Introduction to Research

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Lecture - 01
Group Discussion on Research

Prof. Prathap Haridoss: Hello, welcome to this Group Discussion on Research. This is the first class, an introductory class on this course which we have on Introduction to Research. I am Prathap, I am a professor in the Department of Metallurgical and Materials Engineering at IIT Madras, and these are our panelist.

Prof. Arun K. Tangirala: Hi, I am Arun Tangirala, I am a professor in the Department of Chemical Engineering at IIT Madras.

Prof. G. Phanikumar: Hi, I am Phanikumar Gandham; professor in Department of Metallurgical and Materials engineering.

Prof. Abhijit P. Deshpande: Hi, I am Abhijit Deshpande, I am a faculty member in Department of Chemical Engineering.

Prof. Andrew Thangaraj: Hello, I am Andrew Thangaraj, I am a faculty in the Electrical Engineering Department, IIT Madras.

Prof. Prathap Haridoss: Right. So, when we discuss about Research I think the aspects that we need to look at are that many students aspire to get degrees in which are basically research based degrees. And often based on our background a particular person may not be completely aware of what is involved in getting such a degree and how is it perhaps different from other degrees. So the first thing, first topic that we will discuss today is, what does a research degree such as MPhil, MS or PhD imply or represent.

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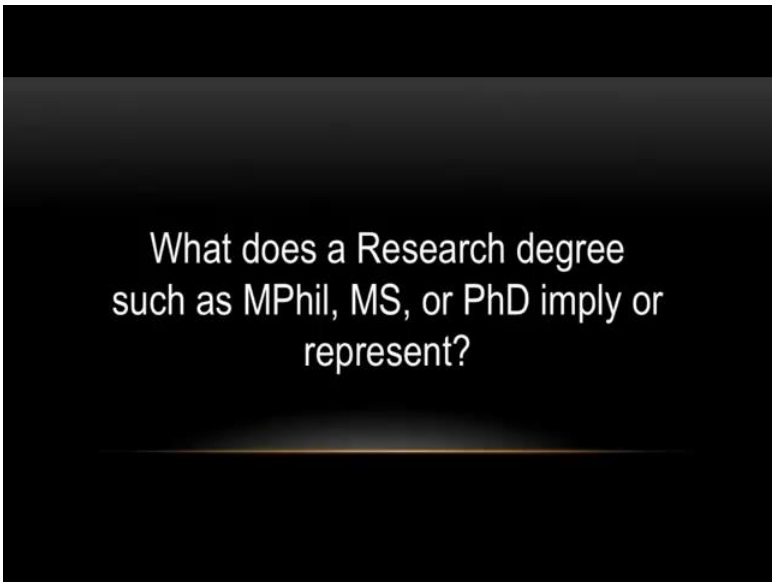

Prof. Arun K. Tangirala: I think what I would say is that it is really different from the under graduate degree that normally one pursue you say B.Tech or a B.Sc and so on. Because, normally in such under graduate degrees you do a lot of courses, whereas in research degrees what we normally think of is doing something new, contributing, first of all knowing what is there out in that area, picking out favorite area and most importantly contributing something. It may be a small contribution but drops make an ocean. So, that really involves a lot of effort from our side; whereas in a course based program like B.Tech and so on we take courses we learn. There is only a small part of discovering something; it is more of learning. Whereas, in research based degrees you are trying to really discover something, think and then postulate, validate, perform certain experiments and so. So, there is lot of self-contribution in this research based degrees.

Prof. Abhijit P. Deshpande: Yeah adding on to that, so that is the difference as Arun pointed out that there are various things which depend on oneself during a research degree. So, a course based degrees is where you know the exams, the assignments everything is sort of catered and everything is well designed. But when a research degree lot of it depends on the researcher himself or herself. And those are the aspects we will be discussing further on as to how what is meant by these aspects of research.

Prof. Andrew Thangaraja: So, one crude way of comparing these two things is, if you conduct a final exam for a course at the end of a subject of a class you write a final exam, everybody is supposed to turn in a very similar kind of answer script right. So that is the key and you write similar answers and you all get good marks. In fact, at the end of MS or PhD, you cannot submit a thesis which is similar to anybody else's thesis. Suppose to produce something which is unique and different and only you have done the work. So, that kind of represents the big shift between a normal degree course and PhD.

Prof. G. Phanikumar: Yes.

Prof. Andrew Thangaraja: So, have that and mind, it is not just one more degree after your MPhil, but or after your Masters it is a really a different sort of a degree when you pursue a PhD.

Prof. G. Phanikumar: Yes, so that brings to the point about the qualitative difference in PhD with other degrees. One may have a misconception that the amount of work, the quantitative work at a bachelor's degree, you do little bit more may be then you can get a Master's degree. But then you do twice of that, that does not mean that you can get a PhD degree. PhD is a qualitatively a very different degree where you are training yourselves to become a researcher and it is one different in also a sense of the ability of a PhD. Once you have finished the degree you are also expected to be at a level that you could guide another person to do a PhD, it is very different that from other disciplines. So, qualitatively there is a big difference.

Prof. Prathap Haridoss: Yeah and so, I would also like to add that you know when you do an undergraduate degree the boundaries are well defined. There is a start point and you can tell exactly when you are half way through the degree and when you have completed the degree. You can tell on the day you joined which is your graduation day, which is the day you pick up your degree all those things are well defined. In a research based degree, it is open ended. So, there is a lot of discovery in the process; you have to figure out when you have a learnt enough and you are able to contribute enough and you have become a master or somebody who is well known in that field who has contributed a lot in to that field, and therefore you are in a position to pick up a PhD degree. So, that's very different from typical undergraduate degree.

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So, we will now look at this question; What is research? So, I will may be start with Andrew and he can tell you something.

Prof. Andrew Thangaraja: Ok. So, I keep coming back to this contrast between a course and research. So, let us take again very concrete differences. You have a text book and a research paper, I think these are the two things you can compare. Text book is accumulated knowledge over several years. Somebody has understood and formalized that knowledge in his head and he is putting it out in a sequence of subject so that somebody else can learn, that is a text book and that is why you learn and that is what you to do. When you do research, it is completely unclear what will happen to that work after that. You know you are going to the real cutting edge of current day development round of the subject and you trying to push the boundaries in a direction in which nobody has thought of before. So, and nobody can be sure what will happen to that work after that, maybe it is very interesting, maybe it is not very exciting later on, you cannot predict anything. And when you do it will never be organized in a very clean systematic way like a text book is. You will have to organize in your head and take time over it. So to me the text book versus research paper difference of, may be a cutting as research paper differences what comes to mind when I answer the question what is research.

Prof. G Phanikumar: Yes, in often when students ask, is there an any text book I can refer to so that I could do my research. May be if there were a text book them may be it is too late to do research in that.

Prof. Andrew Thangaraja: Yes, Exactly

Prof. Arun K. Tangirala: I would also like to add that, in fact reiterate what Andrew just said that the beginnings of research are quite hazy. In fact, it is so foggy and hazy that you may think that is nothing or nothing is clear to you in the beginning. It is only the passion that drives you. So, what is research? Big integral part of research is learning; that is a very important part in fact you see the term search in research so you have to search and discover.

So the searching is for both learning and for discovering. And that of course we will expand shortly on that as to what you do to carry out this searching part in research. But I think the important part is the beginnings are hazy, but there is a joy to the discovery; provided you actually persistently pursue what you want to really find out and so on. In fact, it is like going into a city where you do not know what the destination is, you know that this city is good you heard, it is your favorite city, it is like choosing your favorite field of research but you do not know which monument you want to visit where you want to spend most of your time.

Prof. Andrew Thangaraja: Yes.

Prof. Arun K. Tangirala: And then in the beginning you take, that is where you do a literature survey, find out what are all interesting monuments or sightseeing places in the city; and then you pick your favorite monument and or your sightseeing place and spend more time trying to know what is there and may be contribute to that place and so on. It is, yeah, there is a lot of trial and error in research and you have to be prepared for it.

Prof. Prathap Haridoss: Yes, I think that is a very great analogy that Arun just gave you and in fact we would like to just share this quote from Albert Einstein, which basically highlights this fact that the research that we do involves you know exploring unknown territory, so to speak in, in a particular area.

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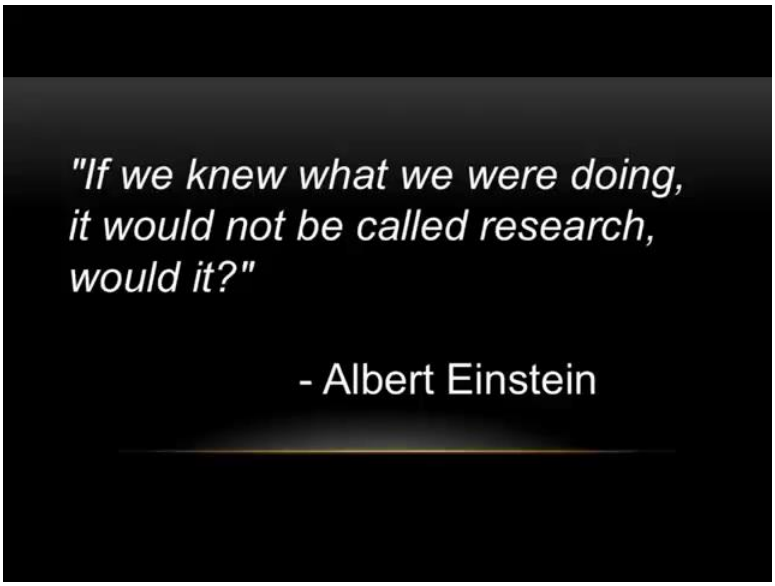

He said, if we knew what we were doing, it would not be called research, would it? So, that pretty much highlights the point that you know there something new, it is not something that you can just go look up and then say now I have done the research. There is something new and you are going to be the person who searches for this new stuff, finds it and then shares it with all the people around you.

Prof. Abhijit P. Deshpande: Yes. The other aspect of research even though we are trying to give you in one hour some sort of gist of what might be research is, from so far discussion it is already clear that it is very, very open ended.

Prof. Arun K. Tangirala: Yes, in fact you need to research to find out what is research also.

Prof. Andrew Thangaraj: Your answer will be different from (Refer Time: 09:43) our answer.

Prof. G Phanikumar: There is another point about that there are some prefixes used for research for example, incremental research and path breaking research. Generally, people don't start of saying that I am going to now do path breaking research that is not how we go about. We do have a structured way of going about performing our routine activities for research and then we are trying to incrementally add knowledge to what is already there and in the process by serendipity or because our mind is prepared, we are looking

for clues and then path breaking research happens. It usually happens rather than you go out starting to do that.

Prof. Arun K. Tangirala: And I just want to add that, in research you are the one who questions and you are also the one who finds the answers.

Prof. Prathap Haridoss: Right.

Prof. Arun K. Tangirala: When compared to text book thing where the questions are then and you have to answer.

Prof. Andrew Thangaraj: (Refer Time: 10:31) everyone knows the answer.

Prof. Arun K. Tangirala: Right.

Prof. Andrew Thangaraj: Just wants you to write it down.

Prof. Arun K. Tangirala: But in research you ask questions and you find answers. The only thing that is important to keep in mind is you ask relevant questions.

Prof. Andrew Thangaraj: Yes.

Prof. Arun K. Tangirala: Not absolute questions. And you give answers that make a difference.

Prof. Andrew Thangaraj: Yes this is true.

Prof. Prathap Haridoss: Through this discussion some of the points that we are going to look at are you know philosophical points like, what we have been looking at discussing so far which are you know the grand scheme of things within which we you know do carry out a research or we look at a research and so on. There are also lot of mundane activities that happen in that actually result in the process through which we do a research in universities and so on. We will also touch up on those because those are the day to day things that we get involved in as we try to carry out a research.

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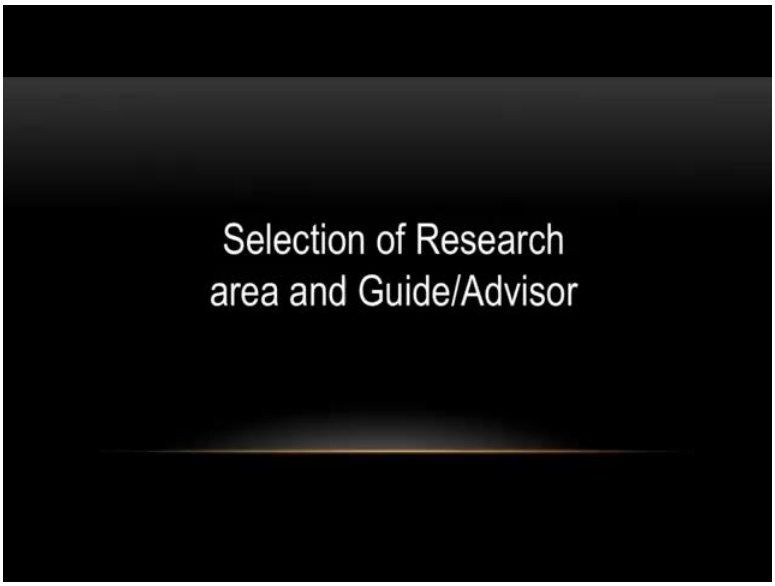

So, one of those things is selection of a research area and selection of your guide or advisor. So, these are the first things that you would do when you try formally get into research. Of course, you could do research on your own as an independent person but most of us are not doing that you know in our own lab hidden away from everybody, we do it as a part of a community, a scientific community which you often you know is thriving in university setting also in research labs and in industry, R and D setting and so on. So at least in the university setting, one of the key things is you have to find the area that you would like to work on and the guide that you would like to work with. And there is no, I mean like in many of these things there is no single way in which you do it, but the area you are interested in is something that you have to understand on your own. I mean this could be due to a lot of general reading you have done in over the years as a student at various levels and you have found some particular area that appeals to you, that interests you in terms of kinds of details that they are looking at, the manner in which the area is being explored and so on.

And so, that is one way in which you can get a sense of you know this is an area that you would interested in. You also have through your general reading you will also have a sense of how much impact that area has to the neighborhood you are in or to the scientific community or the vault over all. So, that may also influence your interest in a particular research area. So, there is multiple factors that influence what you may get interested in and you should take all of those into account. But it is I would say

fundamentally it is very important that you should be interested in that area. If you end up trying to do research, if you just say that I want a degree and I want a PhD degree and you just go join a university and you just pick up whichever advisor is willing to pick you up. The biggest problem that will come is, the day to day; you know the exploration that you do which is part of your research will not appeal to you. And if it does not appeal to you it is difficult for you to do good work in that area. So, you have to look at it in the inverse manner. First of all, it should appeal to you; only then you should be getting into it. So, that is something that I wanted to share with you.

Prof. Abhijit P. Deshpande: One important aspect of this selection of both research areas and guide and advisor, is the central element in your thought should not be worry. In the sense, we always worry about you know; Will I get a job afterwards? Is this area really relevant? So, there are lot of things associated with worry. Actually, one should look at it as a challenge. And so, if you look at it from that point of view because we emphasize enough that it will be you who is the focus of this. In general, one can say that in most research areas and with many guides and advisor, if you drive you will be able to actually make a very good thesis and in the end actually use that for to furthering your overall career goals. So, central element should not be worry but central element should be challenge and interest. And that is how you should try to make this decision.

Prof. Andrew Thangaraj: So maybe I should touch up on the more mundane aspect of selecting area and advisor. So typically, I mean this is what happened to me I think for most people this is what happened. May be in your undergraduate or postgraduate studies there was a course that you picked up and there was something you did which really appeal to you maybe it was thought to you in a very well, very nice fashion and that instructor also appeal to you. So, this is typically how it happens. So, it can even happen in the undergraduate stage. You do a substitute really like it, then may be as a post graduate student entering university you take a course with someone you really like how the course went, how the person handled the class, the subject matter and also how they interacted with you.

So, all these things together can appeal to you and then you might want to think, ok; I can do a PhD in this area, I like this area and do it. This is the more mundane way in which it happens, but I have seen many students do this. I think this is something it shows that the student is not very prepared I think. They would take an undergraduate

core area. Like in Electrical engineering there is an area called signals and systems they would take that area and they will say I want to do research in signals and systems. It is fine, but except that you know all research in Electrical engineering is in signals and systems. So that is the difficulty you know. So, while you like a subject you should also know that you know just because you learnt it in undergraduate you cannot do research directly in that area, it is very highly specialized beyond that. The area will get more and more and more specialized as you go deeper and deeper into it and you have to kind of anticipate that, but like everybody said the guiding principles are yes you should be interested in the area. And also, say will be motivated by your advisor both as a technically capable person and also as a person. All these things go into having a good fit between you and your advisor.

Prof. G. Phanikumar: So, I would like to add that among all the degrees that student normally under goes, PhD perhaps is the longest duration on a single aspect with a single person.

Prof. Andrew Thangaraj: With a single person.

Prof. G Phanikumar: It draws for about 4, 5 years, sometimes may be even 6 or 7 in some sciences. It is very important to pick the right advisor who has both the energy to drive you to take up the challenging aspects of the work and also the experience to guide you when you are into the difficulties coming over some of these topics. So, I think choosing an advisor is very important.

Prof. Abhijit P. Deshpande: Yes, there is also a style of your own and the advisor's. And I think there is good bit of thought that you can give to that also. Because sometimes those can also influence because as we have said it is day to day interaction over such a long period.

Prof. Arun K. Tangirala: I think it is a very important point as you must have probably now guessed, there is no definitive formula that we can give to choose an advisor or an area. I think as for as choosing an advisor is concerned as Abhijit just mentioned also mental compatibility. I think the style of thinking whether it matches, some students are really inclined towards doing carrying out theoretical work. While some students are made for experimental work. So, I think it goes back again to the same point that we have mentioned earlier you need to introspect a bit in and then figure out what suits you,

what you are interested in; whether a theoretical work or an experimental work or a mixed work and so on or you want to do really the cutting-edge stuff and so on.

So then of course, today there is no dearth of information you can really go to website, find out the profiles, check out the publication record even probably read a couple of publications and so on. To figure out whether the work really excites you, and remember in all of these there is no correct answer. There is always a discovery process, there are cases in which students have switched advisors, of course that is a very small proportion. But even if that happens you should not be really getting a depressed about that. Ok.

So, what is important is upfront to be very frank and honest with your advisor, express what your interests are and also listen to what your potential advisor has got to say, and do your own little bit of research about the advisor. And the same goes with the area as well you have to really introspect as Andrew said there are subjects that interest you, but that is just a beginning it is just giving you an idea of what to get into and you have to really probe a bit more into a broad field to figure out where you are. And I think the guide is a very appropriate term going by the previous analogy we said; research is about going into an unknown territory or visiting an unknown city and you are visiting monuments remember you have guides telling you giving to the history about it. So, here also the guides will tell you, when you pick a certain area and when you are talking to a potential advisor you can find out from the potential advisor, whether it is worth carrying out research? How crowded this area is? How crowded this bus that you are going to get in to is? Whether there are any empty seats or you have to stand for long time? Right so keep that in mind there is a lot of trial and error; but your gut feeling will tell you whether this is a right area and this is a right advisor right. It is also discovery process.

Prof. G. Phanikumar: And I would like to stress also, perhaps per our country the importance of homework. Generally, it is known that we have been used to spoon feeding; you know most of our schools, schooling system and later on. So, it is very important do adequate homework before we decide upon whether to do PhD and then also on what topic and with whom.

Prof. Arun k. Tangirala: So, that groundwork is very essential.