The Ph.D. process

What it takes to get it done

Dale W. Callahan

Any piece of knowledge

I acquire today has a value at

this moment exactly proportional

to my skill to deal with it.

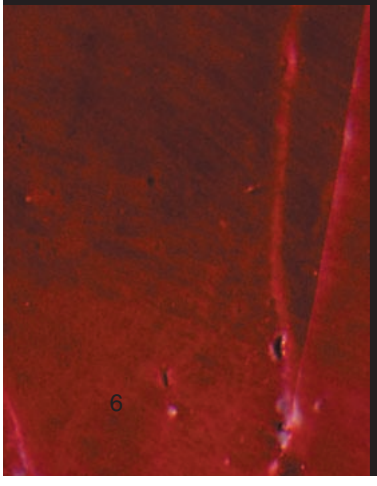
Tomorrow, when I know more,

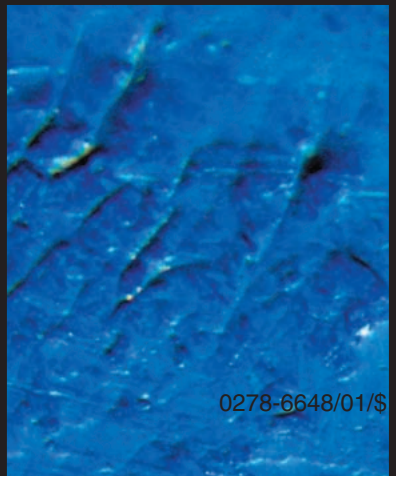
I recall that piece of knowledge

and

use it better.

--Mark Van Doren





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In the bachelors degree program, you are given a very regimented core of material to learn. You, and all the others in your degree program, must learn the same things. It is a test that you need to pass, and in the process you will acquire the fundamental, or foundational, knowledge needed to succeed in your field. (Note: The master's degree program offers more freedom to pick your projects and/or thesis topics but the process is still well controlled.)

The Ph.D. program, however, is completely different. You are free to decide your coursework, your dissertation topic, your advisory committee, and you even have the freedom to crash and burn. In fact, many students get *most of the way* through and never finish. The term you often hear is "I have completed all but my dissertation." This phrase is used so often that saying the letters "ABD" indicates you have completed "All But the Dissertation."

One of the reasons for the high number of incomplete doctoral degrees is because students don't understand the process. Ph.D. programs test not only your ability to do academic work, but also your ability and will to learn and play the game.

What the Ph.D. is not

I strongly disagree with those of you who think that the Ph.D. program is strictly an academic game. Persuading a committee of five people, with possibly five different views on research, to agree on your choice of coursework is a skill that has industry written all over it. The politics and gamesmanship needed to get through the Ph.D. program is required daily in the corporate world.

Ask questions

Remember that the failure to plan is a plan to fail. To develop a plan, you need to research the process. You need to talk to many people and try to determine how things truly work; the key is to look for the commonality among the many opinions given.

Talk with your current or past professors; ask them about the degree program at the university where they received their degrees. Plan to visit a school and arrange to speak to several professors in your area of interest. You should also talk to the chair of the departments, the dean and, most importantly, the administrative assistants. And, yes, talk to recent Ph.D. graduates from the program. It is rare for a school to have a documented process.

Elements of the Ph.D program

The major elements of the typical Ph.D. program—in order of importance—are 1) the committee, 2) the bachelors degree, 3) the post-graduate work, 4) the qualifying exams, and 5) the dissertation. However, most students look at this list in the reverse order.

The committee—This may seem like an odd starting point, but besides your coursework, this is the most critical element. (Your work partially depends on the committee, which is why it is first.)

A Ph.D. committee is usually made up of five professors. Typically, the committee members will have Ph.D.s themselves and will work for the university. In engineering, usually one committee member is from the math department and the other four are from the engineering department.

The committee is critical to your success or failure. Here are two important, often unspoken and unknown, facts about committees:

1. You decide who is on your committee.

2. You should start deciding on your committee members as soon as possible. Often you will be required to choose the members before you start the Ph.D. program, but if not, do it anyway.

The first one seems to throw people off. I discovered it by accident when I was brave enough to ask if I could change one of my committee members. (Yes, there is a one for one relationship between bravery and stupidity!)

You want to hand pick your members starting with your committee chair or advisor. Many will tell you the advisor is the driver of the Ph.D. program, but this is not true. You are the driver. However, the advisor is crucial.

The advisor should have some expertise in the field in which you are planning to do your work. In addition, he or she should be someone you can work with—very well. Don't be afraid to talk to lots of people when considering an advisor. This is no time to be shy. Ask everyone their opinion, and take all opinions with a grain of salt. However, what you are looking for is a general consensus. If many people indicate that a particular person is hard to work with, or will drag out your degree forever, believe them.

Once you have chosen your advisor, have that person help you choose the rest of the committee. By this time you should have some good ideas about whom you'd like to be on the committee, but check with your advisor. It's important that both you and the advisor can work with them. So if you get someone who thinks you're an idiot, doesn't like your area of research, or is just a plain old soured puss, you can't blame anyone but yourself.

Some general guidelines for selecting the committee members are:

Be careful. Talk to the candidates and make sure that they don't have ulterior motives for being on your committee, e.g., they may want you to do their research and not yours.

If there is an expert in your field but you are hesitant to pick that person for fear that you will not be able to defend your work—think again. If the person is an expert, someone will suggest that he or she be on your committee anyway. And, even if the person is not on your committee your advisor, you still can use his or her expertise; that person can ask you tough questions, guide your research, and still be a big help.

Okay, none of this seems very academic. It seems more like you are choosing a board of directors for your company. However, at the Ph.D. level, it is all business. You are the producer of the product, as well as the product itself.

Bachelors degree—The academics start here. Upon entering the degree program, it helps if your undergraduate degree is in the same field as your Ph.D. If not, you may be required to take additional courses to give you a foundation in the area. If this happens to you, don't fret.

If you must take additional coursework, guess who decides what and how much—the committee. Suppose you have an undergraduate degree in history and are going for a Ph.D. in electrical and computer engineering doing networking. However, for the last 10 years, you have sat on a networking standards committee, and you developed and patented new networking technologies. The committee can still require you to take an "Introduction to networking" undergraduate course. Common sense or not, they decide. (If you neglected to read the section on the committee, stop and read it now.)

Post bachelors coursework—The Ph.D. degree does not take into account the masters degree. The only degree that counts is the undergraduate degree. All other coursework will apply to the Ph.D. Therefore, if you have any graduate coursework, take it to the committee. Once again, they decide how (or if) they will count this work toward the requirements for the Ph.D. If you are going for a masters degree and hope to get a Ph.D. later, start asking the Ph.D. questions now.

A quick thought on getting a masters degree first: Since the entrance into a Ph.D. program usually does not require you to either have a masters degree, or to earn one in the process, some people decide to go straight for the Ph.D. degree. However, this is a dangerous approach. If you plan correctly (with your committee), all your masters degree coursework can count towards your Ph.D. But, you will have something to show for your effort half way through (usually less than half way through) even if you do not finish. Otherwise, you can only show the qualifications of a bachelors degree even if you have completed all the Ph.D. coursework. The typical layout for the Ph.D. coursework in engineering is:

Major—24 semester hours
Minor Area 1—12 semester hours
Minor Area 2 (Math)—12 semester hours
Dissertation Research—24 semester hours
Seminars—2 semester hours

This is what you will pay for. Obviously, you can have more hours in each one, and—once again—your committee may tell you that extra courses are required.

The 24 hours of coursework in the major area are courses that apply to your major field of study. So if you are going into power systems control, your major might be a combination of courses on power systems and control systems. Or your major might be in power systems, and your minor area might be in control systems. Yes, you guessed it, your committee decides.

In engineering, the minor area 2 is usually math. Depending on the school (or committee) these might be pure math courses (from the math department) or applied math courses (from any department, as long as you can prove that the courses are math intensive).

The dissertation research is not really your dissertation. These are the credit hours you pay for while doing your dissertation. (Yes, this is the school's income.) A few rules often apply as to how soon you can take these credits and how many you can take at a time. These are usually the rules of the university. One rule that seems to be typical is that you must be registered for dissertation hours in the term that you defend your dissertation.

> The bachelor's degree proves that you can be trained; the master's degree indicates some expertise in your field, and the Ph.D. indicates your ability to become an expert in any field.

Qualifying exams— Once you have completed all your coursework (not your dissertation hours, but regular coursework), you will have the honor of taking a qualifying exam. Once again, procedures differ, and may be hard to find out about, but they do exist. This exam is usually written by the committee. It will cover all the areas of your coursework. Sometimes the committee will have the instructors write and grade the questions relevant to their courses.

Passing these exams is the first major hurdle towards getting the Ph.D. "But," you ask, "what about all that coursework I just did?" That was typical academic coursework. Anyone who has a bachelor's degree can do that. A second qualifying exam, often called the oral exam, is actually part of the dissertation process.

Dissertation—When you think of Ph.D., you naturally think dissertation. This is the crowning achievement of the doctoral program. The process begins after your written qualifying exam. In actuality, many will have already begun their research at this point. When you get here, you need to reevaluate your position and your earlier decisions.

First, think about your advisor and your committee. This statement may not be popular in academic settings, but it is important to do. While not allowed by all schools, you can often change your advisor. Some may have made it easy by having left since you started your program. Either way, now is the time to review your advisor's comments and involvement. Do you think that you can continue to work with him or her? Have there been any misunderstandings in the past that need to be cleared up? You may think your advisor is not that important now, so you may not be that concerned. However, *be very concerned*. Here is where your advisor and the rest of your committee become very critical. Make sure you clear up any previous misunderstandings now, or change your advisor or committee member(s).

You need to ask them the following questions:

- What do they see as the proper form, and topics, of a Ph.D. dissertation?
- Do they think dissertation research should be more theoretical or practical?
- How many papers should be published before you defend your dissertation?
- Should they be conference papers or journal papers?
- How long should the dissertation take?
- Given what you have already done, how much farther should you go?
- What flexibility do you have in doing the research? (Do they want to give you very specific directions or can you choose your own directions and outcomes?)

These questions, and their answers, might give you some feel as to how the advisor and the committee see the direction of your research. There are no correct answers here, but the answers should give you a feel for what they expect. If you feel your stomach churn as they speak, express your concerns frankly to them.

In addition, I suggest you go and discuss the same issues with others in your area of interest. It is preferable to do this before you decide on your original committee, but I have found when we decide on the original committee, we rarely know the exact area of our research.

No matter what, I highly recommend you feel comfortable with these folks at this juncture. The advisor and the committee hold your academic career in their hands. If you are not comfortable, I suggest that you go to other universities and discuss your options with them. While this may seem radical, you are a valuable asset—if you actually finish. Universities with Ph.D. programs usually need to graduate so many Ph.D.s within a three year rolling average. If another school can steal you away at this stage—they will. At the very least, when you come back to your university you have a bargaining chip.

In addition, you might visit the department chair and/or dean. While the committee members may not really care if you ever graduate, your chair and dean may care an awful lot.

A working plan for the advisor

Once you are content with the committee and your advisor, make some plans for managing the process. Wanda Pratt has some wonderful information on this topic (see *Read more about it*). Here is a quick summary of her points:

1. Insist on meeting with your advisor weekly.
2. Prepare for your meetings. Know what you need answered and what you want to discuss.
3. E-mail your advisor a summary of every meeting. This is a great way to avoid misunderstandings.
4. Show your advisor the results of all of your work as soon as possible.
5. Communicate. If you disagree with your advisor—let him or her know. Be respectful, but be straight.
6. Take the initiative. I cannot agree with Wanda more on this point. It is all in your lap. If you never graduate, your advisor's job, pay raise, or career is not at risk—unless one of your parents is the dean.

Overall, your advisor is very busy and has other concerns. Although most will want to help you, this person is not in charge of your work. Unless you are being paid to do the advisor's research and counting it toward your degree, be considerate and do not go in just to shoot the breeze. Be prepared, get to the point and get out. This way your advisor will not dread meeting with you when he or she gets busy.

The dissertation proposal

The first step in writing a dissertation is to carve out a plan of what you will research and write. (Hopefully you have been planning all along and have already done parts of the research as part of your classwork.)

The statement that you will always hear is that your work (the dissertation) must "add to the body of knowledge." When you ask what that means, the answers you get are as firm as Jell-O™.

You might see yourself coming in the door with some Nobel Prize-winning problem to solve that will change industry and society. I see someone who will never finish. Do your earth-

shattering work later; get the degree first. Check out the web site by William B. Thompson listed in *Read more about it* for proposal guidelines.

My approach with graduate students is a bit methodical, but it seems to work:

1. Pick a rough area that interests you and your advisor.

2. Do a literature search on the topic and find five problems that interest you. These are easy to find since problems are what the papers are trying to solve. In addition, the conclusions of many papers and dissertations will indicate future problems that need to be solved.

3. Write them up in a short paragraph or two, with references, as if you were writing a short two-page dissertation.

4. Take these to your advisor and discuss them. Out of the five, you should be able to agree on one as your area of research.

5. Now, take this topic and repeat steps 2 through 4 until the topic is sufficiently narrowed.

The point of this exercise is to get you researching deeply. What is highly discouraged is Web scanning. You must evaluate what the research community considers research papers to get a real topic.

Once you get the topic narrowed and have a great feel for what you want to do, write up a three- to ten-page description of what you plan to do and the steps you plan to take. Make sure the committee understands where your work will end. For instance, if you plan to develop a theoretical or mathematical model of a system, make sure that you state that you are not going to develop a physical model from your theoretical model. Now, go and discuss the plan with your advisor.

Most universities will want you to write up a history of the problem (a reference to all work previously done in this area) as well as a description of your work. If you do this correctly, you should end up with 15-25 pages that make three or four chapters of the dissertation. They might be labeled:

Chapter 1—Introduction
Chapter 2—Literature review of previous work
Chapter 3—Motivation and goals
Chapter 4—Bibliography

The goal is to be finished with the dissertation after you have done what you stated in the proposal. Therefore, make the goals and objectives very clear and make sure you can accomplish these objectives. Changing your goals later is going to be difficult.

Proposal review and acceptance

Once the proposal is written, take it to your advisor for a thorough review. Also, take it to all of the committee members and, if possible, anyone who is an expert in the area. The goal is to make sure that you are on target and have not aimed too high or too low. Make any modifications you need at this point until you, your advisor and other committee members are comfortable.

Now, formally type up the proposal and deliver it to the committee. I recommend that you follow the guidelines of the university dissertation format for the proposal. This will make it professional, easy to read and, if accepted, these parts of the dissertation will be done.

When you deliver the written proposal, set up a meeting with your committee for a date two weeks later. This will give everyone time to review your formal proposal. Go to the department secretary and the department chair to make sure you have all the forms that you will need for your proposal review. (This is sometimes called your oral qualifying exam.) If your advisor is handling this, make sure nothing is left out. In fact, I would volunteer to do this for the advisor—after all, you care more than he or she does.

When you formally present your proposal, there should be few unexpected questions since the committee has already reviewed it and made comments. The committee members will be required to sign a form saying that they agree with your proposal. *Get a signed copy for your records.* You are now a doctoral candidate. More importantly, they have all agreed that when you complete all that you have proposed, then you are finished.

The completed dissertation

Once your proposal is agreed upon, take the initiative to schedule periodic reviews of your work. While not all of the committee members will give you feedback, or even read your work, do not give them the excuse that they were not informed.

Send them a schedule of when you plan to have the different parts of your work completed. In this, give the outline of the dissertation chapters and the dates that you will deliver them. I would ask the committee to meet you at least four times during your work.

The scheduling is your job. Delivering the copies is your job. Keeping them updated is your job. If you go away and they never hear from you again, they will not fret. By setting this schedule, you are giving yourself deadlines and communicating with the committee. Don't worry about changing the dates and deliverables; this will happen, but keep them informed. At this stage you have momentum, and do not let it get away from you, or you will be forever ABD.

Read more about it

• Wanda Pratt, *Graduate School Survival Guide.* [Online] Available: http://www.smi.stanford.edu/people/pratt/smi/advice.html.

• Marie des Jardins, *How to Be a Good Graduate Student.* [Online] Available: http:// www.cs.indiana.edu/how.2b/how.2b.html.

• Association for Support of Graduate Students. [Online] http:// www.asgs.org.

About the author

Dale W. Callahan holds a BEE and MBA degree from Auburn University, an MSEE degree from the University of Alabama at Birmingham, and a Ph.D. degree from the University of Alabama. He is a licensed Professional Engineer in the State of Alabama. Dr. Callahan has served with the National Council of Examiners for Engineering and Surveying (NCEES) to develop tests and test questions in the area of telecommunications for the Professional Engineers exam. Dr. Callahan has been active in IEEE for 15 years. He has 15 years of combined experience in industry and academia and has been an active technical consultant in the areas of software development, computer networking, telecommunications standards, hardware and software testing in the telecommunications industry, and telecommunications billing systems. He is currently an Assistant Professor of Electrical and Computer Engineering at the University of Alabama at Birmingham.