemes would be doomed to frustration if our human resources are not fully developed and utilised.

In a democracy the worth and dignity of every individual is to be recognised. The endowed potentialities of every individual must be discovered and developed to the fullest extent to enable him or her to become a potential worker and a creative citizen contributing to the all-round progress of the society of which he or she is a member. No country can achieve full economic growth if it fails to make use of the talents of its citizens. The progress of a country largely depends on the fuller utilisation of its man-power.

If all the available human resources are to be discovered and developed, a system of education based on sound principles of social justice is very essential.

Social justide in education is another name for "equality of educational opportunities". A nation can strengthen its economy only by generausly investing in the education of its children and youth. Right Education given to right pupil by right teachers through right methods will bring a return to the individual and to the nation many times greater, than the money spent on it. This also referes to Engineering Education.

"A fundamental feature of education in a democratic and socialistic society is the emphasis laid on the equalization of Educational opportunity. The Education Commission (1964-65) has rightly identified the principle of equality of educational opportunity as one of the main aspects of the envisioned revolution in education. Ensuring progressive equality of educational opportunity according to

As a social ideal equality of educational opportunity has met with almost universal acceptance. Yet, what constitutes such equality and what ways and means foster its realization continue to be debated about. Divergent and conflicting interpretations have been offered of these and other related issues.

Metaphorically, the nation of "equality of educational opportunity has been variously interpreted as the opportunity to start together, the opportunity to finish together, the opportunity to benefit from staggered starts, and even the opportunity to run on the same track"(2.) From a different angle, it has been interpreted by some as meaning equalization of access by a suitable manipulation of educational inputs. To others it has meant much more, in equalization of results as well.

Differences in the interpretation of the meaning of equality of educational opportunity have naturally resulted in diverse educational prescriptions and policy recommendations the world over. In the U.S.A. for example, the remedy for racial discrimination and inequality has been sought by some in such programmes as the institution of massive "compensatory education" in favour of blacks. "In Britain the differentiation of "grammer schools" and "Secondary modern Schools", the practice of "Streaming" and now the "Comprehensive Schools" have all been both defended and opposed on the same plank of egalitarianism"(3.).

"The British plowden committee recognizing the fact that equalization of means of school education alone would not in fact result in equality of results recommended the adoption of the principle of positive discrimnation(4).

"The International commission on the development of Education while taking due role of the inegalitarian influences within the educational system, strongly urged for "a resolute social policy to correct unfair distribution of educational resources and effort"(5).

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*1. Education and National Development: Report of the education Commission 1964-66 (New delhi: Ministry of Education, Government of India, 1966, P. 108.

2. Michael Locke, Power and Politics in the school system (London: Routledge and Kegan Paul, 1974) P.P. 77-78.

3; Bryan R. Wilson, "Introduction", Education, Equality and Society London, Allen and Unwin 1975. PP. 28-36.

4. Children and their Primary Schools: A report of the Central

"To make confusion worse, some sociologists have recently challenged the very assumption behind all these recommendations that equalizing educational opportunity would bring about economic and social equality and have gone on to argue that the solution to equality will not within but outside the sphere of Education"(6)

Issues like the ones cited above assume special significance in the Indian educational context today. In spite of the phenomenal expansion of educational facilities after independence, Indian Education Continues to be plagued by inequalities of different kinds. Equality of educational opportunity as a critic has observed, remains an unexamined slogan in our country."(7)

Our education far from promoting equality has become out and out inegalitarian and elitist and its benefits are yet to reach the masses, as is evident from our failure so far in fulfilling the constitutional directive of universalizing elementary education. What is worse, even the few who have had access to a reasonable level of education find themselves utterly disappointed with the outcome. For a large majority of these "beneficiaries" equal educational opportunity has neither resulted in a qualitatively richer life nor served as a mode of social and occupational ascent, thus defeating the very purpose for which it is demanded. For equality of educational opportunity can have little meaning except in terms of the serviceability of education to the development of the individual and society.

Under these circumstances it becomes very pertinent to raise fundamental questions relating to the meaning and aim of equality of educational opportunity. It becomes even more necessary to critically examine and evalute the current polices and practices ostensibly designed to promote equality.

Equality of Educational opportunity is a very comprehensive and highly general notion as its component concepts of equality, opportunity and education touch almost every aspect of Life-Social, Political and Economic.

"The concept of equality constitutes one of the cornerstones of modern democracies. The doctrine of human rights, the notion of social justice and the ideal of welfare state - the universally recognized aspects of democratic philosophy are all either built on or have as their essential ingredient the concept of equality.

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6. Christopher Jencks of Harvard University - Inequality: A reassessment of the effect of family and schooling in U.S.A. 1973.
7. Veda Prakash "objectives of Secondary Education some reflections" The 4th Indian year book of Education, New Delhi. P. 61.

right to equality is accorded to status of a fundamental right in the constitution of India. So fundamental indeed is equality that it constitutes a substratum from which norms about which we all feel strongly and which constitute the part of our moral and political frame works are deduced" (8).

In the history of philosophical thought 'equality' has been used in a multiplicity of ways and with reference to diverse spheres of human activity - economic, Political, Social Religious and Educational. Furthermore in modern times, it has become a term of commendation and ethical prescription. As a result consequence, the all-too-frequent discussions among philosophers social reformers and political and legal theorists on the subject of equality have made the concept even more complex.

Although modern egalitarianism traces its beginnings to the 17th century, the idea of equality itself is as old as Greak civilization. Plato upheld the political equality of the sexes and Aristotle that of all free citizens.

The modern doctrine of equality saw its complete formalation during the enlightenment. This development was influenced by three factors: developments in physical Science of the period which supplied the necessary metaphysic (concept of real uniformity behind the apparent diversity"), the emergence of powerful middle classes in France and England who claimed equality with the nobility and the belief in the natural goodness of man held with a mystic fervour. The egalitarian movement reached its climax with the adoption of the universal declaration of Human Rights by the General Assembly of the United Nationas in 1948.

The idea of equality usually finds its expression in such statements as "all men are equal", "All men are born or created equal", and "All men are equal in the sight of God".

As a descriptive claim the statement "All men are equal" is used to point out certain supposed factual characteristics like the capacity to reason, to choose, to suffer, to experience pleasure. It is sometimes suggested that what makes all men equal is their common possession of the human essence, rationality.

More frequently, "all men are equal" is interpreted not as an empirical generalization about man but as a prescriptive claim, for equal treatment. In this sense it has found several formulations.

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8. W.T. Blackstone, "Equality and Human rights" The Monist Vol. 52, No.4 P.616.

"The claim to equality according to Raphael, is not a claim that all men are equal but that they are equal in respect of their rights. That is, in some sense they have a claim to equality"(9)

To peters the sentence "All men are equal" expresses not a proposition but an exhortation or an injunction to the effect" that one ought to treat everyman equally". "What is implied then by the prescription to treat all men equally is not that all men be liberally treated alike but that they be treat differently if these are relevant grounds for doing so"(10).

For, injustics results just as much from treating unequals equally as it does from treating equals unequally as Aristotle pointed out long ago. Such an interpretation implies that the principle of equality is tied to procedural rules, for adjudicating disputes between disagreeing parties and that it does not exist in a platonic heaven of pre-established ends. Thus the principle of equality gets subsumed under the broader principle of distributive justice which lays down that equal be treated equally and unequals unequally. What the principle asserts is that as far as treatment within a category is concerned it should be equal and as x far as treatment between categories is concerned the treatment should be different.

For the determination of these we have to appeal to other principles. For Example whether it is food, medical care, the right to vote, just wage or education, the principle of equality by itself cannot determine how these goods are to be distributed. What the principle does say, however, is that <u>if</u> poverty is a relevant criterion for say, providing free education and sex or caste is not, <u>then</u> as far as the provision of free education is concerned there should not by any discrimination among the class of poor people. Everyone who is poor, by our criterion, should get free education. But such free education, need not be given to the class of people who are not poor. Likewise, <u>if</u> it is agreed that only those who have the ability and aptitude to pursue higher education should be given opportunities for higher education, <u>then</u> within the class of people who possess these qualities there shoul/ not be any discrimination on other grounds (unless a further category of exceptions is created) and they should all be treated equally in the respect.

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9. D.D.RAPHAEL, "Justice and Liberty", proceedings of the Aristotelian Society, New series, Vol.LI 1950.51, PP. 182-3.

10. Thus the Law courts in India have held that in offences relating to women. Eg. adultery, women in India may be placed in a more favourable position, having regard to their social status and

But such equal treatment need not apply to thsoe who do not possess these qualities. The principle of equality is thus only a formal principle bereft of any content.

The notion of equality of educational opportunity has acquired further importance in view of its close inter-linking with the economic development of society. Economists prescribe equality of opportunity in education as a necessary condition for economic progress particularly of the developing countries. Inequality and discrimination are the chief obstacles in the way of national development.

According to Gunnar Myrdal, "Inequality and the trend toward rising inequality stand as a complex of inhibitions and obstacles to development".(11) Contrary to the ordinary conception of a conflict between economic growth and greater economic equality, they are often in harmony and "greater equality in under developed countries is almost a condition for more rapid growth.

Pierre Juvigny says: To create human capital and desire maximum benefit from it are prerequisities for any economic development. The ideal of equality of educational opportunity thus has a sound basis in the faith of economic life.(12)

While it thus appears that the case for equality rests on its functioning as a necessary condition for economic development, it also might be that the compulsion to provide equality follows not so much from the demands of economic development as from the acceptance of certain ideals and values. "Thus Gore and others have suggested that the compulsion to provide equality of opportunity especially as between different ethnic, religious groups follows not so much from industrialization as from the acceptance of certain value considerations. Industrialization, they argue, requires only widening educational opportunities but not necessarily an equalization of such opportunities."(13)

Whatever be the motive from which the demand for equality of educational opportunity springs, pragmatic or idealistic, there is no gainsaying the fact that the demand is universal. There is hardly any nation today which has not accepted the ideal of equality of educational opportunity in some form or other.

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11. Gunnar Myrdal, The Challenge of World poverty (Harmondsworth: Penguin 1970) PP. 63-4.
12. Pierre Juvigny: Towards Equality in Education (Paris 1952)PP.47-8
13. M.S.Gore and I.P.Desai, "The Scope of a Sociology of Education"

Equality of educational opportunity should be concerned not merely with the provision of equal inputs but with the effect of these inputs in bringing about an equality of outputs raises many problems. With respect to schooling such an idea means that equality is achieved only when the outputs of educational effort - knowledge, values, attitude, skills - are made equal.

"The Indian education system like the larger social system outside, is also out-and out inegalitarian. Its inegalitarian nature is most pronouncedly mainfest at the secondary and higher education stages. It is not, for example, the most talented ten percent of the college-age population that goes to the College rather it is the children of the affluent decile - the stratum, spending over Rs. 100 per capita per month - which is able to send their children to College"(14.)

In a major study to examine whether our education was governed by the goals of democracy equality and secularism with a focus of interest on equality of educational opportunity, Gore and others came out with the finding that despite the fact that 70 percent of the country's population is illiterate, there are not more than 25 percent students in any state at the high school level or above, who are drawn from homes with illiterate fathers. In terms of occupational background most of these came from urban occupational groups and very few from the groups of "agricultural labour" or "manual worker":

India's 4 percent of the relevant age group at College, says Shukla, come out of the less than 50 percent who have completed elementary schooling. They mingle or fail to, among the bare 30 per - cent of Indians who can read or write or at best among the 50 odd percent who live above the poverty line.

According to Shukla in bringing about egalitarian reforms in Education, the real obstacles are not technical or practical. But social and political. It is possible to devise privileged and to build curricular programmes doing the same. However to do so comes up against the resistance of these already educationally and socially privileged.

Equality of educational opportunity can never be fully realized until and unless radical measures are implemented to mend the inequalities in the larger society.

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14. S. Saberwal, "Education and Inequality - An essay in political sociology", Economic and political weekly Feb. 1972. P. 409.

The criterion of "MERIT" assumes importance in the context of Indian Education because it is generally taken for granted as a just and equitable ground of distribution of a limited good like opportunities for higher and professional education. "According to the education commission admissions to higher education for which demand far outnumbers the supply must be made selective using "Merit" as a ground of allocation."(15).

"Merit broadly speaking refers to all the kinds of valuable qualities or characteristices acquired by the individual and in respect of which individuals may be graded. According to this definition of Gregory Vlastos, wit, grace of manner, technical skill, sincerity, generosity, courage, all count as merit". (16)

'Merit' when argued for as a basis for access to higher education is either used to refer to an individuals intelligence or some such mental ability (as measured through tests), or to his previous educational attainments in the form of test marks or to both.

The claim that merit is a relevant criterion with respect to access to opportunities for higher education might be a descriptive claim that certain factors like intelligence, etc., are instrumentally related to the ability to pursue higher education. Whether this actually is so, is however a matter that has to be settled empirically. But the claim can also be a prescriptive or normative claim in that it may enjoin that these factors ought to be considered in the matter of according opportunities for higher education. "It is in the later case, however, that we run into all kinds of difficulties one might argue, for example as to why 'merit' and not 'usefulness to society' be adopted as a criterion for preferential treatment."(17)

The question is would not a consistent pursual of a merit policy result in a MERITOCRATIC SOCIETY? The defender of the merit policy might reply either that 'MERIT' is something that is intrinisically good and hence is to be valued for its own sake, or that a meritocratic society would exactly be the kind of society that is the most desirable one for all of us. Whether merit or some other characterstic

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15. Report of the Education Commission 1964 - 66.
16. Gegory Vlastos, "Human worth, Merit and Equality" Moral concepts ed. London: Oxford University Press. 1969.
17. W.T. Black stone "Equality and Human Rights" The Monist, Vol. 52, No. 4. October 1968. P. 613.

is to constitute a ground for distribution of opportunities for higher education is not a matter that can be settled by logic alone. It requires, in addition to a comprehensive understanding of the nature of the good of higher education, decisions about values having to do with how we want human beings to be treated and our concept of what human society should be like. A society that values freedom, equality and justice has therefore, to seriously consider, before, pronouncing its verdict on merit, the compatibility of otherwise of these values with the consequences of following merit to its logical end.

Daniel Bell the Harvard Sociologist, says that the populist revolt which young fore-saw several decades hence has already begun at the very onset of the "Post-Industrial Society", as can be seen in the derogation of the I.Q., denunciation of theories espousing a genetic basis of intelligence, demand for 'open admission' to universities, pressure for increased representation of minorities in the university faculties, attact on "credentials" and even schooling itself as the determinant of social position.

By the logic of meritocracy high IQ individuals, no matter where they are in society, should be brought to the top in order to make the best use of their talents.

The Harvard psychologist Richard Hernstein argues that if all persons are given an equal start and equality of opportunity based on merit is fully realized, than heredity will become the decisive factor, since the social environment would be the same for all.

Such descriptions of meritocracy cannot be simply dismissed as mere gloomy speculations having no relevance to a developing society like ours. No doubt, the merit policy is not being pursued with the same vigour and ruthlessnessin India as is being done in the industrialized societies of the west, and the chances of India becoming a meritocracy are, at the moment anyway, slender. But this does not take away the importance of the problem itself.

Meritocracy currently is a subject of lively debate particularly among philosophers and sociologists. While many have severaly opposed the meritocratic society, others have put up a stout defence of it.

The main philosophical objection to meritocracy is that it violates the principle of fairness. If one assumes that a meriotocracy is purely a selection of intelligence and that inteligence is based on inherited genetic differences, then one obtains privilege on

for social justice. Social justice, according to the critics, should mean not equality at the start of a race, but at the finish, equality not of opportunity but of result. According to John Rawls, meritocracy, although democratic, violates the principle of fairness for it follows "the principle of careers open to talents and uses equality of opportunity as a way of releasing men's energies in the pursuit of economic prosperity and political domination... Equality of opportunity means an equal chance to leave the less fortunate behind in the personal quest for influence and social position.18.

A second frequently mentioned objection against the meritocratic society is that it instils a competitive feeling which is bad not only to those who fail but also the those who succeed. Meritocracy is not without its supporters also. Daniel Bell classifies that meritocracy is not the same as technocracy. The technocratic mode in view of its preoccupation with technological efficiency relies heavily on selection by credentials which are "mechanical at worst or specify minimum achievement at best". Meritocracy on the other hand, "is an emphasis on individual achievement and earned status as confirmed by one's peers. It is important to bear in mind that a meritocratic society should have its safeguards and should be tempered with humaneness. Merit, today, is conceived not as a fixed attribute possessed by a few people but as a fairly widespread characteristic manifesting in diverse fields and not only in the intellectual field.

To conclude, merit as a basis of distribution can be justified only if every individual is given the opportunity to achieve all the merit he is capable of. In the absence of such opportunities to agrue that merit be given strict priority in matters of higher education would amount to deliberately leaving out a large number of individuals from enjoying the benefits of higher education for no fault of their own. This applies very well to that of Engineering Education.

Quality, as the International Institute for Educational planning in its symposium observed *19 can be viewed from within the educational system in the light of its own criteria such as student performance based on a standard examination. Quality, as the same symposium suggested, can also be viewed by external criteria such as its fitness and relevance to theneeds of its environment. The quality and efficiency of a engineering programme may be high according ot its

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18. John Rawls. A theory of Justice (Cambridge, Mass.1971. P.107).

*19. Philip Coombs, The World Educational Crisis P. 106.

own internal standards but if its teaching, judged by external criteria, is obsolete and irrelevant for its place and time, then its quality and efficiency must be considered poor.

We have to agree with Cooms that educational standards, if they are to make any sense and serve any useful purpose must be viewed as being relative to the particular purpose, place and time of the student clientele.

Quality, it has to be admitted, is essentially a normative concept. It has a reference to the changes in our concepts of society and education. We are witnessing a pleathora of changes in the field of Science and Technology in recent years. Therefore it is highly desirable to change the curriculum of Engineering programmes to suit to the needs of the modern world. This amounts to tell us that we want quality and excellence in the Engineering programmes so that it helps to build a modern India.

It is suggested that to introduce the concept of excellence in Engineering Education, the concerned people should sit together, discuss, the vital issues that are involed in the programme and evolve a quality scheme/programme to suit to the modern needs of India.

There is a general complaint that our engineering education programmes are not up to the mark compared to the other countries. This complaint can be arrested only when we introduce the concept of quality and excellence in our Engineering Education.

Selection of candidates to Engineering Colleges, its content/ syllabus/curriculum/, staff pattern, facilities in the college, human relationship in the college, all these should help to secure the concept of excellence in Engineering Education.

The programme makers should keep in view the modern needs of India and accordingly programmes should be drawn.

I feel that the concepts "Equality", "Merit" and "Excellence" are interrelated helping each other to evolve a quality Engineering Education programme in India.

I appeal to the participants of this Summer School to think clearly about these concepts and try to implement the real meaning of these concepts on an all India basis so that our Engineering Education gets further boost.

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" SOCIOLOGICAL DIMENSIONS OF ENGINEERING EDUCATION"

(Paper presented to the Summer School on Methodology of Teaching and Training from 4-31 August 1980 in Sri Jayachamarajendra College of Engineering, Mysore.)

Education is a crucial type of investment for the exploitation of modern technology. This fact underlies recent educational development in all the major industrial societies. Despite idiosyncrasies of national history, political structure, and social tradition, in every case the development of education bears the stamp of a dominant pattern imposed by the new and often conflicting pressures of technological and economic change.

Technical change is as old as civilization. Since time immemorial, peoples ways of living have been transformed by the introduction of new tools and technical procedures as inventions like the plough, the domestication of animals, writing, the use of steam, the factory assembly line, and the internal combustion engine, have been diffused from one country to another. Relationships of relative dominance between two peoples, population balances, dynastics, and whole religious systems have been upset by some change in technology, just as the inventions which underlie technological change have themselves arisen from changing conceptions of nature and of man.

This century has been variously described as the Age of speed, the Age of science, the Electrical Age, the Atomic age, the age of Machinery the Age of woman, and the century of the common man. It might also be described as the age of test tube and the laboratory.

In an advanced industrial society, It is inevitable that the educational system should have very close relationship with the economy. Modern industrial technology, based on the substitution of Electrical and atomic for other forms of power and introducting new and more intricate forms of the division of labour, transforms the scale of production, the economic setting of enterprise, and the productive and social role of labour. It is dependent to an unprecedented extent on the results of scientific research, on the supply of skilled and responsible manpower, and consequently on the efficiency of the educational system.

Modern industrial societies are distinguished in their structure and development from other of comparable complexity,

principally by the institutionalization of innovation - that is to say, by the public and private organization, on an increasingly large scale, of scientific research in the service of economic and military growth. Their occupational structures are characteristically diversified, with relatively high educational qualifications for employment at all levels but the lowest. Education attains unprecedented economic importance as a source of technological innovation, and the educational system should move towards achieving economic stability. The traditional business of education with the process of culture transmission is performed in quite new terms under the new conditions of technological society. No longer is it a question of handing //over an unchanging, or only slowly changing, body of knowledge and belief. On the contrary, education in modern societies has more to do with changing knowledge than with conserving it, and more to do with diffusing culture to wider social circles, or from one society to another, than with preserving and transmitting the particular culture of a particular group.

Sociology mainly deals with "human relationship" in the technological world. In recent years the sociology of education has been established in education courses as one of the foundation disciplines of education. Basically, sociologists regard education as a distinctly social phenomenon or "institution" which, like other social phenomena, is amenable to objective scientific analysis. The prime concern of the sociologist is to build up a verified body of knowledge about education in relation to society. The sociologist is interested in education in general and Engineering Education in particular because it is one of the central activities of industrialized societies; he studies educational institutions in order to improve his understanding of the structure and institutions of industrial societies and the way in which the young are inducted into full membership of them.

According to R.A.Nisbet, (1) the great classical them of sociology are characterized by first, a moral aspiration; the great ideas of sociology have been generated by individuals with a moral commitment, and second, the frames of thought and ideas of sociologists are the result of artistic imagination, vision and intution.

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1. R.A. Nisbet, the Sociological Tradition, London, 1966, Part-I.

Horton,[2] in a similar vein has argued that the classical definitions of anomic and alienation (to take two key sociological ideas) rest on opposed utopian descriptions of essentially the same social discontent. He goes on to argue that the evolving history of these concepts has not led to the emergence of value free concepts but the transformation of values. He suggests that these ideological changes might be explained sociologically in terms of the changing class position of the sociologist and the organization of sociology. We must also agree with Nisbet and other sociologists who have pointed out that we can only understand the fundamental ideas of sociology if we realise that sociology is . an attempt by industrial man to understand industrial man. The matrix of sociological thought was the industrial revolution.

The changes which we are witnessing reminds us of the many inventions which have so greatly altered modern living. Changes have occured in the arts, in music, in the theatre and in the cinema. New religious cults have arisen, new philosophical ideas have developed, psychiatry has won recognition. There is scarcely an area of culture in which important changes have not taken place during this century and the stream of change flows on.

The changes in culture during the first half of the twentieth century are indeed remarkable, but an examination of a century of Engineering progress (1852-1952) reveals something else of importance concerning the relations between Engineering and science. Engineering and science are factors intimately interwoven in modern culture, first in the sense that they created this new culture, and secondly from the social standpoint because the ever-changing economic and social demands of the day are primary incentives to continued and more rapid engineering and scientific development. Engineering as a potent instrumentality in the rise of western civilization has a history of at least fifty centuries. What developments, then, in the scope and character of modern Engineering account for the remarkable changes of the past century?

James Kip Finsh recounts the outstanding achievements of the Industrial revolution in answer to this question, noting material and organizational features.

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2. Horton.J. The Dehumanization of Anomic and Alienation: A Problem in the ideology of Sociology; British Journal of Sociology, XV, 283 - 300.

We are seeing a century of ever increasing complication and complexity. The older, largely independent, isolated, and self-sufficient rural life, which most of our people led a 100 years ago, has been in the process of replacement by nothing less than a completely new culture. No longer are we a nation of small, self-sustaining units. A family economy has been replaced by a highly interdependent national - in some respects international - exchange of goods, the majority of which were formerly produced at home. Man-or even the family - can no longer stand alone. We are dependent upon others for the bare necessities of life, not to mention new services we now regard as essential. The economy under which we live is no longer under individual control and one in which we may, with relative ease, visualize our needs and wants and adjust our resources to meet them. It is, infact, so involved that even the economic doctors, although aware of many symptoms, dispute causes and differ widely as to cures.

Engineering and science are intimately interwoven in the complicated fabric of modern life, for they have; on the one hand, created this new culture and on the other, the even-changing economic and social demands of the day are primary incentives to continued and more rapid engineering and scientific development.

Industrial revolution has brought a spate of changes in many countries specially with reference to knowledge explosion and popu-lation explosion.

We hear much of the monotony of modern industrial life, of the loss of the pride and incentive, the creative satisfactions, of our earlier craftsmanship era. The answer is of course, that a craftsmanship era could not maintain our standards of living of the present day. In earlier days 'man's work was from sun to sun. Those were the days when the majority of men were brothers to ox". Since the turn of the century technology and industry have created useful, productive employment for millions, thanks to modern machines and power.

Engineering has been, indeed, the great levelling force in the history of man. It has done much to compensate for the differences of night and day of heat and cold. Through transportation and power it has made possible the equalization of differences of location.

Engineering is creative, seeking to satisfy man's material needs

shaping our environment and exploiting our resources for the better use and convenience of man, is inevitably working with or against natural forces or making use of natural gifts.

Ours is a society wherein changes are taking place at various stages. The challenges of present day society is some thing different compared to the past century. Every nation wants to progress viz., economically, scientifically and technologically.

The criteria of progress should be understood as the social growth of social life, it is the gradual elevation of the standard of human development and their societal progress is a movement towards some general and greater human good.

Education in general and Engineering Education in particular should contribute towards the development of a nation from various angles.

Development should be looked on as the way of achieving a society having certain basic qualities, rather than merely offering a degree of affluence that is expected.

In fact, development is usually taken to mean economic development. A number of economists have stressed the inadequacies of the traditionalapproach to issues of development and emphasized the importance of human factor. We need trained manpower for effective national development.

Education has been considered as the most effective means of altering the outlook of ~~xxxx~~ people; this rather than the mere inclucation of skills, is what is needed if the structure of society is to be modified.

The men who built the great economics of the world, and those who today maintain and expand them, could not have done so, had their independence of action and their capacity to accumulate resources been limited by the restrictions and the wilely diffused obligations of a rural subsistence economy. The high-production economies are built upon the ruins of the extended family and of the complex network of values which had given it continuity. In one sense we can view this as a release from a form of tyrany, a freeing of man's energies and desires from the dead-weight of tradition, which has enabled him to reach great creative heights.

Engineering colleges are producing Engineers with sophisticated knowledge of engineering education. At the same time, our concern is that the Engineers should have knowledge about society, its problems, requirements, needs and what not?.

Engineering Colleges should give more importance to practical side of Engineering than theoretical aspects so that, engineers can apply simple technology for example to construct a bridge, road etc, so that they can solve the day to day problems with more confidence.

One of the sociological dimension of Engineering Education is that the Engineers should come out from their ivory tower of narrow specialisation, to work with people who need simple knowledge about how to repair a waterpump, how to do wiring, how to make use of the modern techniques in the field of agriculture etc.,

Engineers are trained for solving complicated things at higher level. As a result they find it difficult to adjust with the people who need simple knowledge about various areas.

It is said that Engineers after their degree find it difficult to work in Engineering firms and they want one year or two year extra training to know the technical know-how of working. This clearly tells us that there is some lag or isolation in the engineering education.

Engineering Colleges should produce Engineers in such a manner that they should fit in well /with the society and contribute for the progress and prosperity of the society.

India is basicaly a country known for its agricultural supremacy. Even today in a majority of villages good old methods have been used/ implemented in the field of agriculture. If we want to disseminate modern techniques in the field of agriculture we want trained personnel in this discipline. Engineering colleges can prepare engineers with the specialised knowledge of agricultural engineering. The main aim of engineering Education is that it should serve the society with all modern knowledge.

I feel strongly that Engineers need a sound knowledge of society, its structure, problems, social change, social control, social order, the process of socialization etc., so that they can discharge their duties more effectively. However, this does not mean that present day engineers lack knowledge about society. Admission to engineering

courses starts after the completion of pre-university. When once the students join the main stream they will be concentrating their attention only on engineering subjects. As a result, they would have had no opportunity to study society and its problems scientifically.

Engineering Colleges should as far as possible give "FUNCTIONAL ENGINEERING EDUCATION" so that engineers conserve society better.

Engineering Colleges should have clear vision of the future needs of our country and give Engineering Education accordingly.

I want the participants of this summer School to evince keen interest in this area so that they in turn can help the "student-engineers" to get a better knowledge of the sociological dimensions of engineering education.

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STUDENT UNREST

(Paper presented to the Summer School on Methodology of Teaching and Training from 4-31 August 1980 in Sri Jayachamarajendra College of Engineering, Mysore).

Violent strikes and dharanas by College and University students have become almost a daily feature in Indian Colleges in recent years. We appear to be unable to restrict or ward off either such things.

The instincts and aptitudes which constitute human nature have to go through a course of discipline for their sublimation and unfoldment and this is known as real Education. Discipline is inherent in Education. Without the former the latter is all moonshine. Such bein the importance of discipline, whenever it is found at a low ebb in any sphere of life, the position has to be carefully examined and means devised to put things in gear.

Unfortunately in India, the time at present seems to be quite out of point owing to a feeling of insecurity and despair engendered by the spirit of indiscipline ramoant almost in every sphere of social and political life. To day indiscipline among students is assuming alarming proportions in our educational institutions.

Student unrests are not of one universal genere. Sometimes it reflects the larger aspects of national or regional developments like what happened during freedom struggle, language agitations, as in Assam now about eviction of 'OUTSIDERS' etc. Such activism is entwined with unsurge in the society and are not of endemic occurance

Education cannot thrive without proper co-operation between the students' home and the educational institution. But there is no relation between the two and even if there any, it is rather critical and not co-operative. This offers wide scope for indiscipline to creep in among the students.

As a result neither the teacher nor the parent but the man on the street is the students guide and his emotional mind, unable to resist the heat of excitement caused by the Ringleader, easily breaks away from the all too thin bond of teacherly influence that binds him to his Alma Mater and he dances to the tune of interested parties mostly political.

Very occasionally student protest is about redressal of genuine complaints of some aspect of University malfunction. Malfunction is more common now than before. The rapidly growing size of the Universities brings in its trail its own brand of complexities and trauma

for all concerned. Universities are increasingly power areas for many to struggle for a share of university largesse. The unconcealed promotion of sectional interests, irregularities in admissions and in examinations, the stories of all round corruption have lowered the credibility of and regard for University administrations. The persons that suffer most from these abberations are the large majority of the orderly and devoted students. This silent and enduring lot, for the most part, do not register their protest, even when protest is justified. It is not rash to say that student activism has not espoused the cause of the large silent majority for the amelioration of the many day to day problems. They are too prosaic to attract the student activists.

It is said by some that student struggles are only manifestation of the right of dissent and protest indispensable for the exercise of the academic freedom of thought. This right is no doubt, essential in the pursuit of knowledge. Unfortunately this right is tried to be identified with the right claimed by student activists to defy, fight, humiliate and take matters to the streets. Owing to a certain amount of laxity on the part of the authorities these student activists seem to be labouring under the impression that by main force they can have any demand acceded to however unreasonable it may be and they have the confidence that even if they fail in the attempt, they will get off with impunity. This is a hard fact and is, inter alia, largely responsible for the recurrence and spread of student unrest all over the country.

In any discussion of student unrest, we are apt to assume that we are dealing with the entire student community. But really speaking it is not so. A substantial segment of students are uninfluenced by and even unsympathetic to student activists. Student unrest is a syndrome of a militant segment everywhere. It is an attempt to parade the will of the few as that of the whole.

The other day a small section of Bangalore University students was holding the entire student community to ransom and that 90 percent of the students and 95 percent of teachers are opposed to the demonstrations staged by a few Ring leaders continuing to remain as students only for formenting trouble.

Recently, in Jayachamarajendra College of Engineering, Mysore, some students were holding the entire student community to ranson in protesting against the introduction of 4 year Engineering programme. I could see a good police personnel inspecting the whole area in the campus.

Like wise there are hundreds of incidents throughout India wherein for the sake of a few students, the entire student community

In India, a university degree is still the primary passport for any type of employment, general or professional. With university educationm tending to become universal, the value of university degree is rapidly getting devalued. All degrees are Losing their potential for securing jobs. The system of buying admissions with capitation money has intensified competition. Only the really assiduous survive the struggle.

If an analysis of the composition of student activists is made, it will be found that most of them are students with indifferent educational record or those hailing from institutions with low standards of teaching and discipline. Lost in the competition they are tempted to seek short cuts to university honours. In a generality of cases, student disturbances are the final outcome of the frustration of students illqualified for serious study, when their endeavour for success anyhow meets with failure.

Further, constructive and informed thinking the world over tends to look upon "Student participation" or student involvement as a promising prophylactic against campus disturbances and student unrest which frequently causes violence. Eminent educationists and social thinkers too have favoured the idea, though, when it comes to practical steps, they whould, for good reasons, err on the side of caution. Politicians out of power, understandably, support it vociferously while those in power, equally or perhaps more understandably look askance at the idea. The end result the scheme cannot get off ground.

The other day the Kerala University and Jawaharlal Nehru University students have asked for the "students representatives" to be allowed as observers on certain University bodies. Likewise in many universities students are pressing their demands and this is there since many years.

The then Prime Minister Mr. Moraji Desai, when approached by a delegation of J.N.U. students in 1978, with regard to student representatives, emphatically rejected the demand. Mr.Desai was afraid that even as observers students would politicise further the already much politicised atmosphere of the University. Many political leaders are of the same opinion that there is an urgent need to depoliticise the atmosphere of the various universities in India. In this regard they must set a clear and unambiguous example themselves. This can be done by doing away at once with the practice of Prime Minister being the Chancellor of the Central University or Universitie and Governor being the Chancellor of state Universities. The practice is a relic from the old British imperialist days. A colonial governmen

possibilities was understandable, though this leverage was seldom pressed or pressed too hard. There is no reason why the practice should continue in free India. It has vitiated the atmosphere in the universities and explains the poor quality of Vice-chancellors since independence, exceptions granted.

It must be understood at once that "Student participation" does not mean permitting - and perhaps bowing to - student rowdyism. It means that students have to associated and actively involved in the whole process of decision-making. The process covers, among other things, devising the curriculum, fixing syllabi, introducing courses, instruction, examination, provision of facilities and amenities, the question of discipline and right conduct, the nature, management and control of student activities, their associations and the like. Any decision on these matters necessarily affects students in one why or the other. It is only elementary justice, particularly in a democratic society resolved on its survival that those whose interests are affected should have a say in the making of those decisions. They must at least be heard.

A fear may be expressed that some of these matters are so important that allowing student participation in the related decision-making may upset the whole academic apple-cart. The student agitations got up in recent times around demands for things like lowering the admission eligibility conditions, relaxation in examination standards, permission to use open books in the examination, revocation of disciplinary action taken by appropriate authorities etc may be cited as conclusive evidence against the practicability of the contemplated move. But this evidence is not conclusive. It is irrelevant. These manifestations are possible, even become inevitable, mainly because the rights of students as legitimate interest group are not recognised and allowed. Positive evidence will be there only when we give the matter a trial. Here and there some representations to the students is available. This is not the right spirit.

It should be known that participation does not mean dictation. The admission of students to the decision-making process does not mean that others abdicate their judgement and responsibility. If we set about the business in the right way, student participation can provide healthy channels for the expression of their energies. Students will be compelled to identify their genuine interests, grapple with their problems, think out their solutions, formulate them coherently and express them effectively. It will be a kind of discipline which would keep them engaged continually. They will learn to listen to others and to agree or disagree on rational grounds with what they

but in a joint-adventure. This results in a new kind of student leadership. Far from disrupting the academic process, as feared, student-participation, with other reforms now being talked about, will, by channelising their energies and ordering their activities, vitalize and strengthen it.

Student participation can serve as a technique for containing and finally removing student unrest. Political intervention or exploitation only aggravates the situation. The trouble arises when students' interests and difficulties remain uncomprehended or unattended to. Student participation will necessarily bring into the open their dissatisfaction, irritations, even hostility arising from real or imagined neglect of their needs. The students in turn will listen what their elders have to say and will have to face the logic on which latter's contention is based. This interaction results in good understanding and induce sobriety.

Finally, let it be clearly understood that it is not politics that vitiates our Universities but party-politics. And, it is entirely up to the political leaders to see that it is kept out of the Universities.

Lastly it is suggested that to deal effectively with serious cases of student unrest, there may be set up in every state, by proper legislation, a standing commission consisting of a High Court judge as the Chairman and the Director of Public instruction, one Vice-Chancellor and one College Principal as members to give justice to the students.

Participants of this Summer school are requested to suggest other method of combating the problem of student unrest. Suggestions are most welcome.

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INTER - PERSONAL RELATIONSHIPS

THE TASK OF THE TEACHER AS LEADER IN BUILDING HUMAN RELATIONS

Rev: Fr: Dr: P.C. Eapen

There seems to be a need for a new concept of Human Relations to be developed among the masses of people of our country. The new concept should emerge from the age ~~ax~~ old faith in human dignity and the right of everyone to share man's God given rich heritage. Social science which seeks to perfect man's relation to his fellowman require scientific analysis, experimentation and the application of scientific theories for the solution of social, political and economic problems.

In spite of all the advancements in the field of Social Sciences very few people are prepared to consider human relations from the scientific point of view. The fundamental principle this new knowledge has produced is encouraging to all who subscribe to the 'cultural concept'. For a long time the popular notion of 'human nature' was that people are naturally warlike and aggressive, inclined to base their actions on animal passion rather than reason. But modern social scientists have given us a new view of mankind. According to them the irascible human nature we see about us is not physically determined. Human nature has been culturally determined. Man is not born with particular traits of personality. But man's superiority lies in the fact that he is the least specialized, the most plastic of all creatures. The great powerful message of the social scientist is, "Man need not be warlike or live in poverty to be chained by ignorance and prejudice". If he is, it is because he made himself that way. And what man has made, man can change.

This new cultural concept can provide us with many more things than a scientific faith in humanity. Some of us, in a wishful thinking frame of mind, look at 'different' people in our own country as though they are a lot worse than we are. As a matter of fact learning scientific facts about other groups of people has taught us that differences found in other people are due to differences in environment.

Education is essentially a dynamic process to help develop human beings. Teachers as leaders have a tremendous responsibility in facilitating growth and development in students entrusted to their care. The successful development of desirable traits and attitudes in students depends entirely on the leadership abilities of the classroom teacher. Investigations carried on indicate that the attitudes of teachers towards students and class work can be measured with

high reliability, and that they are significantly correlated with the climate of the classroom.

What do we mean by the term climate? Climate represents the emotional tone which is a concomitant of inter-personal interaction. It is a general emotional factor which appears to be present in interactions occuring between individuals in face to face groups. It seems to have some relationship to the degree of acceptance expressed by members of a group regarding each others' needs or goals.

It seems that the concept of leadership is rapidly changing. Most of the studies of leadership were devoted primarily to the identification of traits or qualities of leaders. These studies were based in part on the assumption that human beings could be divided into two groups- the leaders and the followers". According to Stogdill,(1) " a person does not become a leader by virtue of the possession of some combination of traits, but the pattern of personal characteristics of the leaders must bear some relevant relationship to the characteristics, activities, and goals of the followers". Thus, leadership must be conceived in terms of the interaction of variables which are in constant flux and change. In 1954 Myers(2) made an analysis of more than 200 studies of leadership. The following conclusions are drawn.

1. No Physical characteristics are significantly related to leadership.

2. There is no significant relationship between superior intelligence and leadership.

3. Knowledge applicable to the problems faced by a group contributes, significantly to leadership status.

4. The following characteristics significantly correlate with leadership: insight, initiative, cooperation, originality, ambition, persistence, emotional stability, judgement, popularity and communication, skills. These characteristics denote qualities of an interactional nature. They are present in leadership situations much more often than are characteristics that denote status or qualities of a more individualistic nature. Actually, most of the personality traits or characteristics that have been found to be associated with leadership should be classified as skills or competencies in human relations rather than personality traits. Leadership is defined in terms of leader behaviour. For example any person could be considered providing leadership for a group when he:

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(1) Ralph M. Stogdill, "Personal Factors Associated with leadership A survey of literature, Journal of psychology, XXV 1948.

(2) Robert B. Myers "The development and implications of a conception of leadership for leadership Education" 1954.

1. Helps a group to define tasks, goals and purposes

2. Helps a group to achieve its task goals, and purposes

3. Helps to maintain the group by assisting in providing for group and individual needs.

Homans[3] presented to following hypotheses concerning interactions that are of great significance to the understanding of leadership.

1. If the frequency of interaction between two or more persons increases, the degree of their liking for one another will increase, and vice versa.

2. If the interactions between the members of the group are frequent in the external system, sentiments of liking will grow up between them, and these sentiments will lead in turn to further interactions over and above the interactions of the external system.

3. A decrease in the frequency of interactions between the members of a group and outsiders, accompained by an increase in the strength of their negative sentiments towards outsiders, will increase the frequency of interaction and the strength of positive sentiments among the members of a group and vice-versa.

Applying the above hypothesis to a College community we might generalise as follows:

1. The more all people, faculty, students and community interact with each other, the more opportunity ~~m~~ they have to like each other.

2. Sentiments of liking grow up between teachers and students who work together on the job, and these sentiments will lead to other activities beyond the requirements of the curricula or courses to be mastered.

3. If the communications between a faculty group and the student body are reduced and this lessening of communications is accompained by an increase in the negative sentiments of each group toward the other, then the members of each group are drawn closer together, but intergroup hostility is increased.

The emphasis to-day is to understand the leader follower relationship rather than attempting to discover the characteristics of the leader. A survey by Bird[3] in 1940 found a total of 79 differen traits attributed to leaders in 20 studies of School and College groups. The agreement was very small; only 23 or these traits appearing in more than a single list. Gouldner in a recent review

concludes that the attempt to discover the traits associated with leadership in general have so far resulted in failure. Jennings suggested that, "it is necessary to ask leadership in what respect? For whom? In what sort of group?

Martin Conway in his study of leaders classifies leaders under four categories.

1. Group manipulators
2. Group representatives
3. Group builders
4. Group originators

1. Group manipulators: are self-seekers. They understand the urges of the people, voice them forth, and thus acquire leadership, and then exploit it for personal advantage.

2. Group representatives: are leaders elected by people to represent their demands, needs and views. They make a distinction between their personal views and those of their electrorate which they represent.

3. Group builders: are those who give a careful thought to what the people really need and are always concerned about identifying things in the best interest of the people. They help people to develop ability for self-awareness: and exhort them to realise their innate potentialities.

4. Group originators: are those who have new ideas to propagate. They try to win people to their own points of view. They often create leaders more than mere followers.

The role of leadership in group phenomena is demonstrated in the important investigation made by Lewin, Lippitt and White who were interested in the different patterns of behaviours which were in various experimentally created "Social climate". There are three main types identified:-

a) Authoritarian
b) Democratic
c) Lasissezfaire

In the authoritatian group, all policies are determined by the leader. He decides the activities to the initiated within the group. The techniques and processes of activities are indicated by him, one at a time, so that future steps are always uncertain. The dictator always keeps himself aloof from active group participation.

In the democratic group all policies are determined by the group discussion. The division of tasks and sharing of responsibilities are also determined by the group. However, the group functions harmoniously and productively.

In the Laissezfaire group there is complete freedom for either group or individual decision. The leader gives the information, but takes no part in group discussions.

In one experiment, hostility was thirty times as frequent in the autocratic group as in the democratic group. Much of the aggresion was directed towards two successive scapegoats within the group. None was directed against the autocrat. In another experiment, the members in the autocratic group showed less aggressiveness, but their behaviour was of an apathetic or indifferent type. This lack of aggression is interpreted as due to the repressive influence of the autocrat. There were outbursts of aggression on the days of transition to a freer atmosphere and a sharp rise of aggression when the autocrat left the group.

The sutdy estblished that the democratic group relations is the best where members of the group worked most carefully, had the greatest involvement with interest, offered many suggestions and in greater numbers participated and finished the tasks they undertook. It also established that the relations among the members depended upon the relations of the leaders to followers within the group.

The teachers should be group builders and group originators functioning with a democratic outlook. They should give leadership to the Students' by establishing a democratic climate where every member accepts and discharges responsibility. Responsiblity is better learned by shouldering responsibility than by learning from books and exhortations.

The following are some of the qualities of a leader:

1. Energy: A lazy man can never become a leader. A leader must possess energy, in the form of endurance, commitment a sense of duty and courage.

2. Intelligence:
   Problem solving and decision making are the two Major function of a leader. He should profit from past experiences and have the forward-looking ability.

3. Character: Symoathy, integrity, initiative, dependability and a sense of purpose should always dominate his behaviour.

4. Ability for socialization:

> The success of teachers as leaders is dependent upon their ability to set the tone of the classroom. They do socialize a lot and help the members of the class also socialise among themselves.

However, lack of communication among individuals and groups, a sort of rugged individualism, a feeling of isolation, loneliness, lack of a sense of security and a sense of belaongingness seem to be the characteristics of the modern youth. The rugged individualism and the impersonal relationship that exists among members of a class often makes the younger isolated, anxious, and full of confusions concerning himself and the aims of life. Many may continue to suffer from hunger or physical pain, but the worst of all pains is loneliness and isolation.

The following are some of the problems which Teachers have to confront.

a) There are problems of emotions, where the best solution seems to be try to change emotions.

b) There are problems of understanding-where further knowledge offers the key to their solution. One of the problems is the problem of caste communal, linguistic and religious pride, and the arrogance which may be the offencive expression of such pride. The pride in the traditions, mores, and culture to which one belongs is quite justified. But it is the debasing of this justifiable pride, claiming that there can be only one good inheritance, and that is the one which is one's own, which often creates misunderstanding and tension. Cultural pluralism is a fact of life and teachers as leaders should always be tolerant to, and respectful of diversities in cultures they identify in different groups.

c) The problem of "closed mind". People haveing a closed mind, often refuse to understand that difference does not mean inferiority. One may often close his mind to knowledge which enables him to develop an appreciation of the excellences of the heritage, customs and culture of other groups different from one's own. The teachers have to come to the realisation that the differences that set one group against another are quite superficial. They should also help to understand how the cultural contributions of all groups are increasingly becoming a part of each one of us. It is still more important for us to understand each other in spite of apparent individual differences.

d) Related to the above is the problem of "false perception", which is technically known as 'stereotyping'. This means false generalisations from isolated superficial, inadequate observations made. Eg. 'They are untrustworthy' 'They are liars' The Statements

like these are either projections of ones' own temperament or can be invalid generalisations made without sufficient basis. This would create great distrust, hatred, and tension between individuals.

Teachers should always keep themselves free from preconceived prejudices, narrow fanaticism and misinformations. Perhaps, the best way out of this malady would be to cultivate intimate interpersonal relationships so as to respect the integrity and dignigy of other persons.

e) Whenever individuals feel insecure in their relations with the rest of the group they will become shy. Shyness develops when one feels inadequate to confront a given situation.

Aggressiveness develops when one feels that he is overlooked or not given fair consideration by his associates.

Loneliness develops when one feels that he is excluded from the sympathy of those about him.

Exclusiveness is greater aggressiveness or prideful demonstration to oneself of one's own superiority because he is not in sympathy with the group:

- a sense of belongngness
- a sense of security
- a sense of status
- a sense of being accepted, recognised and always concerned about the needs of others.

Kurt Lewin's observation of group insecurity as "group Self-hate" is revealing. Here the person tends to reject his own group and idealize the cultural of other groups. Kenneth and Mamie Clark[4] did a study in which they presented Negro children with white and coloured dolls and asked questions about them. These children tended to identify the white dolls as the clean ones, the nice ones and the good ones. The coloured dolls they identified as the dirty ones and the bad ones. Such rejection of one's own group and the idealisation of the other's limits the capacity to appraise situations objectively.

Another group insecurity is knowns as, carrying a "chip on the shoulder". When a person is insecure he must continually test out whether he is really accepted in the group. Often there can never be proof enough. So in his anxiety to find evidences for his being

accepted, he makes a nuisance of himself by demandmmng that his acceptance be proved.

A stable and harmonious atmosphere can never be created by unstable, emotionally arrested personalities. Frustrations very often leads to hostile, aggressive behaviour or withdrawal and self-destructive reactions. Sometimes when there is a less privilaged group outside, the frustration is projected towards that group in hostile aggressive behaviour.

Those who are friendly will always find that others respond to their freindship. United and cooperative activities will facilitate the promotion of personal accuaintance which helps to build respect for the individual and appreciation for his talented achievements. Herein consists the teachers role as leaders in developing human relations skills so as to help develop integrated personalities in themselves and in those whom they associate with.

The conventional role of the Teachers as highly authoritarian person alites need to be considerably changed. In such recogganization of the leadership role, understanding, and the utilization of the dynamics of group processes have to be stressed.

Under the group approach to leadership, a leader is not concerned with getting and maintaining personal authority. His chief purpose is to develop group power that will enable the group to accomplish its goal. He does not conceive of his power as something apart from the power of the group. He is concerned with developing the type of relationship that will give him "power with the group".

It is now being increasingly and rightly recognised that the students, who have the greatest stake in the education process, should have a large hand in determining the College programmes. The Students, for whose sake the College or the University exists, cannot be prevented from identifying their needs and making decisions as to the methods by which they will satisfy their needs. The students behave better when they are respected, entrusted with responsibility and trusted for their ability to work co-operatively with the administration for the welfare of the Institution. Human curiosity is paralysed, when youngsters feel that they have to work under continuous interference and x suspicion. What the students need is proper conditions for the unfolding of their personalities so that they could become efficient in personal social living.

The following questions may perhaps be meaningful in this conte:

1. Are we aware of the pattern of interaction and group relations that exist in our own Institutions?

2. Do we know that bases of the different student groups functioning in their own peculiar ways?

3. Do we know why people behave the way they do?

4. Do we know the sources of student behaviour and the values they reflect?

Teachers as leaders could certainly become efficient and most effective if they could try to:-

1. Promote better, understanding between bhe various groups functioning on the campus.

2. Eradicate ignorance about groups different from one's own.

3. Identify prejudices and ease tensions.

4. Respect individual differences.

5. Help students to deal with people as individuals and discourage generalizations about people.

6. Develop ability to see a problem from various angles.

7. Develop ability to recognise and appreciate what others are trying to do do.

8. Develop an abiding faith in the integrity of all students.

9. Avail themselves of the facilities provided for democratic living.

10. Plan the productive utilization of leisure time by taking up a variety of activities in the area of social work and work experience.

11. Be loyal to the institution one belongs to and keep the interests of the Institution above every other consideration.

12. Demonstrate intellectual humility by listening to people, open up channels of communication with every one and restrain rash judgement.

CAN AUDIO-VISUAL AIDS IMPROVE TRAINING EFFECTIVENESS?

Dr.M.V.Ananthakrishnan

1. WHY USE AUDIO VISUAL AIDS?

Psychlogists estimate that, on an average, the human mind retains 20% of spoken information presented and about 40% of visual information. These data clearly highlight the tremendous impact such media, used individually or in combination, can create in any training situation.

Further, audio visual media provide the trainer with distinct advantages, normally not had with traditional methodology. The salient advantages are that audio visual aids

* help in reimforcing or in illustrating the spoken information:

  e.g. Displaying the model of a car while describing one verbally.

* provide a change of pace

  e.g. The screening of a cine-film in-between sessions may help the teacher in changing his subject or lecture style.

* save time

  e.g. An instructor, especially when hard pressed for time, may find a chart/model coming to his rescue.

* add realism

  e.g. A cine-film shot in a real situation showing the life of a steel worker in a plant, may help in reinforcing the environmental factors existing in a steel plant.

* render assistance in a learning situation

  e.g. Imagine a trainee who has attended a session on cupola operation but has not been able to get a grasp of it. An aid (say a cine film or a chart) can come to his rescue by depicting the various concepts in the form of simulations, animations, diagrams and the like.

* encourage trainee participation & involvement

  e.g. Consider the use of films dealing with managerial tests and rating exercises or charts/transparencies asking for some information to be completed or filled up by the participants.

(*This article was published in NITIE Bulletin, Bombay, Vol.III, No.3, 1975).

The above paragraphs can be made more "down-to-thex-cart by quoting from an article by Hills. According to Hills, the real break-through in effective training "will come not by trying to attach audio-visual aids as unwanted appendages to a mediaeval system, but by recognizing and using audio-visual media as an integral part of a total teaching (training)

2. WHAT DO AUDIO VISUAL AIDS DO?

According to Erickson: "Though we in no sense depreciate the power of verbal methods in teaching (training), we must emphasise the essential character of audio-visual materials, namely, that they make possible a broader range of sensory stimuli. Hence, they provide a more direct form of experience to facilitate hearing, seeing, doing, and trying".

The roles, sometimes superhuman, played by audio visual aids/materials in a training situation are,

* they provide the means for extending the horizon of experience,

* they help in providing meaningful sources of information,

* they provide the trainer with interest - ~~xxxxxxxx~~ compelling spring-~~x~~boards into a variety of learning activities

* they assist in overcoming physical difficulties or presenting subject matter,

* they provide the trainer with rich sources of participation, especially when the materials are produced jointly by the trainees and trainers,

* they provide the trainer with a kit of tools to carry out diagnosis, research and remedial work demanded by up-to-date instructional purposes.

3. WHAT ARE THE AUDIO-VISUAL AIDS?

The "acid" test of an effective trainer or an effective training programme lies not in the types of audio visual aids used but in the legitimate use of the aids available with the trainer/training organisation. In essence, this means that the trainers should not become "slaves" of the aid but always have the aids under their complete command. To clarify further, a trainer, who is habituated to the use of an overhead projector incessantly should be able to adapt himself to a flip-chart board/black board in case of a power failure.

The plethora of audio visual equipment currently available at the disposal of the instructor is amazing and awe-inspiring. But, an attempt will be made here to describe only a few of the commonly used sophisticated aids. These are in addition to popular ones like the blackboard, visual chart, flannel/magnetic board and the flip chart.

Slide Projector: A sophisticated version of the "historical" magic lantern. The slides used are normally of dimensions 2" square or 3¼" square.

Epidiascope: A two-in-one aid. It is the combination of an episcope and a magic lantern. The episcope helps in projecting materials without prior preparations like printed materials from books, journals, etc.,

Overhead Projector: A transparent acetate sheet, on which is drawn the matter to be displayed, is illuminated from below and the image is obtained on a screen. The advantage here lies in the fact that the projection material (sheet

"sound" or "silent" mode.

Tape/Cassette Recorder: This is usually used in language teaching or in providing commentaries for slides and/or silent movies.

Television: A very "powerful" aid somewhat similar to a cine-film projection. However, by the use of closed--circuit-television (CCTV), one can see "live" situations in the classroom, the camera being located in the actual work area. If in addition, a video recorder is available, the sequences can be "shot" and stored for future use.

Computers: A modern "advent" in as far as training/educatio is concerned and this has led to the new field of computer-assisted instruction (CAI).

4. A GOOD AID - WHAT IS IT?

There are seven characteristics of an "aid" which go a long way in contributing towards the culmination of a successful training schedule/assignment. They are

* relevancy & appropriateness
* simplicity
* accuracy
* visibility & clarity & legibility
* supporting role to main presentation
* utility with the least handicaps.

5. HOW & WHEN DO YOU USE AUDIO-VISUAL AIDS?

One should be prudent with the use of aids. Aids, properly used, add to the presentation. Beware! Improperly used aids may lead to annoyance and result in distraction!

Every trainer, for successful usages of audio visual aids, should essentially

* be completely familiar with equipment and its use
* use a few aids only
* arrange aids, so that everyone can see or hear (set up the aids well in advance)
* make sure that the aid is working as desired
* use the aid as a "slave" not allowing it to dominate
* switch off an aid when not in use
* speak to the class and not the aid.

6. REFERENCES

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MULTI MEDIA SYSTEMS IN TECHNICAL EDUCATION & TRAINING
AN INDIA'S APPROACH**

Dr. M.V. Ananthakrishnan*

Introduction:

The effectiveness of any educational system or training programme in a country is evident from the economic and cultural development of that country. India is a country with an ancient cultural heritage and is traditionally an agricultural country. It is with this cultural and economic background that India launched on her industrialisation programme. Even now a good proportion of Indians earn their livelihood through agriculture.

India has made rapid strides in her industrial development programmes, both from indigenous sources as well as a result of collaboration with the more developed nations. But what about the technical manpower needed to man these industrial complexes? Our educational institutions as well as training organisations which are dispersed virtually all over the country are still hanging on to the traditional methods of transferring knowledge. No doubt, industrially oriented courses are being conducted by the colleges of technology, the post-graduate course being invariable under UNDP-UNESCO assistance. Moreover, these colleges have mostly been located in the precincts of a heavy engineering industry or steel plant. The principal idea behind such ideal locations is to provide specialised academic programmes which are in keeping with the needs of the industries around the college. But, all said and done, the net output of such institutions is evident more in the form of numerical output of pass-outs rather than effectiveness and utility in industry and professional life. Thus, in short, one can say that the majority of the academic programmes invariably aim at increasing the academic achievements of the person rather than improve his proficiency in actual working in industries.

The methodology of teaching and/or training leaves a lot to be desired. Many of our teachers still stick to the blackboard and are in the habit of dictating voluminous notes. Modern teaching aids have made virtually no inroads into the teaching techniques.

Technical Education & Training in India: An appraisal

The present educational methodology in our country treats "pure sciences" and "applied technology" as two water-tight compartments. Thus, the inter-disciplinary concept is virtually absent. As a result, the "pure" science graduates are unable to enter industry without undergoing some technical course or some training scheme in industry.

The syllabi followed in technical institutions are either outmoded or too theoretical. Even the practical work planned for such courses are mostly alienated from theory both from the view point of programming and biassing.

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**Paper presented at the International Conference on "FRONTIERS IN EDUCATION", London (UK), July 1974.

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All major industries in the country, on the other hand, no doubt have their own training departments fully equipped with manpower and facilities. But, in as far as teaching aids are concerned, the commonly used are the blackboard, charts and sometimes the 16 mm projector to show technical films. Further, things are not even so "rosy" in case of the small scale industries.

The various aspects which add to the current systems of teaching and training are:

a) The virtual absence of audio-visual aids in teaching/training

b) Stereotyped methods of delivering lectures and dictating voluminous notes.

c) absence of effective co-ordination between theory and practice

d) Setting of essay-type questions aimed at testing the memorising capacity rather than the understanding ability.

The above considerations in a way expose the pitfalls in our system of teaching/training.

Multi-Media Approach to Teaching/Training: NIFFT Trials

Multi-media systems include the individual or combined use of modern teaching aids like the slide projector, the overhead projector, the epidiascope, the filmstrip projector and the movie film projector as far as India is concerned. Modern and sophisticated media like closed-circuit television (CCTV) and computer-aided instruction (CAI) are conspicuously absent although they have had remarkable success in the advanced countries.

The National Institute of Foundry & Forge Technology is a national institution set up with UNDP-UNESCO assistance. Moreover, it is situated in the precincts of the giant Heavy Engineering Corporation (Ranchi). The academic activities being run and planned in the near future include short-term refresher courses in specific aspects of foundry and forge technology, advanced diploma courses in foundry & forge technology and post-graduate courses in foundry/forge technology.

The author has been actively participating in all the courses in the form of lectures in pure and applied sciences. As a part of the teaching methodology adopted by the author, generous use of teaching aids (slide, overhead projection, episcope and movie film projection) has been made. The subsequent paragraphs will deal with a few examples of a multi-media approach used by the author while teaching specific topics in foundry/forge technology. At the same time, stress must be laid on the fact that all the time an inter-disciplinary concept is used embracing physics, chemistry and engineering.

Temperature measurement and Control:

A discussion on this subject entails demonstration of the thermoelectric effect, resistance variation and radiation pyrometry. Some of the kits/aids used or rigged up for this are given below:

thermoelectric effect demonstration: A Cu-Fe thermocouple is made and connected to a millivoltmeter placed on the base of an epidiascope. By placing the junction in a lead bath (cooling), the millivoltmeter dial (projected on the screen) will show up changing values of thermo-emf.

Disappearing filament pyrometer: The author's experiences show that the explanation (in words only) of the colour matching is invariably incomplete. The author has rigged up an OHP development type overlay. It consists of four frames which in turn depict the cold filament, filament hotter than hot body, filament colder than hot body and filament and body matched.

Temperature control/programme: A simulation model of the mercury switch control mechanism is shown through a dynamic model used in conjunction with the overhead projector. On the other hand, the photoelectric control fundamentals is exhibited by means of a demonstration assembly using a film projector (for the photocell), the sound box, a mirror and a wooden / to represent the indicator needle. The total floor space required is 150 cm square.

/Lathe

Structure and properties of metals and alloys:

This particular subject mainly involves the use of the overhead projector although to some extent demonstration models have also been included.

Crystal lattice development: This is a development-type OHP transparency used to prove the possibility of a 2-fold, 3-fold, 4-fold and 6-fold symmetry axis whilst explaining as to why a 5-fold axis cannot occur.

Lattice stresses and strains: This ia a dynamic model to show the occurrence of lattice strains and stresses. Whilst marbles depict the atoms, rubber bands are used to simulate the forces. The introduction of oversize spheres in the substitution and interstitial vacancies give rise to simulations of stresses/strains.

Plastic Deformation: The 'Forgemaster' is a two-dimensional dynamic model which uses the overhead projector to simulate the fundamentals of plastic deformation. Further, the elements of drop press and die forging are all shown using a plasticine stock. This model uses an unique method to simulate gravity in a horizontal plane.

Tensile properties: Again an OHP overlay consisting of two frames. By this the tensile test in dynamically simulated showing elongation, necking and rupture. An added asset here lies in the in situ calculation of elongation and percentage reduction in area.

Quantitative Spectrographic Analysis: One of the methods of analysis using spectrographic techniques is by using the rotating sector method. The rotating sector (normally having a logarithmic profile) gives rise to spectral lines of varying heights depending on concentration. The author has used the multi-media approach using the overhead projector and the filmstrip projector. Whilst the ohp is used to explain the sector geometry, an actual spectrogram is projected using the filmstrip projector. The principle of 'heigh ' measurement is also explained on the screen.

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Proposals for further multi-media systems:

As indicated earlier, the computer and television have not entered the teaching/training arena in India. A radio is more feasible for the average Indian than a television, set. As such a possible alternative would be to supply written notes in advance to the listener to be followed by discussions on the radio network through mock teacher-student sessions.

The setting up of an Audio-visual Aids Committee on a national scale is underway under the initiative of the author, the Indian Institute of Metals and the Indian Copper Information Centre.

Acknowledgements

The author acknowledges with thanks the NIFFT authorities for having provided suitable facilities to carry out and implement the multi-media system approach.

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3. THE T.B.O. APPROACH: AN EXPERIMENT WITH TECHNICAL PHYSICS TEACHING

M.V.Ananthakrishnan,M.Sc.,

SYNOPSIS:

The present paper summarises the attempts made by the author in adopting the TBO (Teaching by Objectives) approach to the teaching of Physics in the Foundry/Forge curricula followed in the National Institute of Foundry and Forge Technology, Ranchi.

INTRODUCTION

The National Institute of Foundry & Forge Technology is situated in Ranchi in very ideal surroundings i.e., in the precincts of the largest Heavy Engineering complex in Asia and within approachable distance of many industrial research and educational institutions. The Institute has primarily been established to cater to the needs (of the up-and-coming foundry/forge industries) in the form of technical know-how and shop/floor personnel.

Engineering Physics (along with Engineering Mathematics, Metallurgical and Instrumental Analyses, Physical Metallurgy, Furnaces and Refractories and Engineering Drawing) constitutes the subjects of the First semester of the Advance Diploma courses in Foundry/Forge Technology. The break-up of the time allotment for Physics is:

Theory	30 hours
Practical	40 hours

In the initial years of the above course, the author had experience in covering the three basic subjects (Physics, Chemistry and Mathematics). This provided a ready opportunity for the author to try teaching experiments in inter-disciplinary approaches to science teaching. A subsequent section will briefly describe the above attempt.

The TBO APPROACH

The Teaching by Objectives (TBO) approach is somewhat similar to the MBO technique adopted in Management Science. Let us, to start with outline the basic concepts of the TBO scheme. They are:

(a) Identifying the need (objective) of Physics in the light of the technical course curricula;

(b) Developing and teaching the Physics curricula and planning related practical work.

(c) Evaluation schemes to test students on the basis of (a) and (b).

*Working Paper, Group on "Physics for Technical Education & Technical Literacy", International Conference on Physics Education, Edinburgh, July 1975. Technical Teacher,Annual 1976.

We shall now attempt to develop our discussion on the TBO approach to Technical Physics Teaching on the above lines, by taking a typical example.

"Furnace Technology" constitutes a common core subject for both the Foundry and Forge disciplines. We will now try to see how we can get about applying the TBO techniques. Firstly, one has to identify the need (objective) of the curriculum. The various aspects concerning Furnace Technology are:

(i) The methods of heating and heating rates.

(ii) The furnace constituents/components.

(iii) Temperature Measurement & Control

(iv) Atmosphere Control

Having identified the needs of the main subject (objective), we shall now proceed to the second aspect, viz., working out the Physics content. (The content is best worked out when done in coordination with the Applied Science faculty and subsequently taught in the class in the same fashion).

(i) Methods of heating and heating rates, Fuel, heating-Types of fuels, calorific value, flash point, viscosity and specific heat fuels. Electrical heating-Fundamental concepts, Electrical resistance heating and induction heating and related physical phenomena and concepts.

Heat transfer processes of conduction, convection and radiation.

(ii) Furnace consituents:

Refractories and their physical properties viz., thermal conductivity, refractoriness.

Furnace framework properties like thermal conductivity melting point etc.,

(iii) Temperature measurement & Control:

Theoretical principles of temperature measurement techniques based on thermo-electric effect, electrical resistance variation, vapour pressure and radiation. Temperature control mechanisms and their physical working principles involving discussions on electro-magnetic relay circuits and electronics.

Now, as far as the practical assignments are concerned they are based on readily available equipment which could be rigged up. Some of the aspects touched are:

(i) Heat transfer properties of good and bad conductors.

(ii) Thermoelectric properties of fabricated thermocouples followed up by the actual use of industrial thermocouples.

(iii) Resistance variation studies of electrical conductors followed up by the actual use of industrial resistance thermometers.

(iv) Study and use of radiation pyrometers and temperature controllers/programmers.

Finally, let us see the evaluation scheme adopted to test the students on the Physics taught and using the TBO techniques. Here again, one attempts at framing questions to test the students' ability to apply the physics to the core subject/chapter, i.e., the objective. A few typical questions are:

(i) Molten metal (at super heat) is cooling ladle. Discuss the various contractions taking place until the metal teaches the ambient temperature.

(ii) You are required to determine the melting rate of a metal in the electricalfurnace, the electrical specifications of which are given. What are the various physical properties you should know? Using these data how would you proceed with the calculation of the melting rate?

(iii) What are the advantages of electrical heating over traditional fuel heating?

(iv) Radiation property vis-a-vis Thermo electric pyrometry-make a comparative study of its advantages and limitations with specific reference to furnace technology.

CONCLUSIONS:

The discussions given in the earlier section are just one of the aspects covered in the realm of Foundry/Forge technology. In essence, it has been dilated upon in some detail to highlight the following advantages:

(i) The Students need not view the Physics teaching as isolated from the main core subject(s). They are given every chance to correlate the two aspects.

(ii) The teachers of the core subjects have the basic advantage of speaking to an audience who are already aware of what is coming up in their main study.

(iii) The Physics teacher and the core-subject counterpart can always get together to ensure a smooth transition.

ACKNOWLEDGEMENTS:

The author wishes to thank the Director, NITIE for having permitted to prepare the present report. The NIFFT authorities are to be thanked also for providing the base to carry out this study.

The Vaccination Theory of Education:

"English is not History is not Science and Science is not Art and Art is not Music. Art and Music are minor subjects; English, History and Science are major subjects. A subject is something you "take" and when you have taken it, you have "had" it and if you have 'had' it, you are immune and need not take it again.

- Neil Postman & Charles Wiengartner in "Teaching as a Subversive Activity"

PROGRAMMED LEARNING IN INDUSTRIAL TRAINING *

M.V. ANANTHAKRISHNAN

ABSTRACT :

The present paper attempts at making a survey of some of the publications brought out in industrial training schemes making use of programmed learning. Examples of the work done in this direction by British and American industries/ organisations are illustrated. Moreover, at every stage, the author attempts to highlight the various avenues where programmed instruction can be included in our training programmes.

INTRODUCTION

"Programmed Instruction has much to contribute to the more effective and economical management of training schemes within the industry" - a conclusion reached in March 1963 by the working party appointed by the Training Committee of the British Iron and Steel Federation.

This is rather a very optimistic fashion of starting the present review of all matters published in the field of industrial training, although it does not present a rigorous study. It definitely provide a comprehensive survey of the diverse applications of programmed learning in industrial training- those which can easily be adopted by our industries.

At this stage, a very pertinent question comes to the mind of the training Officers/educationists of our country : What is the relevance of programmed learning in industrial training in India? The author feels that this "teaching tool" is an invaluable aid in as far as our country is concerned. The justifications for this stand are manifold. Primarily, many potential "talents" amongst our children and youth are compelled by circumstances to go in for employment despite their aptitude for further studies. As a consequence their busy involvements in their vocations leave them with no time to attend regular evening classes in colleges/polytechnics. Thus, the only way out of this predicament, the author adds and contends, is the sincere and devoted

efforts towards the rapid development of programmed learning courses and self-paced tutorial schemes. According to Pipe, "the teacher can delegate to programmed instruction some parts of his task, perhaps the routine part of his subject matter, the concepts that are hard to teach, or those that must be rehearsed until perfect".

RELEVANCE OF PROGRAMMED INSTRUCTION IN INDUSTRIAL TRAINING :

The 1963 working party of the Training Committee of the British Iron and Steel Federation has brought our a comprehensive report on their findings and subsequent recommendations. Entitled "Programmed Instruction" the publication is "intended for use within the industry to provide a brief explanation of programmed instruction". Their recommendations, which are most valuable, can best be summarised as follows:

a) Steps be taken to implement programmed learning in and assist companies in this direction.

b) The Training Department be made the clearning house of all materials available on programmed instruction.

c) A sub-committee be established in order to coordinate in the

d) Attempts be made to coordinate with external agencies (experienced in preparation of programmed materials).

e) Affluent companies be asked to finance and prepare specific programmes. These programmes may later on be distributed either on hire or sold.

f) Companies be asked to examine programmed instruction material (produced by the Federation) and explore possibilities of using them in their own training activities.

g) In cases where member companies are unable to prepare materials on certain specific topics, the job be assigned to outside agencies and the cost incurred thereon should be shared by the users.

According to the British Iron and Steel Federation, their experiments show "beyond reasonable doubt that programmed instruction enables students to learn more quickly than they would by conventional methods, without any significant loss of retention" - slower students no doubt take more time, but a much stronger foundation is built. Thereby, they stand every chance of reaching the standards of the brighter students of their group.

PROGRAMMED INSTRUCTION : A SURVEY OF SOME APPLICATIONS:

To start with, it would not be out of place to briefly indicate the two principal methods of constructing programmes viz., "Linear Programming" and "Branching Programmes".

Linear Programming: (due to Prof. B.F. Skinner)

Involves a course of instruction where each student is taken through many stimulus - response steps. These steps or "frames" follow one another in a direct sequence irrespective of the response of the student to each frame. On the other hand, Branching Programmes (due to Prof. N.S.Crowder) require the student to make response to a question by selecting one answer from several "possibles" offered. If he offers the right answer, he is guided to the next question. But if he fails to do so, he is "helped" in arriving at the right answer, using "remedial steps".

The National Institute of Foundry and Forge Technology, with whom the author serves, is a national Institution established to provide specialised and up-to-date know-how in foundry and forge fields. As such, an analysis of some typical applications (of programmed instruction relevant to these fields) will be attempted in this section expecially those brought out by industries and/or training organisations.

"Basic Principles of Gating" and "Basic Principles of Risering" are a set of two programmed texts brought out by the Americans Foundrymen's Society (U.S.A.). This uses Skinner's linear technique and ably, demonstrates the effectiveness of programmed instruction. Taking the "Basic Principles of Risering" as an example the ~~exktext~~ is made up of 329 frames distributed over four lessons.

At the end of the text there is a "post-test" which is made up of 50 questions selected from amongst the 329 frames. A few sample "frame will illustrate vividly the approach to the subject.

FRAME 5: And we know that when the doctor tells us that we have a fever of $102^{o}F$, he is talking about our body (heat/temperature)-

FRAME 12: A solid metal rod is heated at one end. After a while, the other end is almost as hot as the end that is heated. Heat transfer has occurred by (conduction, convention/radiation)-

Contd.... 13/-

FRAME 33: Heat Transfer will take place only from a point with a (high/low) - temperature to a point with a (higher, lower)-temperature.

As far as the "post-text" is concerned, it is made up of exclusively TRUE-FALSE question, e.g.,

QUESTION = 1: When a substance has changed from a liquid to a solid, we say that it has solidified.

QUESTION 8: Shrinkage is normally caused by the lack of feed material.

QUESTION 10: A material that slows down the flow of heat is called an insulator.

Approaches, identical to the one cited above, have also been adopted in programmed texts like "Principles of Semi-conductor Devices" (Mullard Ltd., U.K.) and "Weight calculations" (Industry Training Board, U.K.).

The author has made a comprehensive and exploratory study of the programmes cited above. According to him, they fully corroborate the feelings of Pipe (quoted earlier) and fully live upto the expectations sought for by the publishers and programmers.

Branching programmes have also been effectively used in industry, for which the materials published by General Dynamics (USA) would be an ideal example. "Non-destructive Testing" is the subject of the programmed tests published in three volumes. To quote the publishers. "This book will teach you how and why a liquid penetrant test works the materials required for a liquid penetrant test liquid penetrant test liquid penetrant indications and their meaning, and the limitations of liquid penetrant testing". They further contend that "when you have completed this book, you should be ready for practical demonstration sessions an on-the-job training to fully qualify you as a technician". Commenting on the method of approach to the programme, their advice is: "Do not rush through this book. Take whatever time you need to get the most from the material presented".

A typical programme (page 3-24 of the text on "Liquid Penetrant Testing") will indicate and illustrate clearly the approach to 'Branching Programmes'.

Page 3 - 24

The low temperature limit of 50°F presents a more serious problem. It may be common practice in some areas to apply penetrants outdoors at temperatures around freezing. Below 50°F, the penetrant becomes sluggish and its sensitivity is greatly reduced. The time charts become useless since they were based on a known sensitivity at normal temperatures. In extremely low temperatures the penetrant may become so sluggish that it will not enter discontinuities regardless of the time allowed. For the charts to be useful under cold temperature conditions the penetrants must remain above 50°F for the duration of the dwell time. This may require heating of the penetrant and the article before application.

Which of the following is correct?

Normal penetrant temperatures must be above 50°F (page 3-35). Temperatures above 100°F will restrict penetrant entry (page 3-26). Penetrants will become useless below 50°F (Page 3-27).

Page 3 - 25 :

Normal penetrant temperatures must be over 50°F - correct.

Page 3-26 :

Watch out now. This is a hote one. Penetrant temperatures above 100°F will not restrict penetrant entry but, these temperatures might cause the article to become heated. The heated article, in turn, could become hard to handle. Additionally, penetrant will lose some of their effectiveness if they are heated excessively. If you will now return to page 3-24, the correct answer will probably be obvious.

Page 3 - 27 :

Your answer is not entirely correct. This is true only in a sense. It would be more accurate to say that penetrant becomes sluggish and test sensitivity is lessened, when the temperature falls below 50°F. Penetrant is not useless below this temperature, but a penetrant temperature below 50°F is certainly not good in a test situation. It is possible that chilled penetrant would not enter tight cracks. Either the penetrant or the article should be heated so the penetrant will do its job as expected,,and the tune charts will be meaningful.

Take another look at Page 3-24 and choose the statement which is entirely true.

At the end of each volume of the above series, there is a "self-test", made up of a good number of question selected from the programmes. Trial runs conducted by the author himself as well as some students have proved the extreme usefulness" of this series in short-term courses and self-paced learning.

ACKNOWLEDGEMENTS :

The author wishes to thank Mr.K.A. Reynolds, F.I.M., Open University (U.K.) for having introduced him to the fascinating field of educational technology during his tenure as UNDP-UNESCO expert attached to NIFFT. The Director-in-charge, NIFFT is to be thanked for providing facilities to carry out the survey and plan "trial" schemes on a small scale. The publishers of the various texts reviewed here deserve special mention for the excellent materials brought out by them.

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4. General Dynamics, Nondestructive Testing (3 vols), San Diego, 1967.

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6. Pocztar J., The Theory and practice of programmed Instruction, UNESCO, Paris, 1972.

AUDIO-VISUAL MARKET PLACE: A SELECT LIST

A. AUDIOVISUAL EQUIPMENT

1. EPIDIASCOPES

Capable of projecting 50 mm x 50 mm, 35 mm filmstrips and opaque material (150 mm square). Lamp (500/1000 W) with cooling fan, operating on 220 volts 50 cycles single phase.

Complete with all accessories like slide carrier, filmstrip attachement and protective cover.

Essential Spares: Projection lamps (2 Nos)

2. OVERHEAD PROJECTORS

250 mm x 250 mm projection platform; 650 W.Halogen (quartziodide) lamp; efficient cooling system; operating on 220 V, 50 Cyc. single phase, projection head capable of tilting a few degrees above and below normal position; Knurl type focusing knob to adjust projection head. Complete with accessories like acetate roll attachment, overhead projector pens, table and protective cover.

(SEE PAGE L23).

Essential spares: Projection Lamps (2 Nos.)

4. SLIDE PROJECTORS (Automatic)

Slide projector capable of projecting 50 mm x 50 mm slides (paper mount or plastic mount), Halogen projection lamps (650 W), remote control mechanism to advance or reverse slides and focus slides. Operating on 220 V, 50 Cyc.single phase. Complete with accessories like Linear slide carriers (50 slides capacity) & rotary slide carriers (100 slides capacity and protective cover.

Essential Spares: Projection Lamp (2 Nos), Slide carriers linear - 2, rotary 2).

5. PROJECTION SCREENS ("MATTE" type")

Size 182 cm and 182 cm (6' x 6') 'Peeralite' quality or equivalent; complete with projection screens, tripod stand, full unit capable of being packed completely.

6. CASETTE RECORDERS (AUDIO)

Capable of playing standard audio cassettes recording and replay capability with "auto stop" facility, built-in- condensor microphone; adaptability to external microphone and recording from other cassette recorders; unit to operate on 220 V, 50 C/s, single phase.

Essential accessories to include remote control microphone, attachments for transferring information from one cassette to another, earphone, TDK Cassettes (90 mins - 12 Nos).

7. 16 mm CINE PROJECTOR (SOUND)

Capable of projecting 16 mm 'sound' cine films, Halogen projection lamp (650 W), optical sound system; equipment operating on 220 volts, 50 cycles single phase; Built-in rewinding mechanism.

Essential accessories include loud speaker, spools (6 Nos) rewinding unit, film splicer, film cement.

Essential Spares: Projection lamps (4 Nos), springs for spools

B. MANUFACTURES/DEALERS (INDIAN)

1. Modern Visual Aids Corpn Aman chambers Mama Paramanand Marg Bombay 400 004.	Epidiascopes, Overhead Projectors, slide projectors, screens, Cassettee Recorders:
2. Photophone Pvt.Ltd., Fazalbhoy House, New Marine Lines Bombay 400 020.	Overhead Projector, Screen 16/35 mm movie projectors
3. Cinecita Pvt. Ltd., Apte Industrial Estate 1076 Dr.E.Moses Road, Worli, Bombay 400 018	Epidiascopes, Overhead Projectors, screens 16/35 mm projectors
4. Educational Scientific Stores, Himalaya House, Palton Road, Bombay 400 001	Epidiascopes, Overhead projectors, screens
5. Central Camera Co. Ltd., Dr.Dadabhoy Naoroji Rd., Bombay 400 001.	Slide projectors, Overhead projectors, Screens
6. Oriental Scientific Apparatus, Workshops, Alexandra Road, Ambala Cantt., Punjab.	Epidiascope, Overhead Projectros, Screens
7. Electro Phonionics India Pvt. Ltd B-10 Jeedimetla IDA Hyderabad 500 084 (AP)	Overhead projectors
8. Educational & Scientific Equipments(P) National House, Tulloch Road, BOMBAY 400 039	Slide projectors, Overhead projectors, Screens
9. Central Electronics Ltd., 4, Industrial Area, Sahubabad 201 005 (U.P)	Automatic Slide Projectors

C. PRICE ESTIMATES (Indian)

	Rs./Each
1. Epidiascope	5,000/-
2. Overhead Projectros	5,000/-
3. Slide projectors (manual)	1,000/-
4. Slide projectors (Automatic)	6,000/-
5. Screens	600/-
6. Cassettee Recorders	1,000/-
7. 16 mm Cine projectors	9,000/-

D. FILM DISTRIBUTORS (FOREIGN)

1. British Productivity Council
   16 South Molton St.,
   London WIY IDE, UK

2. National Educational Media
   15250 Ventura Boulevard
   Sherman Oakes
   California 91403, USA

3. Nightingale Conant Corpn.
   6677, N.Lincoln Ave,
   Chicago, Illinois 60645,USA

4. Stephen Bousustow Productions
   1649, 11th St.,
   Santa Monica, Calif 90403 USA

5. Central Office of Information
   Hercules Road,
   Westminister Bridge Road,
   London SE 1 U.K.

6. Rank Audiovisual
   P.O. Box 70, Great est
   Road, Brentford,M
   Middlesex, TWS 9 HR U.K.

7. B B C Enterprises
   Villiers House
   Broadway, London W5 2PA
   United Kingdom

8. University of Michigan Television Centre,
   400 S fourth Ave, Ann Arbor Michigank,
   48103 USA

9. B N A Communications Inc.,
   9401 Decoverly Hall Road,
   Rockville, Maryland 20850
   USA

10. Stewart Film Distributors
    82-84 Clifton Hall,
    London NW 8 OJT, UK

11. Operational Research Society,
    Neville House, Waterloo St.,
    Birmingham B2 5 TIC, UK

12. E M I Ltd.,
    2-4 Dean Street,
    London WIV 5RN, United Kingdom

13. National Film Board of Canada,
    Ottawa,
    Ontario, Canada

14. Film Library Centre,
    U.S. Air Force,
    8900 S Broadway,
    St.Louis, Missouri 63125
    U S A

15. Philips N V Enidhoven,
The Netherlands (Holland)

16. McGraw Hill Inc.,
1221 Avenue of the Americas
New York,
N Y 10020,USA

17. Guild Sound and Vision Ltd.,
Woodston House,
Oundle Road,
Peterborough,
PE 2 9PZ,
United Kingdom.

E. FILM DISTRIBUTORS (INDIAN)

1. National Education & Information Films Ltd.,
National House, Tulloch Road, Bombay-400 039

2. Ama Pvt Ltd., Canada Building,
Dr. D.N.Road, Bombay-400 001

3. Rangoon Studio,
58 Janpath,
New Delhi 110 001

f f f

PLACE OF LABORATORY WORK IN SCIENCE/ENGINEERING EDUCATION

Dr. M.V.Ananthakrishnan*

1. WHY HAVE A LABORATORY?

According to the philosophy of Neher (1) a laboratory is necessary because:

a) most people learn with their heads as well as their hands. This means that one can learn about some physical phenomena in the class but it may not actually soak in until and unless one has had the opportunity to handle a piece of apparatus and used it to his own satisfaction.

b) a good laboratory should develop the experimental ability of the student. He should develop a sense of isolating out the important aspects in a given situation. A person with a sense of good experimental technique on the same piece of equipment may, in a given time, come up with an answer that is much more reliable as compared to the one attained by an inexperienced person.

c) Many experiments illustrate physical principles that are very difficult to grasp on the basis of classwork alone. However, if a Student can be provided with opportunities to test for himself about many of the principles, he would ultimately know a lot more about the subject and, that too, on a firm foundation.

d) the training in skills constitute an essential part of the education of any individual.

e) it is taken for granted that there are certain accepted ways of doing things and they are best taught in a laboratory. Students should know to maintain laboratory records, get into the habit of tabulating data in a proper fashion, use this data to arrive at results and thereby estimate the reliability and errors in the results so obtained.

2. OBJECTIVES OF EXPERIMENTAL WORK

The principal objectives of any experimental work are:

a. To supplement, through measurement & experimentation, the lecture sessions, by providing an opportunity to gain personal insight into the physical concepts and their principles and relationship. Emphasis must also be laid on the limitations inherent in such techniques.

b. To inculcate attitudes or critical thinking through experience in the careful recording, interpretation and analysis of experimental data.

c. To develop skills in the appropriate use of the various equipment, the techniques and procedures adopted by physicists through experience.

d. To motivate Students by developing interest and enthusiasm in them for the study of physics.

e. To encourage students to think and work independently and use discrimination effectively in the overall study of science.

A study by Ahmed (2) has shown that Laboratory work (using a conventional laboratory) does not improve the performance of Students as compared to those who have undergone a program where the subjects have been taught in a purely theoretical manner. This, at first sight, may apparently indicate the futility of laboratory work. But this is only one side of the picture. What is needed is a concerted effort to receive classroom demonstration and laboratory work in consenance with the theoretical sessions so that students are provided an opportunity to see simultaneously both the aspects of a particular subject. If this is done, laboratory work will definitely find its proper place and play its vital part in purposeful and effective sciences/engineering education.

The pedagogical design of the engineering laboratory has been the subject of considerable controversy among Students, faculty and practising engineers. There is little controversy, however, on the value of laboratory work. Indeed, behind the affirmation lies the general consensus regarding the need for and the goals of laboratory instruction (3)

The American Society of Mechanical Engineers describes a laboratory component of the mechanical engineering curriculum as follows:

> "Laboratory experience in mechanical engineering has several possible goals; to develop a Student's ability to design experiments and analyse experimental results; to familiarise him with modern measurement methods, instrumentation and equipment; to enhance his knowledge physical phenomena and the behaviour of engineering components and systems; to introduce him to the use of experimentation as a part of the design process; and to develop his ability to report on his work and his findings".

3. FACETS OF ENGINEERING LABORATORY -INSTRUCTION:

A QUESTIONNAIRE

Rice (3) reports of a teaching objectives checklist for engi-nnering laboratory instruction. This list of 36 objectives can readily be used in checklist format as a means of gather-ing data which allow for di ferentiation of individual obje-ctives. These objectives can be relatively graded by analysis of data - according to a given group of faculty:

The checklist is made up of four categories and the 36 obje-ctives are distributed among them as follows:

Category: SUBJECT MATTER CONTENT

Student should acquire knowledge of:

1. Relation between theoretical & experimental studies
2. Laws, principles or theories
3. Safety requirements or codes
4. Reference or information sources
5. Facts or definitions
6. Historical development

Category: EQUIPMENT AND INSTRUMENTATION

Student should acquire knowledge of

1. Operating characteristics of specific instrumentation
2. Function & use of specific instrumentation
3. Operating characteristics of specific equipment
4. Functions & use of specific equipment
5. Mechanics of specific equipment
6. Mechanics of specific instrumentation

Category: STUDENT ATTITUDES & HABITS

Student should acquire

1. Appreciation for planning and preparation
2. Competence in conveying information by use of the written word
3. Ability to recognise the relationship of specific cases to general principles or laws
4. Engineering judgement
5. Competence in compiling a neat, presentable report
6. Practice in synthesis
7. Confidence in his ability as an Engineer
8. Practice in analysis.
9. Ability to work with other people.
10. Sense of responsibility and integrity
11. Heightened safety consciousness
12. Competence in oral communication

13. Ingenuity and creativity
14. Heightened interest in the field of engineering
15. Qualities of leadership
16. Abilities to work on his own
17. Appreciation for some of the skills of the craftsman
18. Broader perspective on the field of engineering

Category: EXPERIMENTAL METHOD:

Student should acquire knowledge of

1. Procedures for obtaining accurate experimental data
2. Some sources of experimental error
3. Some techniques for measuring physical quantities.
4. Some precautions in interpreting experimental data
5. Procedures for designing an experiment to accomplish a given task
6. Some methods of error analysis

The analysis of Rices 'work shows that the overall high level ratings were viewed by the "Experimental Method" category. They are in concert with the modern view of the role of laboratory instruction in engineering education, ie., THE ESSENTIAL FUNCTION OF LABORATORY INSTRUCTION IS TO TEACH THE THEORY AND PROCESS OF EXPERIMENTATION.

Further, one item within this category (of experimental method) stands out as one needing the largest measure of additional emphasis ie., "procedures for designing an experiment to accomplish a given task". The implementation of this objective favours increased opportunity for the student to learn on his own in the Laboratory.

4. LABORATORY INSTRUCTION IN INDIA

Methodology: Students in Indian Institutions are invariably encouraged to perform stereotyped experiments. Such experiments normally aim at:

a) rediscovering or proving well-established laws

b) determining physical constants

The ways in which practical work is invariably conducted in India calls for the use of laboratory manuals or printed handbooks/work books. In most of the cases, such instruction sheets are supplied along with the apparatus needed for a particular experiment. Consequently, the students tend to become mechanical with very little or no opportunity to explore the very basis of his experimental investigation.

Range of Experiments: The range of experimental work normally performed by a Student is decided by the University requirements as well as the time available in toto. Moreover, there is no correlation whatever between the laboratory assignments and the corresponding theory classes. This is impossible because of the large number of students and the limited number

Duration: The time allotted for each Lab session varies between one-and-a-half to three hours. Further, the same instructor may not be available to a student if there are more than two contact sessions in a week. So a Student is unable to have continued guidance from the same instructor right through an academic session. In many institutions a group of students jointly perform an experiment.

Open-ended Experiments: Such experiments are almost absent in the day-to-day laboratory work assigned to students. However, such experiments do come up during the university examinations (commonly in science examinations). As a result, many students do fumble and end up in awkward situations of near helplessness. This is further complicated by the fact that very little time is normally/for students to repeat the experiments - either for verification or for practice - they had originally performed during the regular laboratory sessions.

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5. THE SOLUTION - A REALITY OR MYTH?

It would be foolish to claim that individual experiences could be an universal panacea for all ills of laboratory instruction. However, the authors' experience in applied physics laboratory instruction could possibly open avenues for fellow teachers in their own spheres of activity.

Laboratory Physics:- Laboratory instruction in Physics was provided for all students of first year in the 5-year B.Sc., (Engg.) program offered by ~~am~~ the Birla Institute of Technology (Ranchi). The author was responsible for 10 of the 30 Students of a section & that too right through an academic session. The modus operandi adopted was as follows:

a) Students were informed of their individual assignments one week in advance. They were also provided with information on resource material that would best answer their queries and clarify their objectives

b) Students were provided with the various apparatus needed for experiments. They were required to set up the equipment and successfully get through a viva-voce session directed by the instructor. This was mandatory before the student could start on his experimental work.

c) Viva-voce sessions were conducted right through a laboratory session in order to keep track of the students' progress as well as to guide him on the right lines. The results and interpretations thereof were also subject to thorough analysis jointly by the student and the instructor.

d) Limited Laboratory facilities resulted in experiments being performed in groups of two. However, proper scrutiny was enforced to ensure equal participation by both members of the group.

Laboratory Applied Physics:

The studies carried out at the National Institute of Foundry and Forge Technology (Ranchi) were concentrated on orienting laboratory work in Physics to typical applications in Foundry/Forge Technology. The experiments designed for such a program included, to mention a few:

a) Heat transfer properties of good and bad conductors

b) Thermo-electric properties of metals, fabrication of thermo-couples and hands-on-experience with industrial thermo-couples/recorders/indicators

c) Resistance variation of metals as a function of temperature, industrial instruments/recorders/indicators

d) Radiation ,temperature controllers and programmers

e) Physical properties of liquids (like oil and fuel)

The classroom lectures and laboratory guidance were provided by the same instructor. As a result, it was possible to provide periodic correlation between the two components irrespective of the sequence of the laboratory assignments. Similar to the BIT experiences, viva voce sessions were held right through a laboratory session. Students unable to complete an assignment in the allotted time (or completely missing one due to absence) were essentially required to join other groups engaged in those specific experiments. This was recommended because of the philosophy that "Laboratory assignments are given not for determining the accuracy or efficiency of a student but for making sure that the students thereby understand and grasp the principle underlying each experiment".

6. REFERENCES:

1) Neher N V (1961) Proces. Conference on Curricula for Undergraduate Majors in Physics, Denver, University of Denver

2) Ahmed R (1970) Physics in India: Challenges and Opportunities UGC, New Delhi 67-69

3) Rice S L (1975) Engineering Education, Washington, ASEE, 65 (4), 285-288.

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Essential spares: Halogen lamps (2 Nos), Fresnel Lens (1000), Overhead projector pens (2 sets), acetate rolls (6 Nos).

3. **SLIDE PROJECTORS** (Manual)

Compact unit capable of projecting 50 mm x 50 mm slide and 35 mm filmstrips, projector lamps 500 W: operating on 220V, 50 cycle, single phase; Essential accessories to include slide carrier (holding two slides that would be projected alternately), filmstrip attachment and protective cover.