

Guiding PhD students



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Who is the intended audience for this talk?

Primary audience: Faculty in the process of guiding their first few PhD students.

Secondary audience: Post-docs who are considering a faculty role.

If you are PhD student, this talk will make more sense after you graduate.

If you are an experienced faculty, having graduated many PhD students, you should be giving such a talk!

Why am I doing this?

You have gone through the PhD and post-doc process as a student. Now you have to look at it from the advisor/guide perspective. This is different because:

- In addition to doing research yourself, you are now responsible for a student's growth as a researcher, thinker, person ...
- It is a much larger responsibility than mentoring juniors on specific topics or guiding interns/ B.Tech or M.Tech projects.

As you find your own way of guiding students, it might be useful for you to listen to another person's philosophy / approach. Hence this talk.

Disclaimers

I have structured this talk as a series of questions that you could ask yourself.

- I have given my own answers as one data point for you to think about.
- You may not agree with me. It is ok. This is just an example.

These answers are *my* personal philosophy and approach.

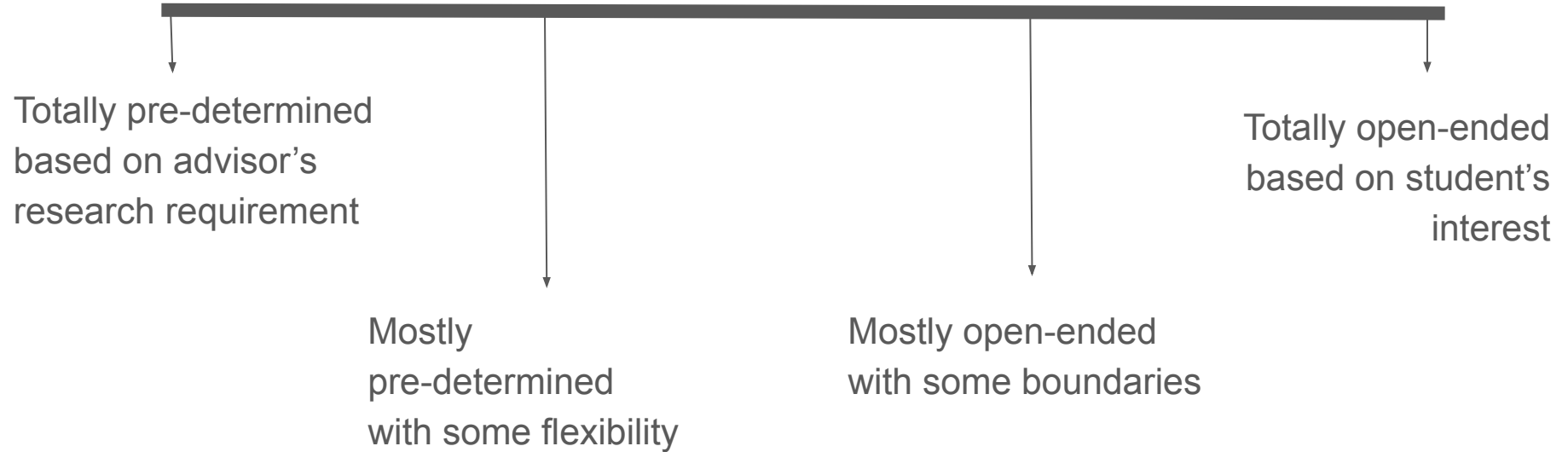
- They may not work for you or your students or your institutional constraints.
- Be aware of the alternatives and pros-cons before you decide your approach.

You may know many of these points already.

- If you find 1-2 new ones that you want to consider, this talk has served its purpose.

Let's begin

The PhD continuum (student view)



What do students expect of a guide?

Conducted a survey. Got 14 responses - 10 ET PhD students, 4 ET Alumni.

- freedom to explore multiple topics
- be open and flexible while deciding the research topic
- make me feel that I am in the driving seat of the PhD vehicle
- provide opportunities to work on projects and give industry experience

- be aware of the students aim/career choice post PhD
- being able to help the scholar engage with various failures and scaffold their emotional well-being in that growth phase
- a critical but positive and constructive research approach
- mirror which shows you your strengths and weaknesses

Reflect: All responses were about individual growth. Recognition for research is a side-effect.

The PhD continuum (advisor view)



Primary focus is on own research agenda

Will look for a student with suitable skills

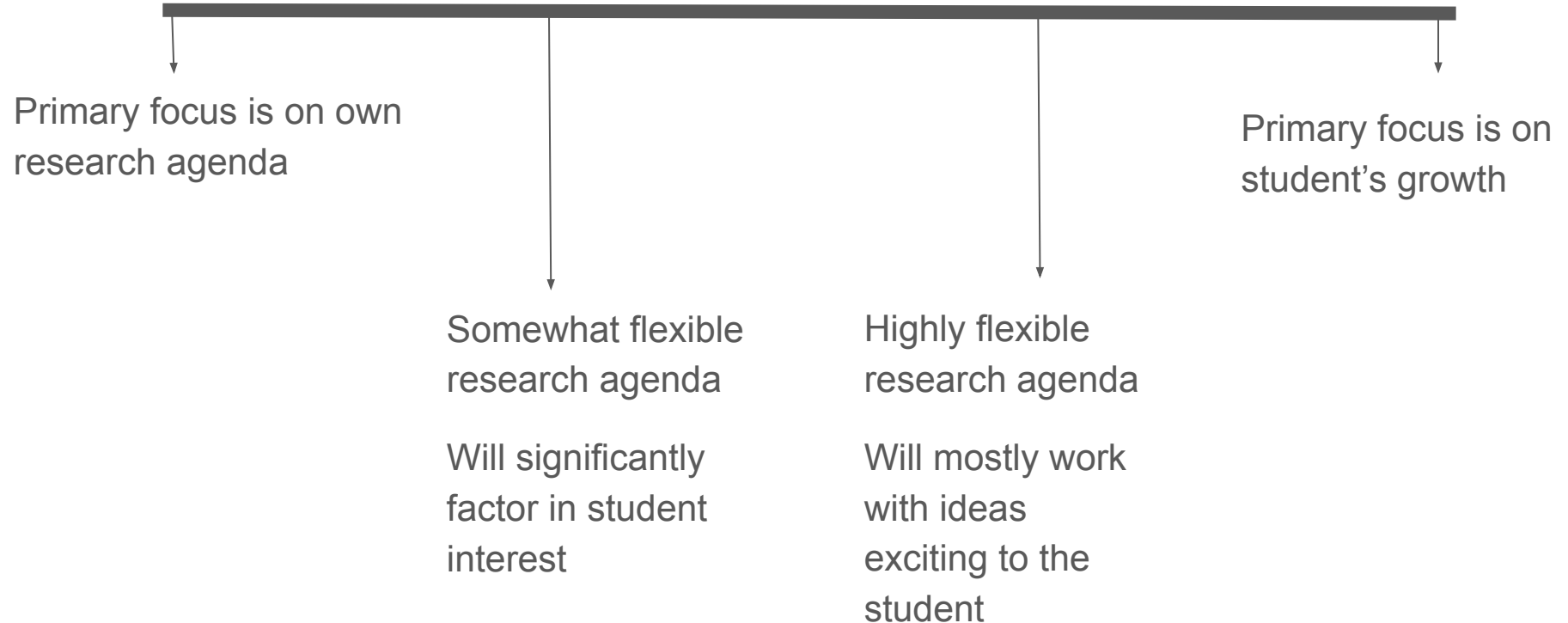
Researcher who also does training/ teaching

Primary focus is on student's growth

Will look for a research problem that is suitable for the student

Teacher who also does research

The PhD continuum (advisor view)



Each point has its pros-cons. One is not “better” than another. Choose what works for you.

Taking a position on the continuum is challenging

You have to navigate through constraints:

- Institutional (what does the institute want you to do? What are promotion criteria?)
- Peers (what are they doing?)
- Self (what do you want to do? As a researcher? As a teacher?)
- Student (what are the student's strengths? How much flexibility should you provide?)

You may have to take different positions for different students, or at different times.

Also, depends on one's beliefs about:

- What is a PhD?
- What is the PhD process that a student should go through?
- What is the guide's role in that process?

What is my definition of a PhD?

Entry from Wikipedia - In the context of the Doctor of Philosophy ... the term "philosophy" ... is used in a broader sense in accordance with its original Greek meaning, which is "love of wisdom." ... the term doctorate comes from the Latin docere, meaning "to teach".

My operationalization of “philosophy”: Student gets training to delve deep into the subject to -

- extend the boundary of knowledge.
- become aware of the assumptions, qualifiers and limits of generalizability.
- examine the validity of axioms / question conventional wisdom.
- ...

My operationalization of “doctorate”: Student acquires expertise in the discipline **and** pedagogy.

Example of “become aware of assumptions”

While reading a paper, a PhD student should be able to (eventually):

- Spot unstated assumptions that may be underlying the research reported.

- Conjecture what might happen if the assumptions were different.

- Predict some of the findings (in qualitative terms) before reading the results.

- Spot inconsistencies across different sections of the research reported.

- Examine claims critically.

What is your definition of a PhD?

Write your answer here.

Recommendation: Go beyond measurable metrics such as research publications.

Activity slides - What to do with them?

As you can see, slides with the above colour title bar are questions for you to think about.

It will be difficult to answer all of them accurately and comprehensively at one shot. It will be unproductive if you are not honest in your answers.

So:
Start with writing the first couple of points that come to your mind.
Then revisit them later, reflect and refine, till you are satisfied.

Recommendation: Keep checking for consistency of answers across questions.

In this workshop, we will pause on such slides and do an open discussion.

Where am I on the continuum as a guide?

I have a highly flexible research agenda.

My primary focus is the student's learning and growth while going through the PhD process.

Analogy: Tour guide vs Expedition leader.

Example of “highly flexible”

In CSE, I had PhD students working on Software Architecture, Wireless Network Design and Mobile Protocol Optimization. I had some interest and prior expertise in these areas but I was not an established researcher in them. I developed my expertise along with the student.

Then I moved to ET. :-)

Example of “will work with ideas exciting to the student”: bilingual education, nurturing of tinkering, visual analytics, teacher training.

I accept the disadvantages of not aligning multiple student theses in the same direction.

My research position

This is a page from my journal, from 20 years ago.

When I joined IITB in 1999, I wanted to build “educational software”. Some senior faculty said that it was not a valid research area in CS. Dept needed faculty in mobile computing. I had some knowledge in distributed systems. So I moved from my PhD area (program verification) to mobile applications and wireless networking.

In 2001, IITB started a network based distance education. I chose this as the context for my networking research.

In 2005, I started moving from education as an application area of networking research to technology-based-education research. I wrote the position statement shown here.

In 2010, IITB started an ET dept. I ‘transferred’ from CS to ET in 2016 and eventually switched fully to ET.

Mar 05

FEBRUARY 18 THURSDAY

Goals — Vision/Mission Level. 1999

Primary :- Create good learning opportunities for students.
Good \Rightarrow Interesting to student.
Challenging enough

Secondary :- Solve meaningful problems

Tertiary :- Insti. sequeisment - visibility
Maximize RoI etc.

Primary Area :- Education Technologies
Secondary Area :- Rural Connectivity
Tertiary Area :- Any other interesting to student with India-specific appl.
& somewhat related to 1^o or 2^o.

All:- Socially Relevant

Apply MIC Test before starting on a problem

- Meaningful?
- Interesting?
- Challenging?

Stay focussed on given appl. area

Last Step after solving the problem \rightarrow GENERALIZE solⁿ to other prob domains

* Do NOT generalize prematurely.

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What are the pros-cons of my position?

Pros:

- A lot of learning happens, technical and non-technical. Both student and guide are generally happy with the outcome.
- Students stay motivated to work, learn many tangible and intangible skills, gain confidence in many respects, fearlessly venture into new areas, are unafraid to attempt hard problems. [Many alumni have validated these points].
- I get a kick out of seeing their growth as students and achievements as alumni.

Cons:

- A strong and sustained long-term research output in one given area is unlikely. Both student and advisor pay a price for this deficiency
- It is not efficient for metrics such as publications. Each student may use a different method, target different conferences and journals, depending on the problem.
- The student pays a price for not having a guide who is already well-known in their area of interest.

Where would you like to be on the continuum as a guide?

Write your answer here.

Recommendation: Analyze the pros and cons of your position. Look for evidence for the pros. Ensure that you can accept the cons.

What do I look for in a potential PhD student?

In addition to dept admission criteria, I look for:

- Passion to solve some educational “problem”.
- Energy to learn the skills and tools required to approach the problem.
- Enthusiasm for multiple activities.

Why?

- I enjoy working with such students.
- I also learn new topics/ skills.

I am not a good fit for students who prefer/need to work on pre-defined or well structured problems.

Example of “what I look for”

Passion to solve an educational problem - Teacher training model for Tanzania.

Energy to learn the skills and tools - Creation of animations using Blender 3D.

Enthusiasm for multiple activities - Organizing conferences, Volunteering at NGOs.

What would you look for in a potential PhD student?

Write your answer here.

Recommendation: Look beyond technical skills. Identify what is a good fit *and* what is not a good fit for you.

Note

It is unlikely that you will find an 'ideal' fit with any student.

The purpose of this exercise is not to evaluate any student against your 'ideal'.

The purpose of this exercise is for you to get clarity on your expectations.

- Which of these are reasonable? Which of these can you let go of?
- Which of these are easy for the student in front of you? Which are challenging?
- Which of these are aligned with the student's own goals and expectations?
- What learning experiences should you design for the student?

What are my goals with a PhD student?

Student should:

- Learn to think deeply and clearly
- Be able to anticipate details and complexity
 - Even when thinking about a topic at a high level
 - Even in areas that one is not an expert in
- Pick up new skills and tools (analysis/synthesis)
- Contribute to research in the area

This translates to specific goals for each student depending on the area, topic and interests.

* This is verbatim from my notes of 2001. I still have the same goals today. Some may seem vague but they make sense to me. Also, see notes section below.

Example of “my goals” being achieved

- Learn to think deeply and clearly
 - All my graduated students can do this.
 - Many have contributed constructive ideas to others' PhD.
 - One example - Shitanshu (moved to a new area).
- Be able to anticipate details and complexity
 - Even when thinking about a topic at a high level - Prajish (Software Engg course)
 - Even in areas that one is not an expert in - JK (NPTEL meetings)
- Pick up new skills and tools - Qual/Quant methods, Communication.
- Contribute to research in the area

What would be your goals with a PhD student?

Write your answer here.

Recommendation: Identify what you want as the main outcomes and what are secondary. Also, what you will work explicitly towards and what you expect will happen along the way.

When do I know that my student is ready to graduate?

When the student:

- No longer needs help to identify and solve research problems.

- Has picked up some new research skills and is proficient in them.

- Can write a paper independently.

- Can contribute to discussions on other students' research.

When I don't fully understand the details of the student's work anymore but I see evidence of rigor and careful thought in it.

When would you know that your student is ready to graduate?

Write your answer here.

Recommendation: In addition to standard metrics, such as research publications, identify your own metrics to know that your goals for the student have been met.

What are my main concerns at each stage of the student's PhD?

Initial (Year 1-2):

- Are we running in the right direction? Have we found a suitable problem?
- Have we built enough background? Done due diligence to related work?
Learned the necessary skills/ tools?
- Will the solution idea lead to something novel, substantial?

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Middle (Year 3-4):

- Are the details working out as anticipated / planned?
- Is there sufficient rigor? Is there sufficient volume?
- Can I see the finish line, however distant?
- What is the student's post-graduation plan? Any Internships to be done?

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Analogy with
flying an airplane:

Final (Year 5+):

- Is the story coherent? Is the writing coherent?
- Are there sufficient publications? What next?

Take-off
Cruising
Landing

What would be your concerns at each stage of your student's PhD?

Write your answer here.

Recommendation: Identify the stages and broad concerns that apply to most of your students. Then operationalize the concerns for each specific student.

Moving on to the process

Note

This section is mostly 'telling'. It may get boring.

I have examples but you may not relate to them.

So,

I will click through them quickly. Then I will keep quiet.

You look into sections that you are interested in.

Then we discuss questions that come up.

How do I begin to work with a PhD student?

I ask a lot of seemingly irrelevant questions, such as:

- What do you like to do? What have you done that you have found interesting?
- What do you want to become? What is your background?

Why?

- It helps me to determine what drives them - what are they passionate about, what is their skill-level, what is their ambition, their motivation to reach it.
- It helps me evaluate potential thesis directions that might suit the student.

Recommendation: **Get to know your students as persons**, beyond entities in an academic setting. If you know what drives them, you will be able to guide them better.

Some examples

Yogi - Bilingual education

Rwito - Visual analytics

Prajish - CS education

Ashu - Tinkering

What do I do upon starting off with a student on a topic?

I Do:

- Spend a lot of time thinking on my own about the topic.
- I have my own detailed notes on where I think the PhD can go.
- I include alternate directions and branching and backtracking points.
- I consider the student's strengths/ weaknesses and factor it into the plan.

I Don't:

- Wait for the student to initiate discussions.
- Rely on the student's notes to accurately reflect the discussions.
- Expect my memory to be accurate and detailed after a few months.

Example



July 2008

1999.

Sameer - PhD topic in design of animⁿ

Broad area:- Visual commⁿ aspects in elearn
(Revisit scope periodically to avoid stray)

Sub-problems:-

1) Given an edu animⁿ of subj X; tech Y; device A;
how do we say it is 'good' from the design perspective?

o/p → Rating scale to be used by non-experts
Parameters to be defined unambiguously
w/ t & decision — defended rigorously

2) Given a concept to be animated, - subj X; -; Soc Z
what is the methodology to be followed to create a good animⁿ?

o/p → Detailed algo that can be simply followed by non-experts to give design decisions to animator

3) Given a good animⁿ for device A
what is the process to be followed to transform it into a good animⁿ for dev B?

o/p → As above.

→ Validate claims about each contribⁿ (o/p)
- Compare with related work
- Create 'good' content for oscar
- Fun with Science
- Blender etc.

1999. Other Qs (Edu)



→ How to identify concepts that shd be expl^d using animⁿ?
- Given domain?
- Generalize

→ How to evaluate effectiveness of using animⁿ to explain a concept?
- Overall rating scale, including all aspects - Edu; Design; ...

→ Given a concept, Subj X; Level Y;
What is effective for teaching it?
- Blackboard
- Hands on expt
- 2-D anim
- 3-D
- Video
- Sensors + Anim
- Any other?

Ex:- When would 3D be a distraction & 2D suitable?

How to capture parameters of concepts considered to aid in above decision?

Ex:- Time scale of expt
(Lifecycle of xYZ → Anim/Video is desirable)

Notes

Why have your own notes?

- The exact words you use while planning an approach are important for recall.
- A student in the initial years may write in their own words, which won't work.
- You don't want to listen to yourself again (audio recordings).
- You want everything in one place to backtrack the thought process.
-

Earlier, I used to share these plans gradually with the student as they mature.

Nowadays, I just grab the student's notebook and write in it. :-)

What do I do to keep a student on track?

I Do:

- Discuss goals and milestones regularly.
- Have weekly meetings, however small the progress.
- Ask them to make ppts / write documents, however sparse.
- Focus more on what they have done right, than on the lapses.

I Don't:

- Wait for the student to initiate meeting requests.
- Micro-manage with respect to timelines and deliverables.

Some examples

JK - Teacher training to constructive alignment - focus on strength and what went right.
Lakshmi - Discuss milestones. Avoid too many secondary projects.

Kapil - involved peers to help stay on track.

Kavya - revised timelines according to situation.

Rekha, Deepti - adjustments according to college load.

Why?

- I acknowledge that students have their own lives, own constraints.
- I don't put undue pressure on them to somehow meet the timelines.

Notes

If a student is not on track:

- It is useful to assess if there are other factors at play - constraints, health, etc.
- It is not useful to judge/label the student as “bad”.

I often tell them:

“It’s ok if you haven’t made much progress. Come for a meeting, let’s talk.”

Why?

Students may feel that you expect to see ‘significant progress’ in each meeting. This is a trap. They get into a spiral of ‘I will do some more work and meet’.

The more time passes, the more their stress increases. You have to periodically reset this.

What do I do to speed up a student's progress?

I Do:

- Create templates for standard tasks, such as planning a study.
- Connect them to relevant senior students or alumni.
- Encourage them to discuss with their peers.

I Don't:

- Assume that the student will be able to operationalize high-level instructions.
- Insist that progress should happen as per my expectations.

Some examples

Lucian - JK: junior-senior connection

Prajish - Lakshmi: peer-peer connection

All: Use of our Research Resources (Templates, Forms, Rubrics)

What do I do when I feel stuck?

I Do:

- Talk to colleagues, get feedback / suggestions on my plan.
- Re-evaluate whether it is ok to flounder for some time or to change the plan.

I Don't:

- Wait till the RPC raises the alarm.
- Transmit my uncertainty to the student.

Some examples

All: I have sought discussion with colleagues on what research design to use, what data to collect and how to analyze it.

I have also consulted senior students and alumni who have knowledge on some specific topic necessary for a current student.

Why?

Since I work on topics exciting to the student, I may not be an expert researcher on that topic. I don't want the student pay the price for my ignorance.

Related questions

What about publications?

This is a page from my journal;
my position from 20 years ago.

It has not led to success in terms of
high impact or research visibility;
but it is what makes sense to me.

I don't recommend this position.



Why Publish?

1999.

- UK study → Responses from people
- Financial reward
 - Research funding
 - Career advancement
 - Visibility & prestige
 - Communicate results to peers.

My reason: - Train students for research

- Publishing/Paper writing is part of the 'learning to think clearly' process for a student
- Feedback from previous batches is that they have benefited from this process.
- Contribution to research/advancement of the field; visibility/Rank of publ' forums
 - are secondary issues.

Where Publish?

- PhD students: Aim for top conf/jnl.
 - Visibility & credibility is important
- MTP students: Indian confs or such that
 - Student shd be able to travel to conf & present.

What about secondary projects?

Tradeoff between learning for future vs time spent on them.

Some examples:

- CS 101 research
 - Secondary project on Question Posing led to a path towards a new thesis.
- Book chapters
 - OTeach, AI in education.
- Conference organization

Recommendation: Do secondary projects, but discuss the pros-cons with the student.

How does PhD guiding work in international research groups?

Let's ask a panel of those who did post-docs elsewhere:

- Rwito - Japan
- Aditi - Europe
- Shitanshu - US

Closing

Summary: Beliefs that I hold

1. I am a teacher who also does research

- I am not a researcher who also teaches

2. Guiding PhD students is a sacred responsibility

- I must do my best to facilitate the student's growth in their intended directions

3. The delta of growth for the student matters more than the quantum of the research contribution

- I accept the cons of my position on the continuum

Summary: Principles that I follow

1. Know your student

- What drives them? Where do they want to go? What are their strengths? What other strengths do they need to build in order to get where they want to go? What are their weaknesses that they must address?
- **Why?** - It helps me to plan learning experiences that help them towards their goal, beyond the scope of the PhD topic also.

2. Student first, other work later

- PhD students have the highest priority on my time; They can walk in anytime, to discuss any topic, for any duration. If I am busy I will give the nearest available slot.
- **Why?** - I am a teacher. I get satisfaction from seeing the growth of an individual student.

3. Guide proactively, spend time

- Think about - what does this student need to learn? what the student should do > how to make it happen? How much scaffolding to provide? When to intervene? What are alternatives?
- **Why?** - I take responsibility for the student's growth. I have to do my due diligence for it.

Summary: Actions that I do

1. Maintain own notes, plans, alternatives and timelines, for the thesis
2. Talk to colleagues frequently, to get feedback on the thesis
3. Involve the student in decision-making
4. Have regular/weekly meetings with the student
5. Keep going till there are a few Aha moments
 - Aha - recognize if some idea has merit wrt novelty of - Problem? Solution? Findings?
6. Continue to think and plan till I can see the finish line

If you are not losing sleep over your student's thesis, you are not doing your job. :-)

Once again, Disclaimers

These answers are *my* personal philosophy and approach.

- I am not advocating that you adopt them.
- I am presenting them to you as example answers to the questions.

Other faculty (including you) may disagree with my position.

- That is fine. There are multiple approaches, each with its own pros-cons.
- Do what works for you.

I am not making any claims of novelty, effectiveness, efficiency, about my approach.

- This is what works for me.

Thank you

This presentation is available at:



Sridhar Iyer, IIT Bombay

Then, Click on 'Talks'



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