

Experiments with Teaching Methodologies

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Abstract: This study uses the backdrop of history of education and development of engineering education in the country to highlight, how the newly introduced subject of research skills is handled by the author. The study reminisces how India had once been the centre of learning. The paper analyzes the kind of teaching and research methodologies that might have existed in ancient India so that well recognized sciences like Yoga and Ayurveda developed in the country. The paper discusses about the faulty practices that have crept in the way engineering education is imparted to the students. Finally the paper discusses about the way this author taught the subject of research skills so that all the three domains of the bloom's taxonomy namely cognitive, affective and psychomotor were taken care of. This is a report about teaching of a new subject of research skills to post graduate students. It signals that there have to be attempts to get rid of the ineffective practices that have crept into the way engineering education is imparted. Students have to be prepared for facing real life problems

Keywords: engineering education, cognitive, affective, psychomotor

1. General

A. Purpose of Education

If we look at the history of mankind life is about having skills and it is about being good at something. A person having some basic education could be in some occupation and if the occupation required him to develop some skills he could go back to the school. For example doing business across West Asia might require learning of the Arabic language. Therefore the traders might be required to enrol themselves into learning that language, but in due course of time education seems to have become a vehicle to become rich and to earn livelihood as it is today. If one wanted to go into a particular occupation he first had to take education for being in that profession. Ideally education should teach how to solve the real life problems .

B. History of Education in India

Without citing any references and by perception it is easy to assume that in ancient India the education system was quite advanced. The Nalanda university can be said to be an international university which attracted students from China, Korea, Japan, Tibet and Greece. Nalanda university had come into existence early as the fifth century while the Oxford university came into being only in the twelfth century A.D. India has given the system of medicinal practices based on experience and traditional knowledge

Ayurved. The Indian system of life science has also given the world a set of practices and life style called Yog which is not just a set of exercises, but complete life style. This study does not dwell into what kind of research and training might have been practised at the centres of learning of Ayurved and Yog in ancient India. Certainly it must have required recalling, survey, experimental observation, discussion and analysis. Yog and Ayurved are said to be traditions 5000 years old, but if we look into our past we find that in due course of time our education system stagnated. It started encouraging rote learning and secrecy instead of analysis and knowledge sharing. For instance mantra would be whispered in the ear of a disciple who will remember it without even realising its meaning and repeat the mantras as and when suggested by the Guru. The rule of the Britishers in the country has been a mixed blessing .They tried to produce writers or clerks for their benefit. This infamously came to be known as Lord Macaulay's system of producing clerks. The Britishers also gifted the country with schools called public schools which certainly were not meant for the general public, but were meant for the children of British public servants in India and the children of the Maharajas to teach them administration and make them aware about the protocols and courtesies associated with administration. The Britishers also introduced to the Indians a system of recruitment to the highest and most powerful posts in the government in which one could get entry by clearing a written exam called a competitive exam. This exam was called the Indian Civil Services introduced by the Britishers in the nineteenth century. The independent India continued to follow this system of competitive exams for different cadres as Indian Administrative Services, Indian Revenue Services etc. The relevant exam for engineers is called the Indian Engineering Services. The sole purpose of education for many became clearing these exams and getting into powerful positions. It became more important to get a degree than to learn and be educated so as to solve the problems of life. Prerequisite for appearing in these exams was having a graduate degree.

C. Development of Engineering Education in India

To create technical manpower and to train human resources engineering institutions were created. The vision was to create technically skilled manpower, but in due course of time faulty practices came to exist in the way education was being imparted at engineering institutes in the country. Absenteeism became a regular feature in engineering colleges. The way education was being imparted became more and more teacher centric, students looking at their presence in the colleges just to get a degree because it was only an MBA degree which could fetch them good jobs.

Employability and skill acquisition dipped. Class rooms became places where monologues were delivered and students remained mute listeners. Engineering education was supposed to make students have set of necessary skills so that they could solve the engineering problems of the society, but it appeared that this did not happen. Looking at the way the whole process of imparting knowledge existed and the way students were being examined it becomes clear that the students were gathering information only in bits and pieces and could not really apply their knowledge nor they had enough skills to solve technical problems. Research in education technology has recommended many new methodologies for effective teaching. Matsumoto (2016) have highlighted the utility of flip class rooms. In flip class rooms students are made to look at the recorded set of instructions in their free time and the class room time is used for applying the knowledge they gained by going through the recorded lectures so this is just the opposite of giving home assignment. Project based learning and case studies based teaching are some other methodologies which are relevant to engineering academia. M Felder et. al (2008) have pointed out that the learning takes place within three domains cognitive, affective and the psychomotor domain. They have also discussed the importance of active learning. The present study highlights the use of active and collaborative learning to handle a post graduate subject so that the subject outcomes are met

2. Methodology used

Research skills was a newly introduced subject to make students familiar with the research methodology as to how one should approach to do research work. Students were expected to download minimum five research papers in their respective field of specialisation and interest. They were expected to study the approach of the authors to solve the problem. The students were to analyse the lacuna or gaps in the paper by doing a gap analysis and they were supposed to fill up those gaps. The learners were expected to suggest how the work could be extended further and in which direction it could further be explored. With this outcome in mind the students were divided into a group of 3 and each group was asked to download minimum 5 papers during the first 15 days of the semester. They were expected to study the papers continuously and consult and meet their guides and subject experts about the difficulties they encountered in understanding the papers. The students downloaded the papers from the online subscriptions of the institute. The purpose of the subject was to orient the student to a scientific research methodology. The students were expected to do a literature review, give critical comments on the literature review, and come up with their proposals to fill the gaps and identify a method to solve the problem. Through out the semester the students worked in a group. This was done so that the students could orient themselves how to work in a team and learn, how to cooperate with each other while working in a team. They were to get an idea about what is group research. Thus this stimulated team work and cooperative learning. There are three domains to learning cognitive affective and

psychomotor. The first part of cognitive domain relates to recalling, understanding, analysing creating and problem solving. This part of cognitive learning was very much incorporated in this type of do it yourself activity. Students were expected to recall what they had already learnt in their class room text books and correlate with the application of the knowledge in the journal papers. They analysed the gaps and came up with their own proposal for solving the still existing problems. The affective domain relates to the attitude of the learner. This exercise was given to a group of the students which encouraged discussion amongst the students. They presented their work done as a team one after or other. Third part of the learning relates to development of psychomotor or practical skills. This exercise involved use of computers and preparation of effective power point presentations. This may be said to relating to 'soft' psychomotor skills.

A. Use of the electronic media for communications

Looking at the present trends hard copy of notices appear to have become irrelevant. Common notices are being placed on institute or department web sites and web pages. Relevant closed group notices are being circulated by the use of electronic media. A group mail ME-WRE-15-17-LDCE was created in the beginning of the semester. The group mail was used to make aware the students about the desired outcome of the subject and the lesson plan right in the beginning of semester. Assignments and related literature were sent to the students through this group mail. Use of electronic medium for communication in addition to the old style notice board became a useful way of communication and it served as a back up to hard copy notices. Notices could be delivered even on holidays. In addition a whatsapp group was also created and communications were done through the whatsapp group. No closed facebook group was created. Students responded well to the electronic communications.

B. Lesson Plan for theory classes

A normal course in the university has three to four theory classes of one hour each per week and a laboratory or tutorial class of two hours each week, but this particular subject had only one theory lecture per week and two hours of tutorial classes per week because this was a do it yourself type of activity resulting into self learning.. For a 90 days or 12 weeks of teaching programme this needed 12 lectures of one hour each and twelve laboratory classes of 2 hours each. The theory classes were used to create awareness about the authenticity and quality of journals by defining their impact factors. The students were also made aware about other terms such as the "H" index of a scientist. Students were made aware and informed about pure and applied research, fundamental and derived research and importance of research work itself. They were made aware about IISN numbers and ISBN numbers. Lectures were delivered on how to prepare an effective power point presentation and how to communicate effectively about the work done. More important than or not less important this was that the different type of research works was explained to the students directly from journal papers in form of case

studies. Papers from experimental work domains, works involving use of numerical modelling and software based works were discussed to highlight the use of different research tools such as mathematical modelling, numerical modelling, regression modelling or use of software. With the knowledge and back ground of the theory classes the students could approach the laboratory classes. Thus the theory and laboratory classes were not independent of each other, but complimented each other and very much linked and ran in a synchronised manner.

C. Lesson Plan for tutorial classes

Students had to apply the knowledge gathered in the theory classes in the tutorial classes. The laboratory hours were used for judging one's interest, down loading of papers from online subscriptions. A good amount of time is needed to decide about what excites an individual what one is really interested in. The students downloaded papers on related topics. Methodology used in each of the papers was studied. The softwares used were downloaded from web, if they were free wares. A familiarity with the software used could thus be developed. From journal papers students could again go back to text books to make their concepts clear. Finally they had to come up with summary and critical comments.

D. Testing and Examination

For testing and examination a mid semester progress review was carried out where the students had to make a presentation. At the end of the semester the following was done to test their understanding

1. A power point presentation by each group followed by a question answer session
2. An open literature test of 45 minute duration where each group could refer to the papers they had downloaded and were to answer the questions given to them.

Questions were prepared based on the contents of their paper. Students could read the papers, discuss with the group members and could answer the questions. At the end of 45 minutes the question and answer sheets were collected. The students could be given a feed back about their understanding on the subtle treatment in the research papers..

E. Taking student feed back

. To take a feed back from the students whether the learning outcomes were satisfied or not a questionnaire containing the following questions was given to the students to fill in their responses :-

- 1 Did the study of this subject help me learn how to carry out literature survey for a research project?
- 2 Did the study of the subject help me develop analytical ability?
3. Am I in a better position to decide about my M.E. thesis project work after learning this subject?
4. Has the subject helped me in developing my verbal abilities and communication skills?

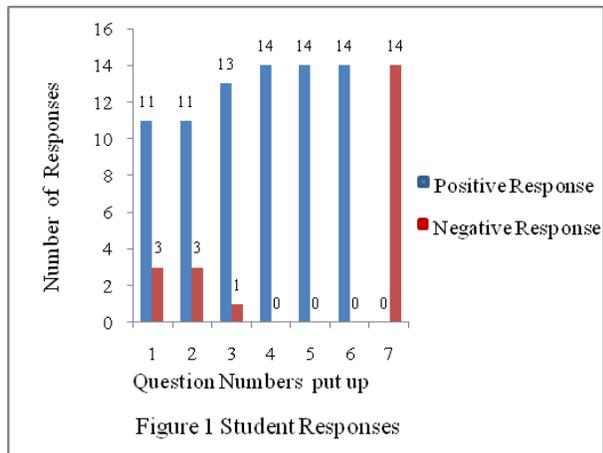
5. Has the subject helped me in making more effective power point presentations?
6. Am I in a better position to co-ordinate and work as a team?
7. Will I take up thesis work on a topic based on literature review?

The student responses to these questions are tabulated in the table1. Students felt that the subject had helped them learn how to carry out literature survey; they felt the subject had helped them develop analytical ability. They also felt that they had developed verbal communication and presentation skills by learning this subject. Importantly their answer to whether they could learn how to work in a team was in affirmative and this related positively to the affective domain which is a positive attribute and an important one in the work place. They also felt that they were in a better position to decide about their M. E. thesis work. The only question which all students answered in negative was if they will take up thesis work based upon the literature survey they had carried out. All 14 out of 14 students answered his question in negative. The probable reason for negative response may be attributed to the fact that they are only in the first semester of their study and they are still exploring the course work for their topic of interest. Probably introducing this subject in the second semester would make more sense to them as immediately after the second semester they have to take up thesis work. Therefore this can be an important consideration to take up this subject in second semester rather than first semester. The student responses are shown in the table 1 below and the table 1 is also represented by means of a bar chart as shown in figure1below.

Table1 Student Responses

Question no as in text above	Yes	No
1	11	3
2	11	3
3	13	1
4	14	0
5	14	0
6	14	0
7	0	14

Some of the questions are more objective than others and there is a need to make the subjective questions more objective.



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Conclusion:-

The methodology presented is a student centric exercise which encourages students to learn by themselves and the teacher only remain as facilitator and regulator. The purpose of the subject is to orient the students to the scientific methodology of research work. The survey conducted at the end of semester reveals general student satisfaction in the domains of cognitive, affective and psychomotor skills. This type of activity could be emulated in other subjects. A critical review of teaching plan of subjects should be done. Those subjects which have four lectures per week should be critically reviewed and examined to see if four lectures per week could be converted to two lectures per week and the two hours thus made available could be used for laboratory classes. There is a need to eliminate those practices which result into limited learning.

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