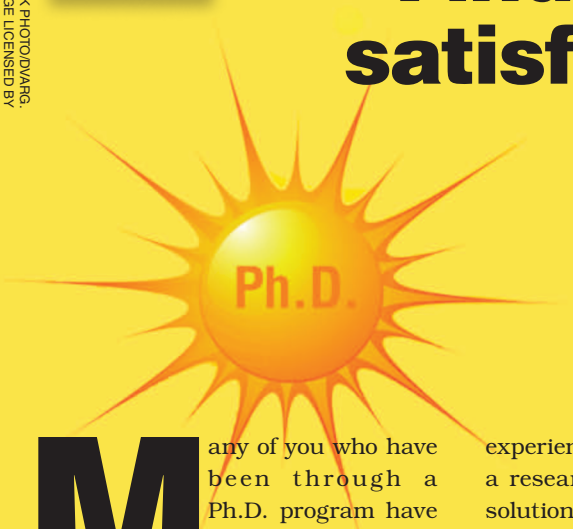
DRAGONS—©CAN STOCK PHOTO/DVARG. CAP AND DIPLOMA—IMAGE LICENSED BY GRAPHIC STOCK.

# Finding happiness and satisfaction during your Ph.D. program

Sharad Sinha and Mahdi Nikdast




Many of you who have been through a Ph.D. program have observed your peers and colleagues feeling unhappy and unsatisfied with their work. This is especially the case during the first few years of a Ph.D., when one is trying to make sense of what he or she is doing. Some of you have experienced it yourself. Working on a research problem to find a good solution is a challenging task. The solution is elusive at times, and there is little knowledge available to proceed further, thus requiring one to think deep and hard.

It is at times like these that students begin to compare their Ph.D. life with that of their friends who are comfortably settled in their jobs, earning money, and having a pleasant life. They begin to question their decision to enroll in a Ph.D. program, the worthiness of the problem that they are trying to solve, and whether it would have any impact on the world. To many outside its domain, research is expected to produce visible results and tangible outcomes. Speaking to such people further complicates the lives of students.

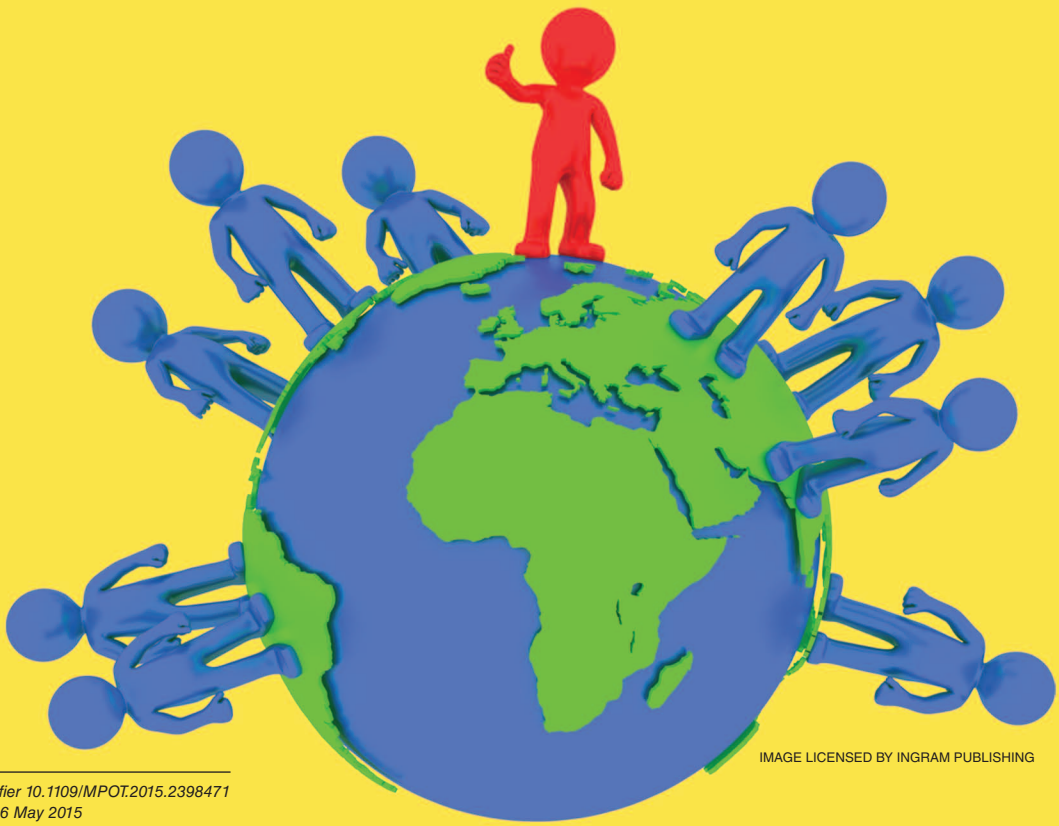


IMAGE LICENSED BY INGRAM PUBLISHING

*Digital Object Identifier 10.1109/MPOT.2015.2398471*
*Date of publication: 6 May 2015*

 0278-6648/15©2015IEEE

They have a desire to make an impact, but their current research is unlikely to have any measurable impact in the next few years. When they see that certain research areas get more publicity, they may feel that they chose the wrong area. All of these questions and confusion create a vortex of emotions that leaves many students dissatisfied. Needless to say, any questioning by their advisors on research progress leaves them pricked. Both happiness and satisfaction seem elusive.

## The role of motivation

When students feel this churn within themselves, they should ponder their decision to enroll in a Ph.D. program. Perhaps they chose it because they wanted to expand the frontiers of knowledge by contributing new insights. Maybe they chose it because they loved solving challenging problems, examining current knowledge, or performing experiments. On the other hand, some may love the idea of letting their imagination and creativity take flight while others were motivated by people who earned much more money after a Ph.D. The fact that people with Ph.D. degrees were highly valued in their society or professional field could have been another source of motivation. Just as Gregory Mallory is often quoted as having replied to the question, "Why do you want to climb Mount Everest?" with the retort, "Because it's there," a few students might have chosen it simply because they loved the idea of getting a Ph.D. Constantly reminding oneself of the things that motivated the pursuit of a Ph.D. program is good way to keep composed in trying times.

## Understand the nature and philosophy of research

The nature and philosophy of research is in itself a subject of study. However, a basic understanding can be helpful. Research can be classified broadly into short term and long term. Short-term research is typically focused on outcomes accomplished in around five years, which could then be put to reasonable practice. As an example, consider designing an integrated sensor that could sense multiple poisonous gases in different environmental conditions with a high degree of accuracy and repeatability. Long-term research focuses on outcomes in a minimum of approximately ten years. For instance, consider the use of photonic interconnects for on-chip communication. Various aspects of it have already been under investigation for nearly a decade, and yet there is no chip today that relies solely on photonic interconnects.

There is also the distinction between applied and basic (or theoretical) research, although many research projects are a blend of these two in varying proportions. Applied research is more problem oriented, for instance, the gas sensor project mentioned previously. Basic or theoretical research is more involved with understanding the nature of materials, their fabrication, how to use them, and their interaction with other components. Take, for example, photonic interconnect research. There are also distinctly theoretical areas of work (e.g., designing a new cryptographic algorithm or improving the complexity of algorithms involves working with abstract mathematical principles).

As a Ph.D. researcher, one's primary goal should be to conduct research. Whether anybody uses that research or not is a different question. Some may use it, and many may not. There are a number of reasons why most research remains on paper and does not get translated into a product. However, whenever some research does get translated into a product, it has built upon the work of others—work that remained on paper. Therefore, in general, no research work is waste.

The utility of research that actually advances the frontiers of knowledge may become visible long after the research was actually conducted. There are numerous such examples in scientific history. Consider Fourier transforms as an example. When Joseph Fourier developed the transform—a mathematical contribution—he would not have known that one day it would be used in various types of image processing applications. To those who want to see immediate utility, his research would have been nothing more than a figment of imagination.

Scientific research is also an economic exercise as it cannot be conducted without money. Clearly, economic policies play a role in determining areas of research that appear to be "hot." For instance, big data processing is the "in" thing these days. Money and resources are being poured into it. There are even universities offering degrees in data science. You may read a lot about research in this field in the popular press. Don't be disheartened if the press does not cover your area of research. Its aim is to attract readers by choosing research projects that have potential. Readers are more interested in something out of the ordinary. In a way, the popular press serves to let the imagination of a layman take wings. But don't forget that not everybody buys into research projects covered by the popular press. There is no harm in seeking fame and popularity for your research project, but that should not be the goal.

## Fixing a goal

Speaking of goals, an important factor that may cause dissatisfaction is the very absence of a goal. Defining a clear objective before starting a task should be a high priority, and, when it comes to your Ph.D., it is the highest one. This is particularly true as you need to spend a considerable amount of time on your studies, and, without a convincing objective, you may just give up. Moreover, it is your motivation that keeps you going through all the challenges that you face during your Ph.D.

When it comes to defining your objective, you need to think about what you would like to do after graduation. You may think that this might not be practical, especially in the early stages of your program, but it is necessary to have a picture in

your mind. Usually there are two options for Ph.D. graduates: industry and academia. You should ask yourself: "Which sector would I like to enter?" Start by listing your capabilities, and carefully focus on how you can improve them during your Ph.D. For example, if you picture yourself as a faculty member in a university, you may decide to work more on your publications, teaching experience, and supervision experience. However, many companies require their applicants to have acquired mostly practical skills, such as being able to work and design with computer-aided design (CAD) tools or possess device fabrication experience, rather than having a satisfactory number of qualified publications.

Thinking about your abilities and what you can acquire through your Ph.D. program is a good way of fixing a goal. Sometimes Ph.D. research is so theoretical or blue sky that it may not add much value to your resume when applying for industry positions; so it is better to figure that out as soon as possible and look for ways to make your resume look more interesting. Another good way is to go back and re-examine what motivated you to get your Ph.D. in the first place. Be guided by such motivations when fixing goals for yourself. Finally, if you haven't focused on a goal yet, late is always better than never. Look at your peers and learn where they ended up after their graduation, and decide for yourself.

## Getting inspired

In addition to a well-defined objective, inspiration can further help you get through your program. Ph.D. research is a challenge for which you are responsible. You need to go through all the possible solutions that exist and propose one that outperforms the others. Sometimes, there is no known solution, and you need to create one. During this process, however, you need to bear in mind that you are not the only one who has been tackling such difficulties. There are many others facing the same challenges, and many more have successfully passed through them. Get inspired by others who succeeded. A very good example is to read the biography of someone you admire or who serves as your mentor. A mentor could be your supervisor, a colleague, or a famous scientist. Try to learn from them to understand how they perservered. Your Ph.D. can be inspired by the life of many great scientists and inventors. While looking into the challenges they faced, try to put yourself into their shoes, and see how you can apply the approaches they considered to solve the problems you are facing.

While Ph.D. research is unlikely to turn you into the next superstar scientist or the next Newton, studying the history of science and technology will help you in seeing research from multiple perspectives. History contains rich stories of the persecution of scientists and the scientific trials and tribulations and of strong-willed men and women. Although you may have disliked history as a subject in high school, now is the time to flip through it. History teaches many things—the most important being that it can provide hope.

## Seeking support

In the end, you need to make an effort to have a happy Ph.D. experience. Ph.D. work requires a lot of focus, often requiring long hours of work inside the lab. Besides, failure is what students usually face until they step into something useful. As a result, they usually feel disappointed, lost, and stressed. Don't let that happen to you. While Ph.D. work has a high priority, don't entirely devote to it unless you are the type who likes regularly spending long hours investigating a research problem.

Always make some time to spend with loved ones and friends. Discuss the situation you are facing with senior colleagues and friends, and ask them if they have any suggestions. Try not to spend too much time inside the office or the lab. Get involved in some social activities that your school organizes for students. Participate in sports. Talk often to your family; you will find that they are very helpful. Find a hobby perhaps; this helps you focus on something other than your research for a while. Such activities help refresh your mind—very often the solution is right there and you just don't see it. We both love to cook. At times, we have prepared dishes from various cuisines to release our mental pressure.

## Conclusion

It is human nature to seek happiness and satisfaction, and how one achieves these goals depends a lot on oneself. The time you spend pursuing a Ph.D. program can help you learn many things besides scientific research. Academic life provides the freedom to pursue different ideas. You can use it not only to do good research but also to build your character. With a steady mind and awareness of many aspects of life, including research, happiness and satisfaction will come to you.

## About the authors

***Sharad Sinha*** (sharad_sinha@ieee.org) earned his bachelor's degree in electronics and communication engineering in 2007 from Cochin University of Science and Technology, India, and his Ph.D. degree in 2014 from the School of Computer Engineering at Nanyang Technological University, Singapore. He is a corresponding editor of *IEEE Potentials* and a visiting scholar at The Hong Kong University of Science and Technology.

***Mahdi Nikdast*** (mahdi.nikdast@polymtl.ca) is a postdoctoral fellow at the Department of Computer and Software Engineering in Polytechnique Montréal, Canada. He earned his Ph.D. degree in electronic and computer engineering from The Hong Kong University of Science and Technology, Hong Kong, in 2013.

P