Why should IIT give you a PhD?

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Research Scholars Forum event
22 May 2015

IIT should give me a PhD because

I have worked hard to improve my knowledge of my area. I am now an expert in my field.

1. True
2. False

- Vote individually

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- Justify your answer to your neighbor
- Vote again (change your vote if required)

IIT should give me a PhD because

I have worked hard to improve my knowledge of my area. I am now an expert in my field.

1. True
2. False

- Improving your knowledge and becoming an expert is a *necessary condition*, but it is not *sufficient condition* for you to get a PhD.

IIT should give me a PhD because

I have built a new “system” to do X. My system incorporates all the good features of existing systems to do X. It took me years of hard work.

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1. True
2. False

- Building a new system to do X is a *desirable condition*, but it is not *sufficient condition* for you to get a PhD.

Compilation of obvious or known solutions or mere development of a system is NOT a research thesis

To be considered as an acceptable research thesis:

- you need to show what is novel in your solution compared to known solutions.
- you need to show that your system has resulted in improvement of some relevant metric.

IIT should give me a PhD because

I performed several experiments and collected a lot of data. My analysis has resulted in the following graphs showing that “X is related to Y”.

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IIT should give me a PhD because

I performed several experiments and collected a lot of data. My analysis has resulted in the following graphs showing that “X is related to Y”.

1. True
2. False

- Performing experiments may be a *necessary condition*, but it is not *sufficient condition* for you to get a PhD.

A report of the experiment you performed

is NOT a research thesis

even though it may contain a good idea.

To be considered as an acceptable research thesis:

- you need to show the need for the experiment.
- you need to show how the experiment will advance the state of the art (new knowledge, new techniques …)

What is a PhD?

Questions

In Jan 1993 I started on my PhD. I first attempted to find the answers to two questions:

1. Why is the degree called a PhD?
2. Why is it awarded independent of a discipline?
    - IIT Bombay degree will only mention the thesis title.

There was no Web, so I had to search through books in the central library to find some answers.

- Do you know these answers?

Answers

Today it is easy to find these answers on the Web.

Definitions from Wikipedia:

- entry on "Doctor of Philosophy": "The term "philosophy" does not refer solely to the field of philosophy, but is used in a broader sense in accordance with its original Greek meaning, which is "love of wisdom"."

- entry on "Doctorate": "The term *doctorate* comes from the Latin *docere,* meaning "to teach"."

- Do you know what these definitions imply?

Activity

State whether the following statements are True or False:

Activity

State whether the following statements are True or False:

S1: You are all listening to me simultaneously.

Activity

State whether the following statements are True or False:

S1: You are all listening to me simultaneously.

S2: Buddha and Jesus were contemporaries.

Truth

- The statements are True in the conventional sense, BUT we have to keep in mind that the answer DEPENDS on:
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=> we are implicitly using commonly accepted definitions of the terms "simultaneously" and "contemporaries".

- A PhD is about becoming aware of implicit assumptions and examining such definitions.

Implications - Ph.D

Some other interpretations for "Philosophy", in addition to "love of wisdom" are - delving deep into the subject and –

- examining the validity of axioms.
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- extending the boundary of knowledge.

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Example: Given a statement "Active learning is good",

- the task of a PhD is to investigate the extent of validity and generalizability, i.e.,
- make explicit the qualifiers -
  - Active learning is good for X topic, Y goal, Z audience, W mode, and so on ...
  - Active learning is not good for X', Y', Z', W', ...

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- examining the validity of axioms.
- questioning conventional wisdom.
- extending the boundary of knowledge.

- Self-study exercise:
  - Reflect on: What is the axiom that you are investigating?
  - What is the knowledge whose boundary you are extending?

Implications - Ph.D

- You should be able to teach
  - Basic/Core courses in your discipline
  - Advanced courses in your specialization

- This means that you should have:
  - Knowledge of the content – what to teach
  - Knowledge of pedagogy - how to teach

Implications - Ph.D

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- Self-study Exercises:
  - Reflect on whether you can teach courses? How well?
  - What additional expertise do you need to build in order to do this well?
    - Ask your IDP-ET colleagues to do a workshop for you on effective teaching-learning strategies!

Implications – Ph.D

- The *process skills* that you acquire in a PhD are transferrable - both for the "Ph." and "D." parts
  - problem-posing, solution design, estimation, algorithmic thinking, creation & revision of scientific models, data representation & analysis, decision making, …
  - oral and written scientific communication, teaching-learning skills, …
  - Example: I did my PhD in program verification, then worked in Networking for 10 years, then moved to ET.

Implications – PhD

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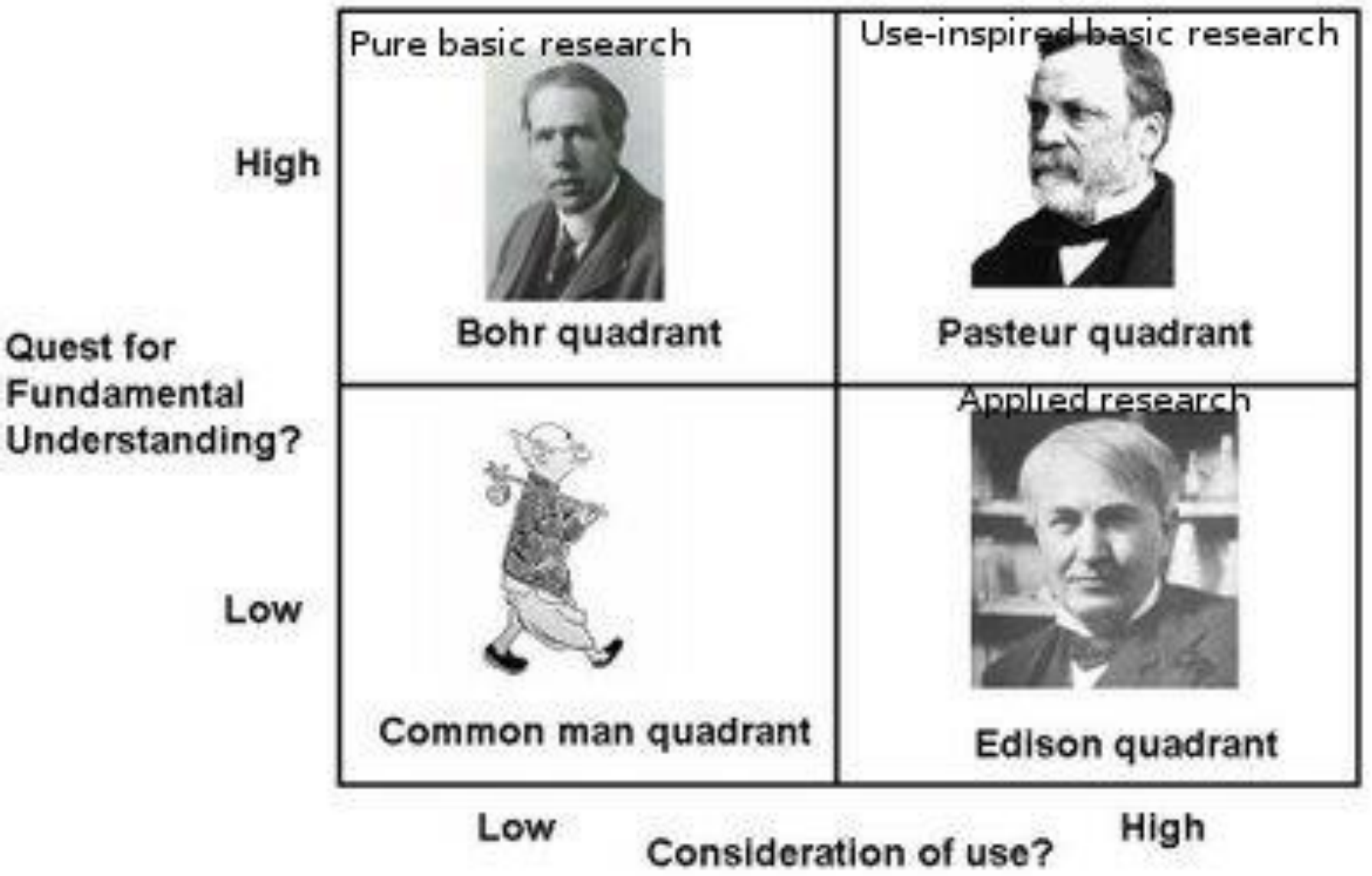
- Hence
  - most PhD degrees do not mention the department, even though a PhD has domain specific components.
  - most PhD guides harp on the "PhD process".

Strive towards: Pasteur's Quadrant

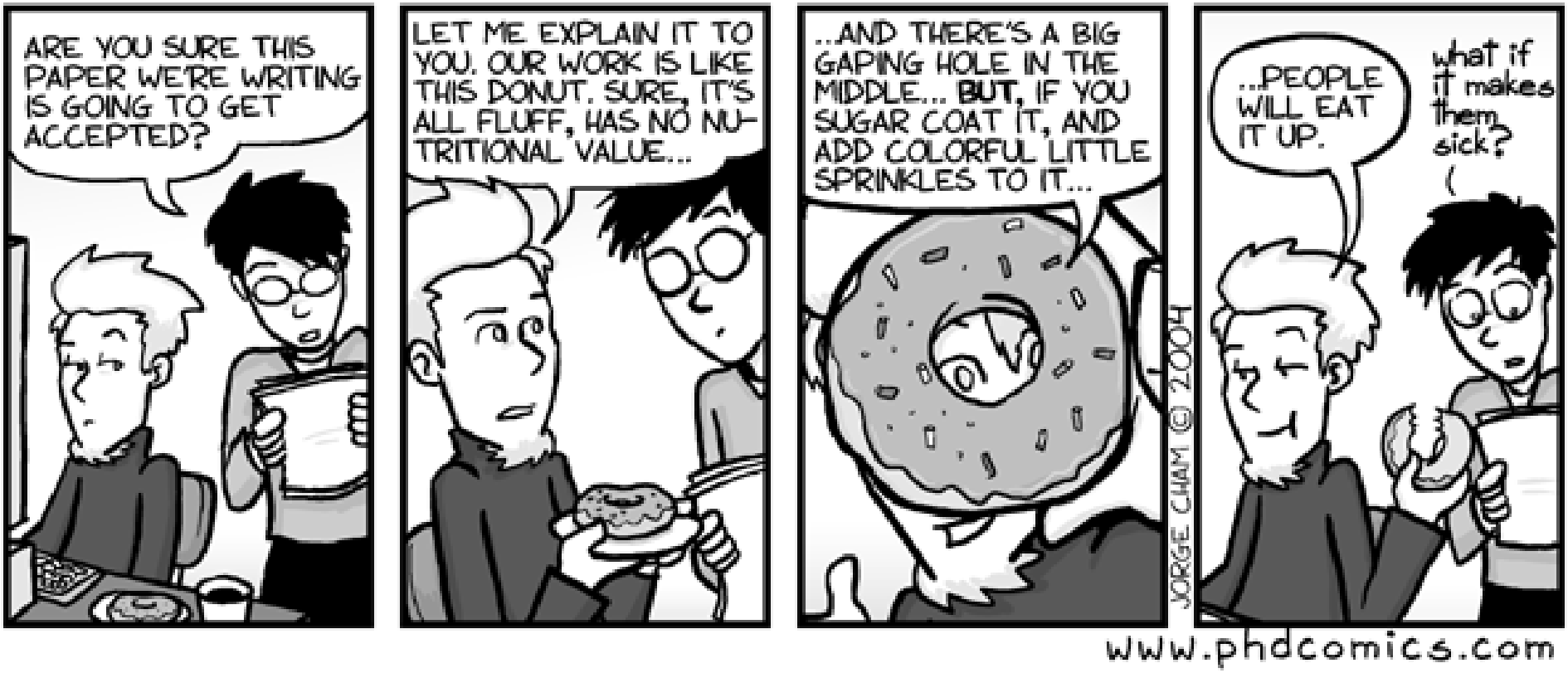


What is expected of a PhD thesis?

by Research Progress Committee (RPC), examiners and scientific community.

Disclaimer: The opinions in this presentation are those of the author(s) and do not necessarily represent those of **all** faculty in your institute.
Check with your thesis supervisor to confirm what criteria apply to you!

Why does my RPC complain?



- RPC / examiners hate fluff and look for value. They are trained to find holes and be suspicious of sugar coating
  - Go for idlis instead of donuts! ☺

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- Think (individually): What according to you is the goal of an APS?
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  - Together, try to come up with 1-2 additional points [3 minutes]

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  - Write down 1-2 points. [1 minute]
- Pair (with your neighbor): Look into your neighbor's answers. Copy those that you agree with!
  - Together, try to come up with 1-2 additional points [3 minutes]
- Share (with everyone): State 1 point from your list.
  - Identify points that have not been made any earlier group.

Some points from the audience

- Progression, direction, correction
- getting criticized, getting inputs, getting perspectives
- platform for future planning
- change the direction, to be on right track

- self-evaluation - justify what you have done
- documentation of work, learning to presenting your work concisely
- ensure that students work; time-bound evaluation
- benchmark with other students
- assess maturity of thought, assess quality and quantity of work
- come up with grant proposals

- understand expectations of RPC better
- teaching RPC members something new

Goal of your APS

- Summative Assessment
  - determine the degree to which student has met the learning goals
  - measures performance of the complete year based on report and presentation
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- Formative Assessment
  - suggestions for solution/ direction/ approach
  - identify weaknesses, research lacunae, hidden assumptions
  - helps us to rethink and improve quality of the work
  - Treat your APS as a formative assessment *during and after the APS* – this will ensure that you don't get defensive and listen to the suggestions

Recall: What is not a research thesis?

Compilation of obvious or known solutions or
mere development of a system
is NOT a research thesis

A report of the experiment you performed
is NOT a research thesis
even though it may contain a good idea

So what is a research thesis?

Referees look for	Your thesis must have
Novelty	Analysis of prior work to show that your idea is unique
Positioning	Analysis to show that your work is required, how your work advances the state of the art
Soundness of procedure	Steps to show that you have implemented solution carefully
Evidence to support claim	Data to show that your solution works as claimed
Overall coherence	Consistency between parts of your thesis – treatment should address problem, results should give answer to problem

What exactly is meant by ‘Novelty’?

- Dictionary: “The quality of being new, unique, original, innovative, or unusual”.

What has to be novel? → At least **one** of the below:

- Your Problem – Research Question(s).
- Your Solution – Strategy to solve a known problem.
- Your Domain – Adapt a known solution to your context

Strong to Weak

- Can a non-innovative strategy be developed into a strong research paper?
  - Yes, **provided** it is positioned well (See next slide).

What exactly is meant by ‘Positioning’?

Dictionary: “situation/relation with respect to others”.

How to do positioning? → Do **both** of the below:

1) Have you shown analysis of *related* prior work to bring out the gaps?
   - papers that have addressed a problem similar to yours
   - papers that have a solution approach similar to yours

2) Does your solution address any of the gaps above?

As the novelty of your problem or solution decreases, the accuracy of your positioning must increase!

Explain the relation to other work clearly

Awful	The galumphing problem has attracted much attention [3,8,10,18,26,32,37]
Bad	Smith [36] and Jones [27] worked on galumphing.
Poor	Smith [36] addressed galumphing by blitzing, whereas Jones [27] took a flitzing approach
Good	Smith's blitzing approach to galumphing[36] achieved 60% coverage [39]. Jones [27] achieved 80% by flitzing, but only for pointer-free cases [16].
Better	(Good Above) + We modified the blitzing approach to use the kernel representation of flitzing and achieved 90% coverage while relaxing the restriction so that only cyclic data structures are prohibited.

Source: Writing good Software Engineering Research Papers. Mary Shaw. ICSE 2003.

What is ‘Soundness of procedure’?

Dictionary: Following a systematic pattern without any apparent defect in logic

This is *domain dependent* and the techniques used to ensure soundness differ from one area to another

Some ideas here include:

- Systematic implementation, examining boundary cases, careful collection of data, rigorous proofs, …

What is ‘Evidence to support claim’?

Dictionary: That which tends to prove or disprove something; grounds for belief.

This is *domain dependent* and the techniques used to support claims differ from one area to another

Some ideas here include:

- Decide what to measure and how to measure - The metrics for evidence should be in sync with the goal of your study.
- The analysis that you perform on the metrics data should form the basis of your claims.

Questions that examiners ask as they read your thesis

- How would they have tackled the problem set out in the abstract and the title?
- What questions would they like answers to?

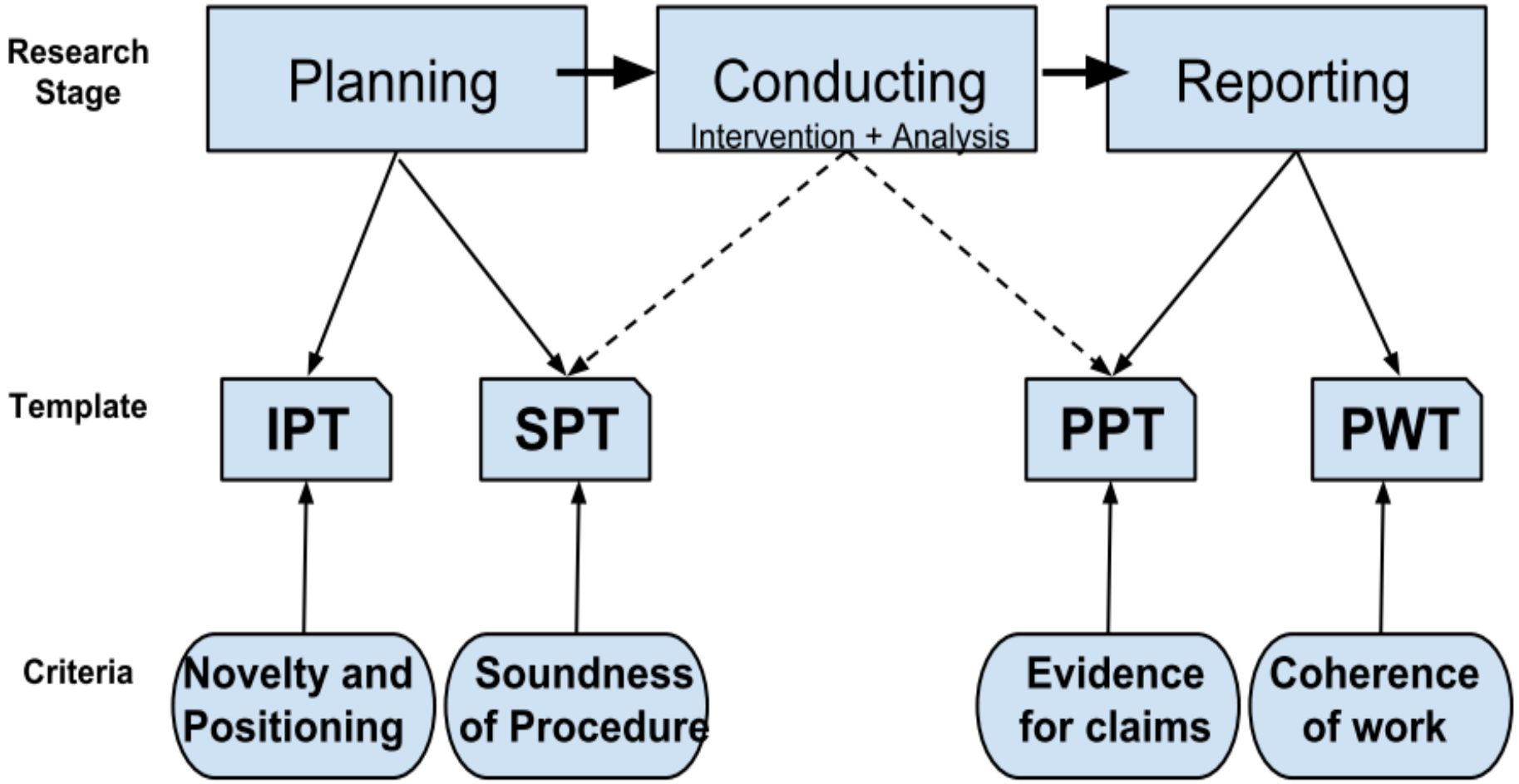
- Do the conclusions follow on from the introduction?
- How well does the candidate explain what he/she is doing?
- Is the bibliography up to date and substantial enough?
- Are the results worthwhile?
- How much work has actually been done?

- What is the intellectual depth and rigour of the thesis?
- Is this actually ‘research’—is there an argument?

Source: It’s a PhD, not a Nobel Prize: How experienced examiners assess research theses. G. Mullins and M. Kiley, Studies in Higher Education Volume 27, No. 4, 2002

How do I ensure that my research meets the criteria?

Check out the templates created by IDP-Educational Technology, IIT Bombay



Source: Guidelines and Templates for Planning, Conducting and Reporting Educational Technology Research. Sahana Murthy and Sridhar Iyer. **T4E** 2013.

Research Templates

Download from www.et.iitb.ac.in/resources.html

1. Idea Proposal Template (IPT) - helps you explore if your idea is suitable for a research study.

2. Study Planning Template (SPT) - helps you plan the research study around your idea.

3. Paper Planning Template (PPT) – helps you plan the flow and ideas that will go into your paper.

4. Paper Writing Template (PWT) – helps you plan the paragraphs that will go into your paper.

Making your PhD an enriching and enjoyable experience

"Nearly everything is really interesting if you go into it deeply enough." – Richard Feynman

Some gyan

- Attend invited talks - including those outside your “area”
  - This will improve your breadth of knowledge
  - You may get ideas from a different field to use in your own
- Take opportunities to present your work to diverse audiences
  - This will give you greater clarity on your work
  - You may get feedback on aspects that you have not thought about
- Develop/Maintain a secondary technical skill
  - Programming, writing, tinkering, …
- Develop strong peer relations
  - They help you survive the lean phases in your PhD
- Don’t neglect your extra-curricular activities. ☺

Conclusion: Two points to keep in mind

1. Being a PhD student at IIT Bombay,
   - you are contributing to science/knowledge, by your work.

Remember this point whenever you feel depressed about your PhD.

2. However much you contribute through your work,
   - it is only drop in the ocean.

Remember this point whenever you feel too great about your expertise. It will help maintain perspective.