



Research tips for first-year Ph.D. students

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As higher education becomes increasingly popular, more people tend to start pursuing a Ph.D. degree program at a university. Pursuing a Ph.D. in is different from one field to the next. Nevertheless, many criteria are the same among many Ph.D. programs. In particular, when it comes to freshmen Ph.D. students, they very often face similar challenges and concerns. With research being the fundamental requirement in any Ph.D. program, such concerns mostly stem from the fact that a freshman may not be fully familiar with how and from where to start research.

In this article, I will provide some good tips to help freshmen Ph.D. students to choose the right research topic and conduct successful research in their Ph.D. programs. While I have an engineering background, I strongly believe that the following tips are not tied to any specific field and can be applied to students with varying backgrounds.

What is research?

Research is defined as a serious study of a subject to discover new facts or test new ideas. According to the definition, the first thing to observe is the term *serious study*. Research requires spending a lot of time and effort to fully understand and explore a topic, leading to dis-

covering new facts and ideas related to that topic, which is the second part of the definition. It is worth emphasizing that the purpose of conducting research is not only to understand the concepts of a topic but also to propose novel solutions and discover new aspects related to that topic—things that have not been previously found.

What interests you the most?

The most important thing to consider is your interests. No matter which topic you decide to conduct your research, it is always important to

your effort and time on something that greatly interests you. This is particularly important, as your interest can be the best motivating factor for you to keep moving during times of difficulty during your Ph.D. work. Many students choose a topic in which they have no interest or just a bit of interest, and they only switch to another “more interesting” topic after they have wasted a lot of their time and energy.

Now, you may ask, “How do I know if a topic is going to hold my interest?” Although you cannot know about all of the aspects of your



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make sure that you choose the one that is of your highest interest. A Ph.D. degree requires spending a lot of time and energy, and you want to make sure that you are investing

research topic at first, try to explore it in as much depth as you can before choosing one. This helps in avoiding many surprises when you are doing your research.

Consult your advisor and senior colleagues

A good way to help choose your research topic is to consult your advisor and senior colleagues. Most of the time, before you start your Ph.D. and during the admission process, you are required to choose a faculty member with a specific research field as your preferred Ph.D. advisor. Once you are admitted into a Ph.D. program, it is time to consult your advisor to decide on which specific topic you would like to work. Nevertheless, don't expect your advisor to make it simple for you. It is up to you to make the final decision in a consultative process with your advisor. Also, respect the field in which your advisor is working. It is clear that, in the end, you need to choose a topic that is in the general interest of your advisor, since your research is a collaboration between you both.

In addition to your advisor, your senior colleagues/labmates can be helpful. Meet your colleagues and ask them in which field they are working and how they chose to work there. Ask if they are happy with their choices and try to learn from their experiences and failures. Also, if you are about to choose a topic that requires collaboration with some of your senior colleagues, it is the best time to see how easy they are to work with. As mentioned previously, while you need to consult with your advisor and senior colleagues, it is very important to know that you are the one who makes the final decision, a decision that you ultimately will be responsible for during your Ph.D. program.

The importance of literature review

When it comes to choosing the right topic for your Ph.D. project, nothing is more important and effective than fully exploring the topic through different publications and textbooks (if any). Most of the time, the topic you choose to work on has been reviewed and explored by other researchers in various published

papers. When you have a couple of topics in mind, you should start reading about those topics to find out which one best matches your background and interests. Such papers are the best resources for you to get a generic idea of the principles of a topic and what has been

done already, as well as what your contribution could be. Usually, the introduction sections in the papers can help you understand the general scope of the topic, while the related works can aid in finding out what has already been accomplished within that topic. Not only does the literature review help you choose your Ph.D. project topic, but it is helpful for your Ph.D. thesis as well. While you are reading the papers related to your topic, remember to keep a short summary of each paper. These summaries can all be used in the related work section of your Ph.D. thesis and save you a lot of time when you are writing your thesis.

The impact of your research

Ask yourself the question of how the solutions and results you will be presenting will be employed by others in society. (And whether such a study is required at all.) You need to consider the fact that some Ph.D. projects target problems that are currently an issue, and other topics focus on issues that will rise in the near future. In both cases, you want your contribution to be significant.

Conducting research is like picking a fruit from a tree: there are some small fruits that are easy to pick, and you don't need to put so much effort to pick them, while there are other larger fruits further up on the tree that are

difficult to pick and require some effort. Similarly, in the "research tree," the simple topics are easy to work on and they will not bring you a significant contribution at the end. However, choosing challenging topics, although requiring a lot of effort and patience, is more

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likely to result in a significant contribution. A significant contribution is very likely what will help you the most in finding your future career.

Research requirements, time constraints, and being realistic

When it comes to selecting your Ph.D. project, it is very important to consider the resources and equipment to which you will have access to conduct your research. Most of the time, the research tools and the machines needed to perform the experiments are very expensive, and if you do not have access to them through your university or advisor, then you will be in trouble. Therefore, it is for your best to consult the list of tools and equipment you require with your university and advisor before settling on a topic.

Moreover, respect the time constraint. Most universities have a timetable for Ph.D. projects, and you need to deliver the project on time. This limitation may get tighter when a company is involved, when you are required to not only respect the time limitations set by your university but also abide by those timelines set by the company. Make sure you choose a topic that can be done within such time constraints. To make your life easier, divide your project into different phases and try to finish each phase before a deadline that you set for yourself.

It is also important to be realistic when choosing your Ph.D. project. Choose a topic that is in the scope of your knowledge and background and make sure it is one that you know you will be able to accomplish in a few years of time.

Start your research

After you choose a proper Ph.D. topic, it is time to start your

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project. Bear in mind that you still need to keep performing literature reviews and keeping an eye on recent publications. Remain updated on the latest progress and achievements on the topic on which you are working.

The next thing to consider is dividing your project into different phases, including some short-term plans and long-term ones, with a deadline dedicated for each step. The final short-term plan may be publishing your results at a conference or in a journal, and, in the case of a conference or a special issue in a journal, you need to take into account the submission deadlines. Remember to document all of your thoughts and results at each step. Such documents can help you prepare your publications and your Ph.D. thesis later, and you can observe your progress throughout the process. Also, these types of notes are good options if you require submitting a report to your advisor or the company with which you are collaborating.

The importance of courses

Some students may think that there is no relation between the graduate courses you take during your Ph.D. program and your research. Well, in most cases, that is simply not true. Try to choose and take the courses that are relevant to your Ph.D. project topic. Most of the graduate courses are tailored to deliver very specific information, and they are

good resources if you need to learn about a specific subject in a short amount of time.

Also, do not hesitate to try courses that are not related to your Ph.D. project. Doing so can be useful, as it helps to look at your project from another perspective. Taking unrelated courses helps you become familiar with other subjects and may spark an interest on another topic to focus on after you finish your Ph.D. project.

Try to apply what you learn from your courses to your Ph.D. project. Most courses require a final project, and such projects are a good opportunity for you to take your newfound knowledge to your Ph.D. project by defining a course project topic that is related to your Ph.D. topic. Very often, such final course projects can be published as a paper in a conference proceeding or a journal.

Publications are important

Others will know about your Ph.D. work through your publications. Therefore, it is essential that you

take into account publishing in well-known conferences and journals to let others know what you are accomplishing. While doing so is important, it is better to start with a significant contribution other than publishing some papers with very little novelty. Nevertheless, take into account the importance of delivery time. If you are working on a topic on which many other groups are also working, you may consider publishing your work with a significant contribution as soon as possible to take the lead in the field. While it is beyond the scope of this article to discuss the quality of publications, try to make sure that the publications you are targeting are reputable (e.g., those that require peer review prior to publication).

Keep up the hard work

The Ph.D. life is stressful and full of ups and downs. Remember that what you are trying to do is not simple. If you feel tired, then get some rest or take some days off, but never give up. Sooner or later, your hard work will lead to solutions to your problems. You are taking the first steps of the Ph.D. journey, an experience of which many others have successfully completed, and you can do so too if you keep on working hard.

About the author

Mahdi Nikdast (mnikdast@ieee.org) earned his Ph.D. degree in electronic and computer engineering from The Hong Kong University of Science and Technology in 2013. Since 2014, he has been a postdoctoral fellow in the Department of Computer and Software Engineering at Polytechnique Montréal, as well as in the Department of Electrical and Computer Engineering at McGill University, Canada. 