Effective Engineering "Teaching" in Practice
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Lecture - 11
How can we use research in education ? - (part - A2)

Welcome back. In the previous lecture we looked at the right students and ways of motivating them. I gave you one example, my own example which is called the CFA exercise, I presented some examples of good CFA exercise and I told you what impact it could have, what long term impact it could have on the learning of students. Let us move further.

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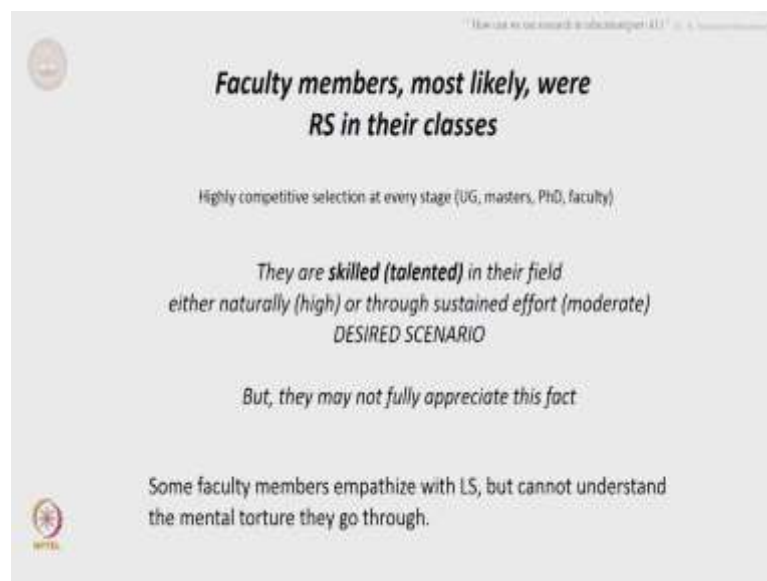
Faculty members, most of us right, most likely were right students in our own classes, we do not realize this. So, we have all done well in the various courses that we took and that is why we are faculty members. Essentially because of this thing, we leave out some of the oddities, minor oddities that may arise when this may not be true, but mostly this is true. Because the selection is highly competitive at every stage, you talk about undergraduate competitive, you talk about the masters next that is competitive to get in, talk about PhD next that is highly competitive and then becoming faculty that is even more competitive all right.
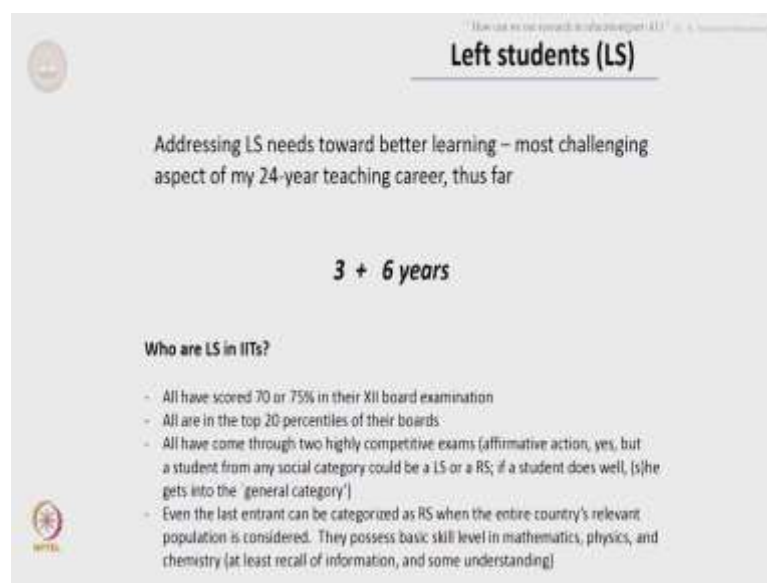
So, at every single stage it highly competitive therefore, one had to be very good to become a faculty member and therefore, most likely they were right students in their classes. They are skilled or talented in their field either naturally which means the talent is very high or through sustained effort and usually you get up to a certain level you can never really compete with somebody who has a natural talent and something it is my belief and this indeed is a desired scenario, teachers must be really good.

However the flip side to this is they may not fully appreciate this fact, they do not really appreciate that they are being on the right of the distribution because they have not really very comprehensively looked at their own classes, they were into whatever they were doing that, they did that well which is very good, but they kind of missed out on what they were really. And most likely they will not have really spent much time thinking about people who are not doing well in their classes. They would be completely blind to even their existence many times.

Some faculty members can empathize with the left students are not doing well they can empathize, but understanding them, understanding the mental torture that they go through is very very difficult because the faculty members were most likely right students of their own class, they do not have the experience all right. And one needs an experience or few experiences to realize what the students were not skilled or not good in that particular subject are really going through. Sometimes when you sign up for something, sign up for a course which is not natural to you, then you realize what people go through. I myself signed up not for this purpose, but for totally different reason, a dance class, a classical dance class and the teacher was my own daughter who is an accomplished Koochipudi dancer and when I began learning that at a very advanced age, that is when I realized what somebody who does not have a very high level of skill, my skill is not too bad, but it is not high even that is good enough to realize what people could be going through.

So, if you really want to experience what left students are going through, sign up for something that you are not good at right, it is my recommendation.

So, the left students, let us talk about them. Addressing the left students needs toward better learning has been the most challenging aspect of my 24, almost 25 years teaching career thus far its 24 and a half right now right. It took me 3 years to even understand the problem and then 6 more years to get over stage at which the strategies that I am that I tried out, became good enough to communicate to somebody, it took me three years to understand 3 years to come up with various strategies that would repeatedly, reproducibly improve the learning of left students and then 3 more years after that to be able to communicate to somebody. So, 9 years of work so far in this focused thing apart from the other experiences from the 24, 24 and a half year old career.

So, many people ask me you know IITs are highly competitive to even to get in, you mean to say that there are LS in IITs of course, there are, because LS is relative, it depends on the population. To understand who the LS are, let us look at their background, what people feel is right because all of them would have scored at least 70 to 75 percent in their 12th standard board examinations. This keeps changing, but a few years ago, these were the criteria. Let us look at this and the criterion does not, a criterion change does not mean much in terms of the ability of students. So, this is a good reflection of the ability of students, any student who comes in. A few years ago, these were the criteria. All must have scored at least 70 or 75 percent in their board examinations, 12th standard board examinations.

All are in the top 20 percentiles of their boards, all have come through two highly competitive exams and you can talk of affirmative action, but what we see or what I see in my classes is students from any social category can be a LS, can become a LS. We will talk a little more about that. So, that is not really a major concern or that is not really a major factor, the affirmative action is not really a major factor in this particular aspect. And also consider this, whichever student from whatever social category if they perform well in the joint entrance exam, they get listed under gentle category right. So, that is always there.

Therefore, even the last entrant, because of these reasons, even the last entrant can be pretty much categorized as a right student when the entire country's relevant population is considered right in the exams. They possess the basic skill level in mathematics physics and chemistry, at least recall of information and some basic understanding is certainly there. This is the set of students, any student is like this, only then can a student get in at all. Even here, even after they get in they become LS. So, why do they become LS? The paper lists the various methods I went through to find this out, all backed by data and evidence, but let me present an intuitive view first.

Based on personal interviews conducted in an informal tone and the notes were made after each interview because you know these are a sensitive set of students, if I start writing as I speak, that is not going to help at all. They will you know bottle up and they are not going to open up to me. Therefore, the talking was done in a very informal tone and then the notes were made immediately after each interview.

Why do they become LS, they could be one of these reasons, relatively lower learning ability levels, especially in the apply, analyze, evaluate and create skills compared to their highly competitive classmates in an undergraduate program, it is comparative.

A feeling of inferiority that they develop when they compete with the best in the country in the large common first year classes, it is also called freshmen in some countries the first year common first year courses, this leads to the development this is what they said or from what they said, this was gleaned out. The lower language skills of some LS which leads to lack of understanding in the class material could turn them into LS right, they do not understand, the medium of instruction as English and they do not understand that and that could lead to this a few. I have numbers this number is not too large, percentage is not too large.
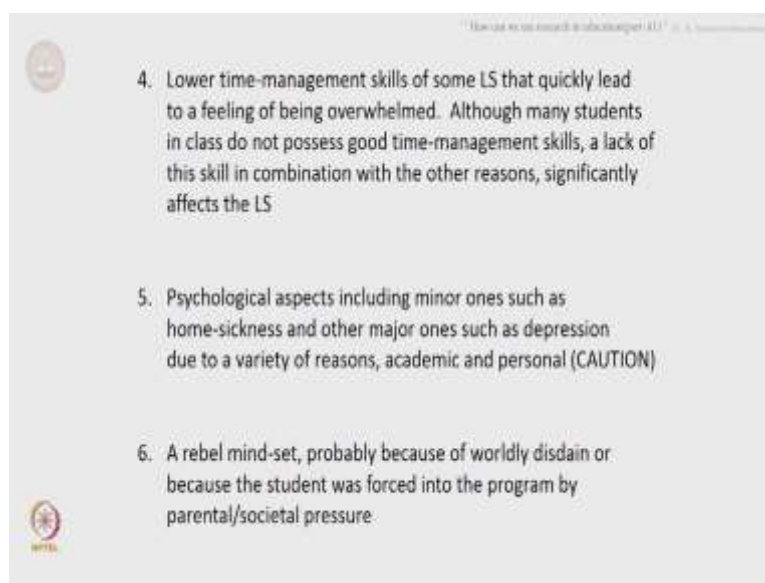
Lower time management skills of some LS that quickly lead to a feeling of being overwhelmed, this can happen very quickly in IITs where the work load is very high. Although many students in class do not possess good time management skills, a lack of this skill in combination with other reasons significantly affects the LS.

Psychological aspects including minor ones such as homesickness and other major ones such as depression due to a variety of reasons - academic and personal, can turn somebody into an LS. But be very careful while dealing with these people. Whenever I have seen or I have sensed some major difficulties, I have very smoothly guided them through the institutional machinery to get professional help. We are not professionally trained to help such people with difficulties, mental difficulties of this kind, psychological difficulties of this kind and I do not think we should even attempt to do anything like that because without training if you do that, you could make the situation worse for the student.

And also a rebel mindset probably because of worldly disdain when this happens it is called welsh meds in German. This happens at the teenage level and so on or because the student was forced into the program by parental societal pressure. And this is a way of the student saying to his or her parents - you forced me into this, I am not going to perform in this, you will know what it means and so on and so forth, let me show you what it can be, I have come into this program because you pressed me to now I do not

really want to do well in the program, whether the student likes the program or not is a totally different aspect right. This can happen, this also happens, a certain small fraction. I have given the fractions in the paper.

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So, what happens? They are unable to concentrate to the needed extent, they are unable to recall, understand or apply the relevant knowledge, they attend classes as a ritual, you know most of them attend classes as a ritual 90 percent, they come and sit there blank faces not very sure what is getting across, you know very clear from the way they look at you that they are just blank. And 10 percent of them are actually highly irregular ,they do not even attend classes, they become demotivated, they lose self confidence which is very disastrous because whatever they are able to do, whatever they have the ability to do they will not be able to do because they would lost the self confidence to do that whatever they capable of doing they are unable to do. They are unable to do course exercises or even write exams. They fear failure in the course and in life in general. They suffer multiple anxieties, they worry about the future and they talk about being in a hole. All these were obtained during interviews with the students right and unfortunately all these happen to them.

Many of the people have tried to address this through ways that they think might work, but these strategies do not really work. I by myself tried some in the first 3 years, they

did not work such as directly asking the left students to get help from the instructor or the classmates, never do this, this does not work.

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You tell them, please get some help of the other and so on so forth in a class, it is not going to work or even outside the class if you meet, them talk to them and say you must get help from either me or your classmates in that tone, that is not going to help.

Forcing the LS to attend study sessions after class you know conducted by senior students or faculty to help them, somehow they do not feel comfortable in attending those classes. They see, they have a totally different you know feeling to work towards it, they are very sensitive, they feel that they are being exposed they do not want to do that. Asking them to meet us to discuss difficulties, if you start by doing this that will not work; I will tell you later how it works, but if you start by saying come and meet me in my office no; that most likely they will not come.
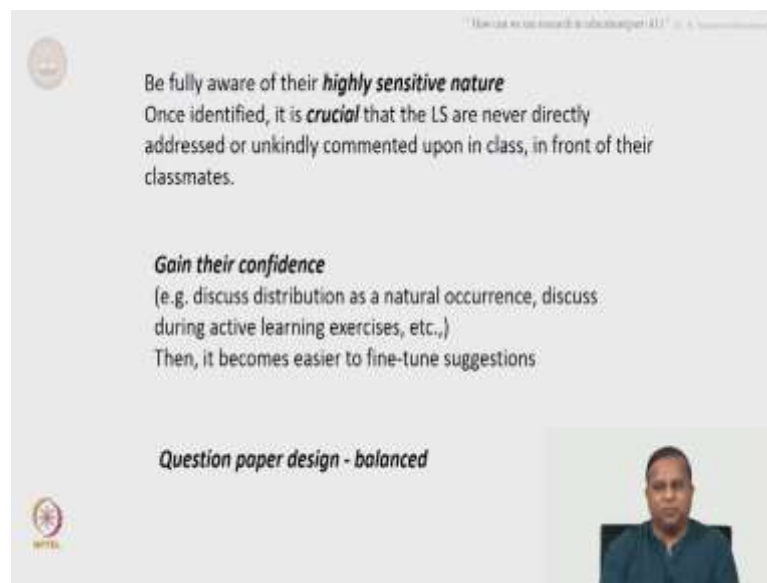
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Strategy that do work are as follows. Need to understand the LS psyche you know, essentially their helplessness, this is what I mentioned about taking a dance class helped and so on earlier. And the key point seems to be, to unobtrusively without them knowing, identify the left students as early as possible in the course.

What I do is, I give them a diagnostic test at the end of the first week. This is a course on as I mentioned on transport processes in biological systems, transport phenomena and biological systems and therefore, the first week is spent in reviewing material energy balance and then applying material energy balance to biological systems in particular. They have already done a course in material energy balances and therefore, at the end of 3 classes I give them a diagnostic test on that material, something that we reviewed in the first week. And I design it to be a little difficult to identify LS.

What this does is it identifies all LS very well and nobody is left out, but what it does is it also identifies about 10 percent false positives, students are not actually LS, but who just in do well in that particular diagnostic test. And one can always find out based on interactions on class, the student would be responding to certain difficult things very well and so on so forth, you do not expect that from LS. So, through all these intuitive means you can figure out that they are not really LS, but they just do not do that exam well. It will come out very quickly within the next couple of weeks, it is very clear that you need not consider them to be LS, it is only 10 percent max, but all are LS are identified.

And I do not advertise this diagnostic test as a means of identifying LS. The purpose of the diagnostic test is to form groups for cooperative learning, such as the tutorials and so on so forth that we covered in a previous chapter. We need to be aware of the highly sensitive nature of the LS and once identified through the diagnostic test, it is highly crucial that the LS are never directly addressed or unkindly commented upon in the class in front of their classmates. However well meaning that comment would have been.

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You meant at well, but it did not come across that way and that is it, we have completely lost them for the entire course, they are never going to come back to you to get your help and so on so forth. So, never ever do this.

Gain their confidence, there are various ways of gaining their confidence. I typically discuss the distribution as a natural occurrence during appropriate times in the class and then when I give them active learning exercises I go around, I talk to them, I talk to them as though I am talking to an average student and, there is a feeling that slowly develops in them, the instructor is really serious about helping them or the instructor may be able to help if I approach the instructor, that has to come within them by your actions, not by your words. Once you gain their confidence it becomes much easier to fine tune suggestions to improve their learning and by the way all this does not take too much time right.

It is just the tuning to the LS that is needed, once that is done, there is very little extra time that one spends because all the work has been done already, it is communicated already. If you follow this you can easily identify and help the LS. And question paper design has to be highly balanced, this we will discuss as a part of in the later part of this chapter itself.

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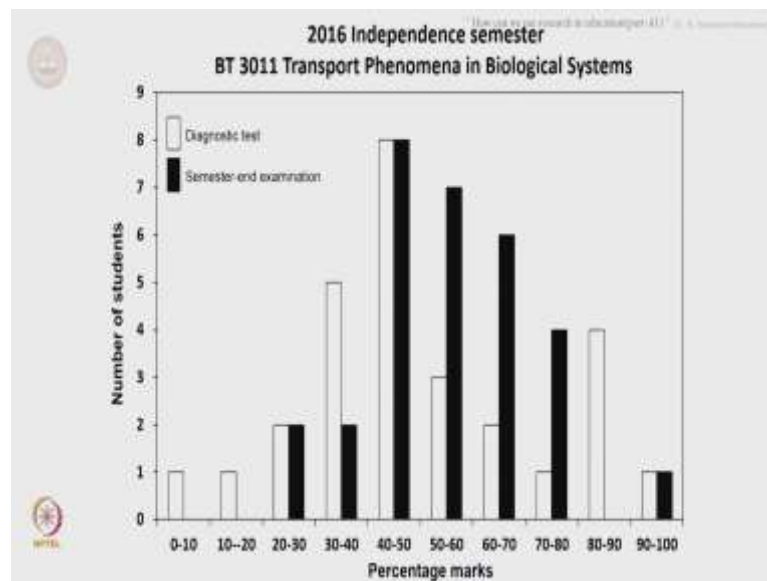
So, this is the data that went into the paper. Let me present the data first, and then tell you about the paper, the details of the paper. This is very recent 2016 independent semester transport phenomena in biological systems, this is number of students percentage marks, the open rectangles are the marks in the diagnostic test, the filled rectangles are marks in semester end exam.

As you can see in the diagnostic test, there is distribution that goes from 0 to 10 all the way to 90 to 100 there is a certain distribution here and in the end semester exam, that distribution has shifted, there is nobody in the 0 to 10 or 10 to 20 mark range. There were two students in the 20 to 30 range the marks were actually closer to 30 and therefore, the huge distribution, rather the entire distribution has shifted to the right leaving no one in this region which means the LS have been significantly helped. They have all pass the course right.
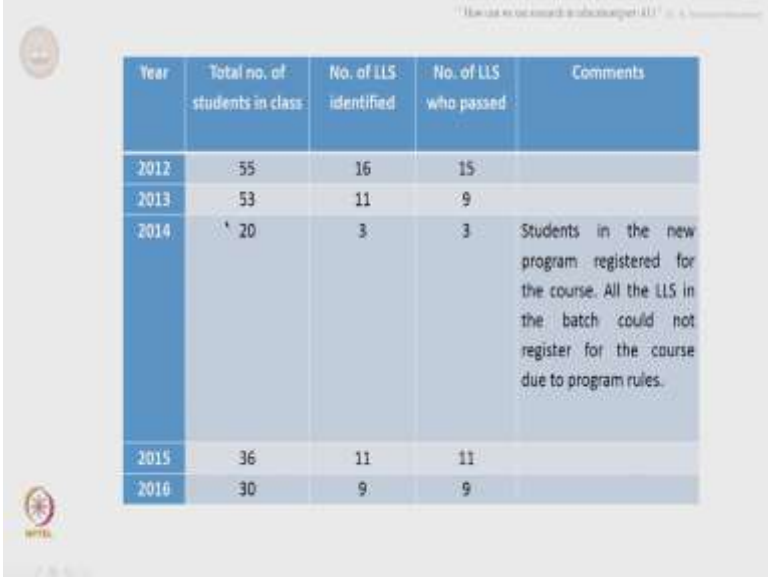
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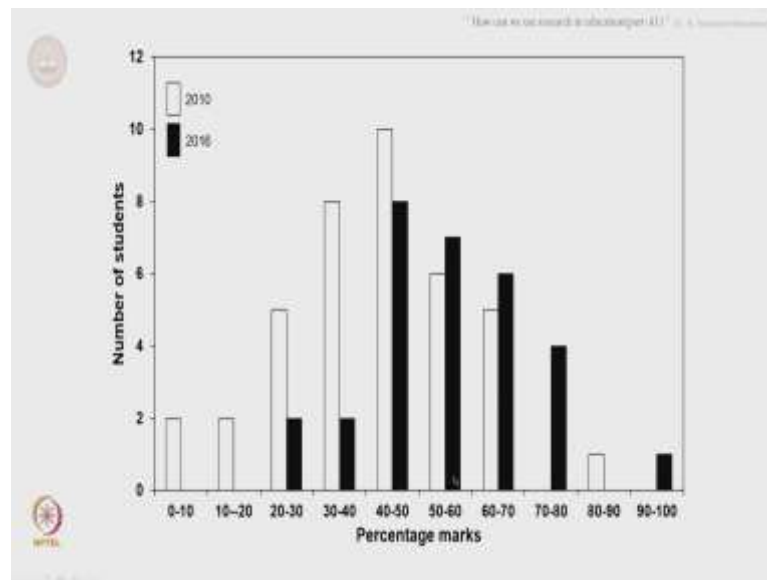
This is between two years, that is diagnostic test in the final exam in a year is a semester. This is data between 2010 and 2016 this is the end semester exam marks or the entire course marks. Number of students, percentage marks I think this is end semester exam marks.

So, as we can see in 2010 which is the last year when I did not consciously try strategies to improve the LS, the distribution was still some people from 0 to 10, some people from 10 to 20, reasonably large number of people in 20 to 30 and so on so forth. Whereas, in 2016 when I had reach the certain stage in the ease with which I could do these things, the distribution has shifted to the right we have the lowest marks in the 20 to 30 range again I think the lowest was around 27 here and the two students, 27 and 29 if I remember that right and then the distribution has shifted to the right.

Year	Total no. of students in class	No. of LLS identified	No. of LLS who passed	Comments
2012	55	16	15	
2013	53	11	9	
2014	20	3	3	Students in the new program registered for the course. All the LLS in the batch could not register for the course due to program rules.
2015	36	11	11	
2016	30	9	9	

And this is the data on the total number of students in class in the various years here, the number of LLS who are identified or LS identified through the diagnostic test the number of LS identified who passed. Of course, I have not included the false positives here. In 2012 in a class of 55 there, were 16 identified and 15 passed, 2013, 11 identified and 9 passed and in 2014 which is the year when the program shifted we started a new program. And therefore, the LS were not really present in this particular batch in such larger number, they will not have even been able to register for the course by the by the program rules, there were only three who were not very, you know, too much to the left and they all three passed. And the last two years and including 2017, I have data for 2017 also just completed, all identified LS passed the course. This is what is possible by following these strategies.
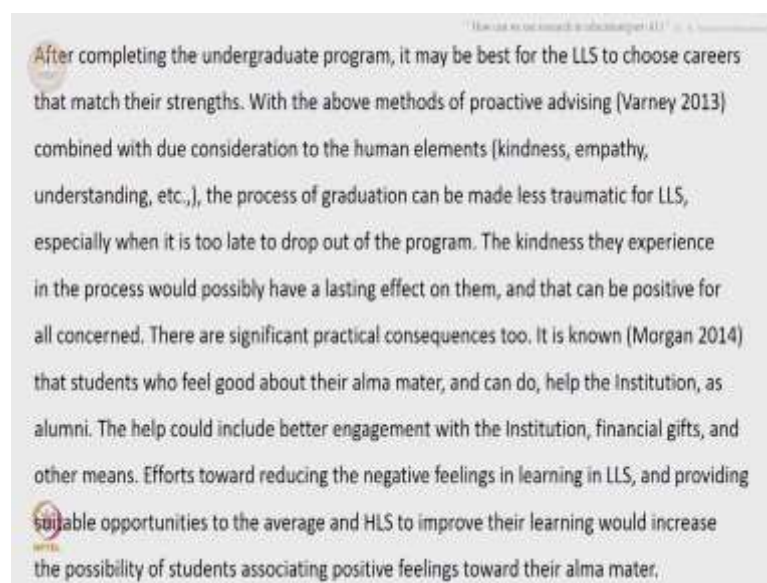
I would like to, you know, tell you where I am coming from. I am not saying that you need to really push the LS into this particular field and so on so forth, but where I am coming from for the LS is something like this.

After completing the undergraduate program, it may be best for the LLS to choose careers that match their strengths. With the above methods of proactive advising, these are the various terms, this is taken from the paper, do not worry about it now it will become clearer later when you read the paper. The above methods of proactive advising combined with due consideration to the human elements such as kindness, empathy ,understanding and so on, the process of graduation can be made less traumatic for the LLS especially when it is too late to drop out of the program. This is where I am coming from.

The kindness they experience in the process would possibly have a lasting effect on them and that can be positive for all concerned. There are significant practical consequences too. It is known that students who feel good about their alma mater and can do, help the institution as alumni. The help could include better engagement with the institution, financial gifts and other by and by other means or other means. Efforts toward reducing the negative feelings in learning in the LLS and providing suitable opportunities for to the average students and HLS to improve their learning would increase the possibility of
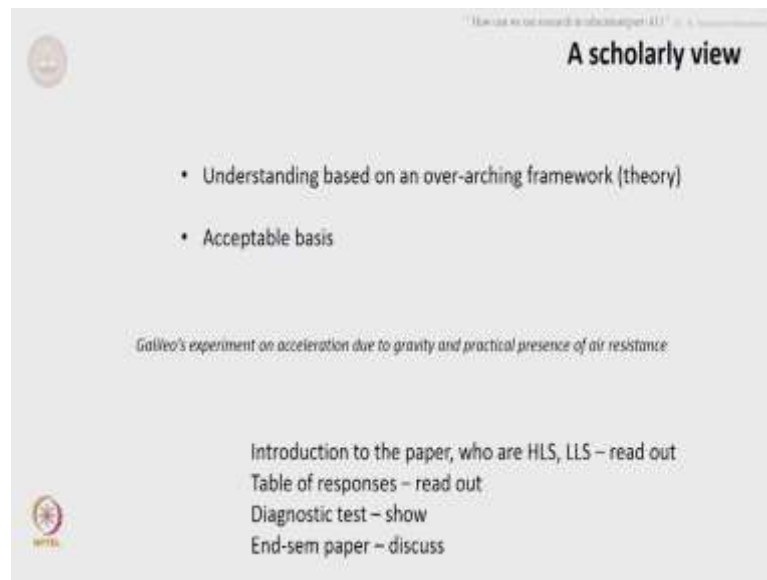
students associating positive feelings toward their alma mater. And this I think is very good for all concerned and this is where I am coming from.

I hope you understand that I am not trying to just push the LLS, there is a certain reason why we need to improve the LLS learning, it is good for all concerned. They are a part of our class, I think everybody is a part of the class and I believe that the instructor is responsible for everybody in the class.

With that let me get on to the formal aspects, the scholarly view. That is the whole point, I was going to present an intuitive view of something which resulted in a reasonably formal paper therefore, you can make the link quite well. So, the scholarly view is something like this. It is an understanding based on over arching frameworks or theories and so on so forth. That is pretty much what consists this scholarly view mostly. And it should have an acceptable basis. To understand this a little better, let us we are all engineers, so we would appreciate this. Galileo when he did his famous experiment from the Tower of Pisa to show that the acceleration due to gravity is the same on all objects. He took a cannonball and he took a feather and dropped them.

And of course, they would not have reached the ground at the same time because of air resistance, but note that acceleration due to gravity is an important concept, air resistance is a totally different concept both of them come together in a practical situation along with many other things, there could be wind and so on so forth. They come together in a practical situation and the practical situation is the actual class that we have whereas, you know the value that is associated with understanding the gravity, acceleration due to gravity framework and air resistance framework or gravity theory and air resistance theory and so on so forth, that we all know. So, this scholarly view is to understand the acceleration due to gravity or the air resistance or other means separately well, to understand what is happening in a class better and thereby rationally improve the class which could be one outcome, this is a practical outcome ,of course, the learning the understanding itself is an outcome on its own right. So, that is what scholarly view is all about, at least as far as I understand it, there could be much more nuances to the whole thing.

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What I am going to do now is to finish up by introducing the paper to you. Whatever I have discussed now is in the paper and let me show that paper to you now, which is possibly. I think what I will do is we will take this paper alone as a short session we are out of time now, as a short session when we meet the next time, that way we could spend a lot more time on that.

See you then.