Paper Planning Template

For the benefit of students in

IDP in Educational Technology
IIT Bombay

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(Version history is maintained on the last slide)

What is this all about?

- The main objective of this template is:
  - to ensure that there is a logical flow of ideas *before* you start writing your paper.

- Not following this (or a similar) template may result in:
  - Wasted effort for your guide (reading through your paper draft and then pointing out gaps/flaws).
  - Wasted effort for you (writing paragraphs that you may have to later delete).

Approach

There are 5 sections in this template:

. Jot down what you have done

I. Setup the problem

II. Explain your solution

III. Defend your solution

IV. Organize the paper

- These sections will help you to get your ideas (and your paper) into a logical sequence.

What are you supposed to do?

- Write bullets for each slide that follows, to answer the question posed as that slide's title
  - There are points written in each slide to guide your thinking.
- Write in your own words
  - Your guide should be able to follow your paper's **logic** by simply reading these slides (without having to ask you questions about each bullet).

- The slides in Blue are an illustrative example of what you need to do.

0. Jot down your idea

What is your idea?
what work did you do (or what do you plan to do)

- In this slide, write your ideas for the work that you already did (or want to do)

- Informal language, and 'thoughts' or 'feelings' are okay at this stage.

What is your idea?
what work did you do (or what do you plan to do)

- Conduct 3-hour Blender workshop.
- Teach how to rotate 3D objects in Blender using various Blender features (such as **).
- Experiment to see if Blender training is useful to improve the mental rotation abilities of students.

I. Setup the problem

Why setup the problem?

- You may have done some work. Merely describing it is not sufficient to make it into a research article.
  - You need to think about the context, usefulness, and rigor of your work.
  - You need to think about other similar work that you will compare with.

- If you do not sell your problem well, the referee will not buy your solution.

How to setup your problem: 1. What is the main concept underlying your work?

- Illustrate the concept and its applications with an example, to give an intuitive idea.
- Then give various definitions of the concept from literature.
- Say which definition you are following and why.

1. What is mental rotation (MR)?

- Illustrate MR with an example
  - Show who needs (uses) MR ability and for what purpose. Attempt examples from different areas.
- Give various definitions from literature
  - What is the diff between “MR” and “MR ability”?
- Say which definition you are following and why.

2. Why is your work important?

Usually, need to establish the importance of two things:

1) Why is the fundamental concept behind your work important?

2) Why is your specific work important?

- In this slide write about “who requires your work”.
- Justify from literature, not just your “feelings”.

2. Why is MR ability important?

1)Who requires such abilities?

- For example, students of engineering drawing, and developers of 3D animations.

2)Why is it important to *teach* MR ability?

- For example, the skill cannot be automatically acquired, previous work has shown that many students do not have the skill.

- Justify from literature, not just your “feelings”.

3a. What prior work has been done? Broad related work

What prior work is relevant to your work, at a broad level? That is,

- Look for important prior work even `distantly' related to your work. For example:
  - What are traditional ways to solve the problem?
  - Is there a theoretical basis to solve the problem using X technique (eg a learning theory basis)?
  - What techniques have been tried empirically to solve the problem?

3a. What are traditional ways to acquire and improve MR ability?

- What references are available to establish that MR ability can be acquired and improved?

- What sort of courses are there to acquire MR?
- What is done to “improve” MR ability?

- This is your broad “related work”.

3b. Analyze the broad related work

- Identify themes and categorize the related work
  - Use figures and tables.
  - Attempt a concept map.

- Report both positive and negative results
  - Add your analysis on why these differences might exist.

3b. Analyze prior work on acquiring and improving MR ability

- Identify columns for your categorization table:
  - For example, setting (classroom or online), sample (students or teachers), instruction method (physical or computer-based), duration, research method, measurement method, and results.

- Compare how much each method has improved MR, to what extent and in what context.

4. What are the current “pain points”?

- What are the problems in existing solutions?
- Is there any gap which current solutions do not address?

- How do you think your work can address above problems or gaps in existing work?

4. What are the current pain points?

- What are the problems in improving MR ability along traditional ways?
  - Some points in this can be from your “feelings”

- What is your hope about attempting to improve MR ability using your way (Blender training)?
  - Which of the above problems are you addressing?

5. What prior work has been done? Specific (relevant) related work

- Who else has attempted to solve the problem using a technique similar to yours?
  - If none, say so explicitly.
  - If some are doing similar techniques, say which drawbacks from traditional techniques they have addressed and which ones remain.

5. Who else has attempted to solve the MR ability problems using CBT?

- Repeat the analysis (step 3b) for these works
- Say which pain points they have addressed (from 3b) and which ones still remain
- If there are no techniques similar to yours or addressing your context, say so explicitly

6. What is your problem?

- Phrase this as questions at two levels –
  - First level should be a question in broad terms that will be interesting to the reader.
  - Second level should be one or more questions specific to the experiment being reported in this paper
- Avoid phrasing the questions as sentences.

6. What is your problem?

- Broad-level: What impact does the use of CBT have on the spatial abilities of the learner?

- Specific-level:
  - Q1: Does a 3-hour Blender training improve the MR ability of 1st year engineering students?
    - 3 parameters have been made specific:
      - CBT → Blender;
      - Spatial abilities → MR ability;
      - Learner → 1st year engg
  - Q2: What skills from the Blender training do students apply while doing mental rotation?

7. Check for consistency

1. Check whether the idea that you have jotted (section 0) addresses the questions you have stated (section I; step 6).
   - If not, think which must you change – the problem you stated, or your idea/plan for work?

2. Check whether the questions you have stated in step 6 are in sync with the points in step 2.
   - If not, establish the importance and need of your work more strongly (on the basis of related work).

7. Check for consistency

- Check whether your Blender training actually addresses MR ability
  - By this stage you should know which parts of the Blender training are likely have impact on MR ability and why.

- At this point the reader should be convinced of:
  - Improving MR ability is important.
  - Reading about your technique to improve MR ability may be interesting (because it is novel or easy-to-implement or effective or appealing to students, …).

II. Explain your solution

What is your solution approach?

- Describe your overall approach (Treatment)
  - Ex:- 3-hour workshop with hands-on Blender
- Describe what you will write for the details
  - You need NOT write the details here itself.
  - Ex:- You can put points like “I will first show a figure of the workflow”, “Then I will put the table of the instruction schedule”, “Then I will write about which items address MR ability”.
- Add slides here to complete your description.
  - This section is relatively easy to write.

Why is your method likely to work?

- Defend your approach (Treatment) using logical arguments; Later you will defend it using data.
  - Is this treatment even worth experimenting?

- Argue that the steps are:
  - Sound (in some logical order)
  - Complete (cover all aspects of your problem stmt)
  - Necessary (directly target improvement of MR ability)
  - Sufficient (no critical step has been omitted)

- Add slides here to complete your argument.

What are the limits to your method, or when is your method not likely to work?

- State the boundaries in which you are working.
  - This could be related to : domain (eg does my method improve learning in subject X), sample (eg 1st year engg students) , environment/ context, (eg content for ITS used without teacher being present), ...and so on.
- Identify all assumptions that you are making and state them here. These are threats to validity.
- Justify why it is okay to make these assumptions.
  - State how you will minimize the validity threats (what will you do in your experiment / analysis to make sure that the assumptions do not mess up your results).

What are the limits to your method, or when is your method not likely to work?

- Boundary / Scope:
  - Study mental rotation ability of 1st year computer science students in Mumbai university engineering colleges.
- Limitation:
  - If we conduct this study with design students, we might expect different results. If we have a longer workshop ...

What are the assumptions?

- Assumptions:
  - It is unlikely these students would have had extensive prior training in MR abilities.
  - It is unlikely these students would have had extensive prior exposure to 3D software.
- Minimization:
  - Even if some students have this exposure, we expect that the effect of the prior knowledge will be taken care of by our analysis (of normalizing using pretest score).

Check for consistency

- At this stage, check that the solution you have explained in fact answers the questions you have posed in the slide “What is your problem”.
  - If not, see if your solution works for a modified version of the problem.

- The solution you just explained must also be consistent with your 'idea' in section 0; It should not be an extension or variation.
  - Ex: Original idea of Blender skills training to improve MR does not include group-work by learners, so group-work should not be in treatment.

3. Defend your solution
Why should I believe you

What is your (experiment) method?

- Research Design
  - What is your Research Design?
    - Ex: single group, pre-post
  - Why is your Research Design suitable for your solution?
    - Ex: We want to measure increase in MR due to Blender skills.
- Sample
  - What is your Sample? What is your sampling strategy?
    - Ex: 1st year engg students, purposive.
  - Why is your sample and your sampling strategy suitable?
    - Is the sample representative? Generalizability towards the population identified in the broad-level question?
    - Ex: 1st year engg students need MR abilities (connect to section I, step 2).

What is your method? .. contd

- Tools
  - What are your Tools / Instruments?
    - Ex: VB Spatial ability test (for Q1) and 3-point questionnaire (for Q2).
  - Why are they suitable for your experiment?
    - Ex: VB is a standard test for measuring MR.
  - How robust are they?
    - Ex: VB spatial ability test has been used before; show evidence for validity and reliability.
- Procedure
  - What is your Procedure?
    - Describe setup, treatment, sequence and duration of activities, stages (if any) group assignment. Give sufficient detail so that your experiment can be replicated.
    - Ex: 3-hour hands-on workshop; Include schedule and script

What is your data analysis technique?

- Mention descriptive statistics (means, histograms, correlations) that you intend to calculate.
  - Ex: I will include a table showing means and SD; I will show a histogram of pre-test, post-test distributions; I will examine gains of low-med-high achievers; I will compare questionnaire responses of high-gain versus low-gain students.

- To establish causality (draw inferences), mention which statistical test and why.
  - Ex: To determine if post-test distribution is different from pre-test, I will use effect-size, paired-sample t-test.

What are your results?

- What details of your findings are you going to include here?
  - Ex: scores, means, gain.

- In what format will you report your findings that make them:

  (a) easy to understand, and

  (b) highlight significant findings.

- Create graphs and tables to satisfy (a) & (b).

Why are your results significant?

- What details are you going to include to show that “a difference has (or has not) been made”
  - Are your differences significant (not due to random occurrence)? Justify using appropriate statistics.
    - Ex: Calculate diff between mean of pre-test and post-test. Check whether the diff is significant using paired-sample t-test. Calculate gain.
  - How “large” is the difference?
    - Ex: Calculate effect-size. 0.55 => moderate.
- Do this at various levels of granularity
    - Ex: Identify gain for [Low – Mid – High] scoring groups. Identify groups for [Low – Mid – High] gains.

Is there correlation between treatment and results?

- Have you established the correlation between your treatment and the results?
  - Ex: A “large” percentage of students whose diff is high said that they mostly used Blender skills for post-test.
  - Ex: Use “the appropriate correlation coefficient” for scores (continuous, interval variable) versus questionnaire responses (categorical, ordinal variable).

- Can you show that the correlation is not a random occurrence?
  - At what confidence level is correlation coefficient significant?

Can you establish causality?

- How can you now establish causality?
  - Show that the improvement is due to your treatment steps and not due to any other factor.
    - Ex: Argue that strategy A for solving MR problems could have been learnt only through Blender activity A'.
    - Ex: The normalization using pre-test minimizes history threat (ensures that students prior MR ability was not a factor for the improvement).
    - Ex: The training was only 3 hours during which students learnt only Blender, so no maturation threat.

- Revisit topic “threats to internal validity” from RM course.

Again, check for consistency

- Double-check that the results can be used to answer the question you posed in the slide “What is your problem”?
  - Ex: Reporting data of students' perception when it is not part of your specific questions (Q1 or Q2) is inconsistent. You could add a Q3 if you have collected such data.
- Make sure that there is a logical connection between your results with your solution steps
  - If not, you may have to revise the “Explain your solution” section.
    - Ex: If you show a graph of “students who liked the training” versus “scores”, ensure that you have explained how each of these were measured in your 'Tools' section.

4. Organize the paper

What are your key contributions?

- What knowledge is your paper contributing to the community?
  - A paper is not simply a report of what you did and what you found.

- What are the points that you should highlight about your work and keep harping on?
  - Everything that you did is NOT worth highlighting.
  - You *must* identify the key points (at most 2-3) that you want the reader to note!

What is the title of your paper?

- Title:
  - Option 1:
  - Option 2:
  - Option 3:
- Do NOT just pick any title
  - The title should capture those aspects of your paper that you want to highlight (see previous slide).
  - Consider titles that are too broad and too specific and then decide the 'about-right' level; Then refine the 'about-right' level to generate the 3 options above.
  - The title should attract the reader to at least read your abstract!

What is the introduction?

- This should be brief AND complete
  - starting with setup of the problem, outlining the solution, to making claims about your results.

- Revisit all the points that you have noted for the previous sections in this PPT
  - Identify which ones are you going to include in the Intro.
  - Ensure that the points in your intro have a logical flow.

What are the other sections?

- What sections will you create in your paper?
  - What are the section titles?
  - What are the sub-sections?
  - What are the points (from this PPT) that you are going to make in each sub-section?
  - Have any points been missed out?

- Revisit ALL these slides to ensure that your paper has a logical flow (according to you).

What next?

- Discuss your answers to these slides with your guide
  - Incorporate ALL comments.
  - Iterate till guide signs-off on the flow of the paper.
- Write your paper draft
  - After each para or sub-section, keep checking to ensure that your writing is as per the flow agreed.
  - If you need to change the flow, discuss with your guide before you incorporate the changes.
- Iterate till guide signs-off on the paper's details.
- Submit (and hope for the best)!

Template history

- Created in Jan 2012
  - Sridhar Iyer: specific to Kapil's paper for T4E 2012.
  - Sahana Murthy: generalized to suit other students.

- Version 1.0 Released - 2nd Feb 2012.