Motivating UG Students Towards Studies

(Excerpts from the report presented at 153rd Meeting of IIT Directors at IIT Mandi)

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31 March 2016

Abstract

IITs were established to be at the cutting edge of technology and the frontiers of knowledge. They are expected to generate graduates with these capabilities, as well as produce new technologies, products and processes needed by the nation.

The incoming undergraduate students, driven relentlessly by parents and society, are coming into the IITs for two major reasons: getting high paying jobs on graduation, and for the respect one earns in society in getting into the IITs. Passing the Joint Entrance Examination (JEE) of the IITs, in itself, is a big prestige for the student and his/her family.

The above are external motivators, which do not connect with internal motivations, leading to a loss of interest in studies itself, what to talk about frontiers of knowledge. As a result, most students fail to link up with the aspirations of IITs and expectations of the nation from the IITs.

The situation is not easy, and major steps need to be taken to come out of it. To motivate students, four sets of recommendations are given here pertaining to (1) academics, (2) developing broad outlook, (3) a strong induction program, and (4) steps to improve verbal ability.

1 Introduction

This is an excerpt from the report of the Committee of IIT Directors presented at the 153rd Meeting of IIT Directors at IIT Mandi on 26 March 2016.1 The committee was entrusted

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1The Committee of IIT Directors was setup in the 152nd Meeting of the IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee interacted through email and had a physical meeting at IIT Delhi on 26th November 2015. After a follow up discussion over email, the report was prepared and submitted on 19th January 2016. It was presented at the 153rd Meeting of IIT Directors at IIT Mandi on 26 March 2016.
with the task of recommending measures to be undertaken to motivate undergraduate students at IITs towards studies, and to develop their verbal ability. The Committee looked into the aspirations of incoming undergraduate students, what the nation expects from the IITs, and the gap that exists, which is a major cause for the demotivation of the students.

Nation has high expectations from the IITs. They are expected to be at the cutting edge of technology and at the frontiers of knowledge, and to generate manpower which is able to perform the tasks at these levels. IITs are also expected to produce technology needed by the nation, industrially, socially and strategically.

Looking at the prevailing situation, several recommendations are given which have the potential to bring about a fruitful change in the scenario.

2 The Incoming Students into IITs

The students coming into IITs have, by and large, been heavily coached. They have spent several years preparing very hard for the JEE (Advanced) at the cost of everything else pertaining to other subjects, extra curricular activities, hobbies, general reading, social activity, or time with family and friends. Even in Physics, Chemistry and Math., the subjects in which they have been coached so heavily, they have had little time to reflect or experience the joy of learning. The internal drivers of motivation for an individual which pertain to interest in the subject matter have been smothered.

Two major reasons have been conveyed to them for getting into the IITs. First IITs are a passport to good jobs and good life. Second, they would gain respect in the eyes of others by joining the IITs. Both these are external drivers of student motivation, although of different types.

The students have worked hard under intense pressure to do what their parents and society wanted them to do. Many of them have faced intense fear of failure. So the journey has not been very pleasant.

Even after succeeding and joining the IITs, most of the students feel that they did not get a branch or the institute of their choice. So even after getting into the IITs, it is still a failure for most. The irony is that ”their choice” is again not necessarily their choice but what they have been told to choose. The primary factor behind it is the so called good job, which means a high salary package.

After having joined their allotted branch and the Institute, they get down to studies, and suddenly find that it is still a long way to go. Passing JEE is not the end but continuation of something whose values they are unsure of or is different from what they wanted to study. All the elements are in place for demotivation to set in.

Thus, a mad rush for the IITs without the student determining for himself his interests and his goals is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into the IITs but failure in getting the desired branch, with peer pressure generating its own problems, leads to an environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further leads to poor daily routine.
To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

In the next section, we present what qualities we want from the graduating student and then how to go about achieving it.

3 The Graduating Student

We first identify the desired qualities in the graduating student.

3.1 Essential Characteristics

3.1.1 Area of Study

It goes without saying that the graduating student must be well versed with the concepts and skills in his chosen area of study. For example, a student of Mechanical Engineering must be well grounded in the understanding of concepts therein and the skills needed to function as a mechanical engineer. He should also be prepared well to undertake higher studies, if he so desires.

3.1.2 Language

The graduate must be strong in language - in reading, writing and communicating. This has gained even greater importance in recent times. Language ability also allows one to deal with unstructured or ill specified problems, an ability extremely important for design, innovation and research.

3.1.3 Society

An engineer functions in a society. As a designer, his products influence the society enormously. Acceptability of a product or a process requires the engineer to understand the social milieu and the larger context in which the product or the process is used. While working in operations, similar understanding is needed. As a person, the student works and functions in society. Hence an understanding pertaining to social, economic, and political systems is also important as a citizen.

3.1.4 Relationships

Team work is extremely important in all human activity, but perhaps even more so in engineering. In a factory or in an office, in a plant or on site, it is usually teams that work together to accomplish a task. Besides, an engineer is also a human being living in family and in society. Therefore, understanding and dealing with relationships is of crucial importance, whether at work place or society.
3.1.5 Character

As an individual, one faces many challenges. The factors offering challenges range from load of work to adverse atmosphere at workplace, errant colleagues to dysfunctional systems, from fulfilling one’s responsibility to facing temptations. What are the qualities that need to be developed in every graduate so that he can deal with various situations he might face as an engineer as well as a citizen.

What are the attitudes to work, and indeed to life as a whole, that are needed to function well? Such a person should be able to deal with different situations, have a positive frame of mind, fulfill his responsibilities and beyond, and contribute to others and to society as a whole.

3.2 Meta Skills

The graduating student besides having knowledge and skills in his area or branch of study, must have the following meta-skills which are not specific to any area of study.

1. Critical thinking: One should be able to analyze a given problem and reason with it.

2. Creativity: One must have the ability to design, to take many different inputs and synthesize them.

3. Hands-on General Skills: This is the ability to do things with one’s hands across domains. Ability to plan and then manage the implementation is a part of such an ability.

4. Life-long Learning: This is a skill which requires the ability to identify a learning goal, locate resources, and use them to learn on one’s own, etc.

5. Relating to Art and Culture: Creative expression is at the heart of engineering profession as also in others. Different dimensions of creativity need to be explored. This can be done by exposing the student to visual and performing arts, for example, painting, sculpture, pottery, music, dance, etc.

6. Self-reflectivity: Ability to introspect is at the heart of character building. It allows the student to set goals and develop a sense of responsibility, decision making ability, and courage to act.

3.3 Underlying Values

To develop the knowledge, skills and meta-skills outlined above in the graduating student certain underlying values need to be inculcated and promoted. These would be important for the development of the above characteristics.

1. Joy of Learning: Students need to recognize the joy of learning within themselves. This has been particularly dulled due to a strong pressure to study for a few focussed subjects for the competitive exams. Even while studying these subjects, not enough
time is left to explore the topics which interest oneself. Studying becomes a way to achieve something else and ultimately a chore.

2. **Excellence vs competition:** To be at the cutting edge of technology and frontiers of knowledge, which is what is expected from an IIT graduate, the student must move towards excellence. Mere competition will not do; on the contrary, it would actually deflect one from excelling as well as working in a team.

3. **Cooperation:** Working in a team is at the heart of industry and society. Cooperation as a value (vs competition as a dis-value) needs to be understood by the students. Along with this comes the willingness to share credits with team members, which is a deeper value.

4. **Ends and Means:** Understanding the difference between ends and means, and that it is not sufficient for ends to be pure, and the means must also be pure is crucial to how one leads one’s life. Along with strength of character, it helps decide whether the student would lead an ethical and corruption free life. This value needs to be imbibed from environment and needs to be practised everyday starting with small things in life.

5. **Sensitivity to others:** This means having a feeling for the other, and help the other in his difficulties. Dignity of labour is an outcome when one feels a relationship with all people. Ones self esteem is not affected by the work one does.

6. **Doing larger good:** A desire to do good in the society and the world helps develop an attitude of service. It develops a sense of commitment towards one’s responsibility.

### 3.4 Summary

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills are needed. The underlying values which are important for the learning process are critical because without them, the learning process itself would be hampered.

### 4 Recommendations

What should be done to bring about the above characteristics in the graduating student? How to bring about a change in institutional environment? The committee deliberated on a large number of options. The recommendations are given under four major headings:

1. Academics
2. Developing Broad Outlook
3. Induction Program

4. Verbal Ability

4.1 Set 1: Academics

The major recommendations under this heading pertain to making studies more project oriented, improving pedagogy, and providing greater flexibility in curriculum. In other words, provide opportunities to the students to experience the joy of learning – exercising their imagination, working with their hands, and building artifacts or discovering something new.

4.1.1 Layered Learning

The incoming students have studied hard for Physics, Chemistry and Mathematics. Therefore, in the first semester, other types of courses, particularly those dealing with technology, should be introduced. Hands-on courses would fit in well.

Layered learning needs to be introduced. It operates through practice, theory, practice and so on. It means that the student is given a problem to work upon (practice), then theory is introduced, and then again practice. By working on the problem, questions are raised in the student’s mind, and the student learns to think on his own. When theory is introduced, there are questions already for which he is seeking an answer. This makes the learning much more effective.

The above can be done through improved pedagogy as well as through curricula. For example, there could be an early hands-on project in the 3rd semester. For this project to be effective, hands-on courses need to be taught in the first two semesters. Having a course on reverse engineering in the first semester itself would also promote hands-on learning (see experiments at IIT Mandi).  

4.1.2 Connect Courses with Real Life

Students today want to know why they are studying a subject. By connecting courses with real life problems, the answer is provided directly and concretely. These students get motivated and the learning becomes much better. The courses can have term papers and case studies as part of the course. When they relate to real life, it enhances the richness of the course as well as motivates the students. Faculty with industry experience who are also good at articulation can play a key role here.

4.1.3 Make Learning Project-Oriented

A substantial final year project is a major part of the BTech program at most places. However, it is reported from many places that the students are not interested in doing their final year projects. How can we make the project-oriented curriculum a success?

First, currently in most IITs, a substantial BTech project starts in the 7th semester. This is not a good idea because the students are highly distracted in that semester due to placement related activity. Whereas at the start of a project, activities are quite
unstructured, for example, problem identification, literature search etc. Focussed thought is needed later when approaching the solution. Due to placement preparation, not much work gets done in the 7th semester, and the student never recovers from the loss.

Keeping the start of the project in the 6th semester would solve this problem. Besides this, there are three other advantages. First, those students who get passionately involved with their project in the 6th semester, many decide to also utilize the following summer to work on it. Second, after the completion of the project, the student is still in the campus in the 8th semester, therefore a paper can be written on it, or finishing touches can be put on a system built in the project. Third, if the work is continued on the project by the next batch of students, know-how transfer can take place as there is an overlapping semester between the two sets of students (namely, the 6th and the 8th semester).

To allow the interested student (need not be all students) to do sustained project work over long duration, special schemes need to be designed within the curriculum. It would also help the student choose the course work appropriately. For example, students opting for it would have to do project work starting from the 5th semester, and thus have a project slot every semester continuously up to 8th semester. They may be also be given a special degree such as B.Tech.(Honours).

This would also make it possible to do inter-disciplinary work. As an example, for a project involving biology and electronics, the student would be able to do courses in the allied discipline at an early time (say 5th and 6th semester) when the project work is starting.

Showcasing of projects in an open house through a public display of models or research posters can assist in ushering a new value system among students.

### 4.1.4 Use of Learning Objects

A learning object is a real life object which is studied from multiple sides for the sake of learning. Such an approach brings inter-disciplinarity in a natural manner. For example, river Ganga as a learning object would involve looking at water pollution, water flow, festivals, culture, religion, water transport, etc. and the inter-relations between these different aspects.

### 4.1.5 Recognize Teaching

Teaching has gotten de-emphasized with the desire and effort to build stronger research. It should not be forgotten that both teaching and research go together, and good teaching underlies good research. Teaching needs to be re-emphasized today.

When new faculty members join, the institutional leadership should tell them that good teaching is valued at the institution. For teaching to be counted for promotions, student feedback on courses should be collected. Development of teaching laboratories and new courses should also be given weightage by the institution and the Selection Committees.

It is noticed that young faculty are not able to connect with students. Even when they are good at lecturing, they are not connecting with the students’ needs. Students need mentoring, besides being lectured to.
Passionate teachers try to make the entire class learn and inspire their students towards the subject and learning. Awards for great teachers can go a long way in establishing institutional values towards teaching.

4.1.6 Permit e-courses

Student should be able to take e-courses and earn credit. Suitable restrictions may be placed so that the facility does not get misused for taking light load or avoiding studies.

4.1.7 Flexibility in curriculum

A curriculum has to cater to the diverse academic needs of the students. Some students while doing a project might wish to take some supporting courses early on. This would be possible, only if the curriculum provides for elective course slots in 3rd year or even in 2nd year. Yet another student might get deeply interested in an inter-disciplinary area and might wish to do a project along with advanced courses. In another case, a student might wish to develop breadth and take courses from several areas.

All these would become possible only if the curriculum does not specify a large (fat) core and is not rigid in specifying courses in fixed semesters. It should rather specify the minimum credits to be earned, along with what courses are compulsory. The student gains substantial flexibility when the curriculum allows freedom regarding the semester in which to take a course (even when compulsory). The pre-requisites of courses have to be specified, of course.

Work also needs to be done on pedagogy to make the courses more interesting. Making classes more interactive, flipped classroom, use of visuals - images and films, literature, theatre, field visits, internships are some example methods. How to make the students active in large classes is a challenge, but much work has been done on it in recent years in the West. It needs to be experimented with and adapted.

4.2 Set 2: Developing Broad Outlook

To develop a broad outlook among students, an awareness and understanding needs to be created about society, family and self. A significant component of Humanities and Social Science (HSS) needs to be introduced, perhaps as much as 20% of total curricular credits. Note that some of the best engineering institutes keep as high as 25% course credits for HSS courses. For example, MIT keeps 25% of credits for HSS in its engineering curriculum.

The following are some of the areas that need to be covered to provide breadth of vision:

4.2.1 Social Science

Courses in Social Science which teach about societies, particularly developing societies, would be important for the student to gain an insight into social processes. Social work can be part of courses through case studies and term papers or social service be carried out through NSS.
It is important to develop thematic courses under social science rather than disciplinary courses. For example, have a course on Developing Societies rather than on Sociology, Economics, Political Science. Thematic courses would engage students better and also present the material with respect to real situations. They would present a more holistic picture of society. Disciplinary courses can come later. It is also important for students to do term papers and projects in their courses.

4.2.2 Language

Courses in language should be available to enhance language skills in English or Indian languages. Students with poor English skills would have to go through a mandatory Basic English course. It is also important to promote Indian languages, so that students connect with their roots and culture.

4.2.3 Management

An engineer has to frequently manage things at work place, and guide people under him or her. Suitable management courses may be designed and made available. They can be from psychology, social behaviour, organizational functioning, etc. However, care should be taken that this does not become a path to avoid studying ones core area.

4.2.4 Humanities

Courses in humanities develop the humanistic outlook. Philosophy, Psychology and Literature come under it. (Literature may also be considered under language.) While Philosophy develops reasoning with respect to hard open problems, Literature helps develop human sensibilities.

4.2.5 Universal Human Values

Need for character building has been underlined earlier. It gets the student to explore oneself and allow one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. A course in Universal Human Values provides the base.

Methodology of teaching this course is extremely important. It must not be through do’s and dont’s, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The teachers must come from all the departments rather than from outside or specialised departments likes HSS. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them.

4.3 Set 3: Induction Program

New students enter an institution every year. They come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment
and inculcate in them the ethos of the institution. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days. (Experiment at IIT Gandhinagar with an orientation program, several weeks long, is noteworthy in this respect.)

We propose a 5-week long induction program for the UG students entering the institution right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, etc. The time can also be used to take care of some critical lacunas in background and preparedness to undertake studies.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

4.3.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 5:30 am for physical exercise. There would also be evening games or at other times according to the climate. These would help develop team work. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

4.3.2 Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for 5-weeks.

These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

4.3.3 Literary

Literary activity would encompass reading, writing, debating, enacting a play etc.

4.3.4 Human Values

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values course described in the previous section could start during the induction period and continue for rest of the semester as a normal course.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

4.3.5 Preparatory Courses

This period can be used to overcome some critical lacunas some students might have, for example, English, computer familiarity etc. These should run like crash courses, so
that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.3.6 Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to a variety of people and topics.

4.4 Set 4: Verbal Ability

Several recommendations under Set 2 and 3 above, relate to verbal and language activities. Here, we describe a mandatory book reading program in the summer after 1st year. All first year students in the summer after their first two semesters would be required to read 3 to 4 books. At least 1 to 2 of these books would be in their mother tongue. After reading they would submit a critical summary of the book on which they would be asked to present or answer questions when they return to the campus after the summer.

A list of great books will have to be prepared out of which the student would choose. The list would include books dealing with autobiographies, historical novels, science (history and discoveries), literature, classics etc.

5 Major Shift Needed

IITs were established to be at the cutting edge of technology and frontiers of knowledge. They are expected to produce graduates with knowledge and skills to do research, produce new products, components, and processes. They were not meant to produce graduates who take up ordinary jobs requiring routine skills.

In addition to producing highly trained manpower, the IITs are also expected to contribute to the development of technologies and systems needed by the nation. Increasingly, demands are being made on IITs to deliver on this count as well.

To achieve these twin objectives, a major shift is needed to bring about a change in aspirations of incoming UG students and faculty expectations from them. There is a need to build an academic environment, develop holistic thought, and shaping of character of our young students.

The shift can be brought about through three methods:

1. Through academics – Changes in courses, curricula, project orientation, developing broader outlook.

2. Through environment – Larger change in prevailing atmosphere starting with the induction program.

3. Through self-filteration – Right set of students to come in.
The first two above are described earlier and the changes can be carried out by the Institute by implementing the four sets of recommendations given earlier.

The third point above is particularly difficult to handle. It relates to understanding by the potential incoming students of their own aspirations and interests and what the IITs stand for. And this needs to be done even before they have entered the IITs. It is difficult, even impossible, for any mass examination to measure the above.

A strong message needs to be sent to all concerned about what the IITs were meant to do. Then, only those students would come into the IITs, who have a deep interest in technology and science. Other segments of society as well as the internal stake-holders would also understand it clearly, and work to achieve IITs’ goals.

There is a need to de-glamorize IITs. IITs should build prestige, not glamour!

The larger number of projects that would get floated could be handled by involving alumni or people from industry for project guidance, forming student project teams mixed across batches where the junior students learn from their senior fellow students, and using other creative ways.

6 Summary

IITs were established to be at the cutting edge of technology and the frontiers of knowledge. The incoming undergraduate students are driven by their parents and society to join the IITs without understanding their own interests and talents. As a result, most students fail to link up with the goals of IITs.

The graduating student must have knowledge, meta-skills and values related to his/her profession as an engineer, as a citizen, and as a human being. Most students who get demotivated to study engineering or their branch, lose interest in learning.

To bring about a change, four sets of recommendations are given here on (1) academics, (2) developing broad outlook, (3) a strong induction program, and (4) steps to improve verbal ability.

1. The first recommendation is that academics be made more project oriented with greater flexibility in curriculum. Projects may relate to research, innovation, system building, etc. At the same time, there is a need to connect projects to real life, so that IITs also deliver new products, and processes for the nation.

2. To develop a broad outlook towards life as a whole, curriculum should include a significant component of humanities and social science (HSS). An important aspect of this is Human Values, through which the students look at their self, and are able to set their goals related to their family, society and nature. As the students develop a better understanding of these areas, it will result in their being better engineers and communicators, and would be able to see their larger role in society.

3. A strong induction program is needed to orient the incoming UG students to the goals of the institute, and inculcate in them the institutional ethos, and to put them at ease on entry.
4. Finally, steps are also needed to develop verbal ability among students. A summer book reading task is suggested. This is besides the courses to be taught as a part of HSS (Recommendation Sets 2 and 3).

Implementation of the above would be a slow process and change of mindset would take time but it can be done.