Session 4: Methods, Results, Discussions and Conclusion

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METHODS

Objective of Method Section (1)

1) To describe IDEA (novelty) of the work

- ❖ How the idea managed to achieve the desired outcomes.

- ❖ Show the analysis/derivation/ simulation to prove the idea can work.

Objective of Method Section (2)

2) To describe the implementation/ procedures of the idea.

- Informing readers on the materials, software, components, equipment, etc. used.
- Narrate how data is collected, how experiment is carried out, what are the mechanism/process to achieve the results.
- Include sufficient details such that the experiment can be **reproduced**.

A good method section enables an interested reader to replicate your work and obtain the same (similar) results.

Benefit of Writing Good Method Section

- A clear and precise writing will convince the readers that you were careful and systematic, clear-thinking and competent professional.

- Your work is reliable and can be trusted.

- If others can reproduce your results (based on your written method), then they are more likely to believe your conclusions.

Important Points

- Do not repeat the details of (previously) established methods.
  - Use References and Supporting Materials, instead.
  - If needed, a broad summaries or key references are sufficient.

Method should comprise of

- **How** did you approach the problem?
  - Explain the **general type** of scientific method you used: mathematical (analytical), experimental, simulation, survey, interviews, questionnaires, statistical analysis.
- **What** tools did you use?
  - Describe the materials, subjects, software, equipment, resources that are involved
- **How** did you do it?
  - Detail the steps/procedures/process to achieve it.

Language and Writing Style

- Use **past tense**.
  - was found, was put, were added, was designed etc.
- Use **passive voice**.
  - "The circuit was constructed using…"
- Use **standard** systems for numbers and nomenclature.
  - International System of Units (SI)
  - Standard conventions
  - Accepted nomenclatures
  - Try not to introduce your own conventions, nomenclatures etc.

RESULTS

Importance of Results

- Most critical part of the paper.
- This is the "proof" or "validation" or "evidence" of your idea, solution, hypothesis, objective.
- Also, to **benchmark** your work with others.
  - To ensure your superiority are not "self-proclaimed!"
- If similar work is not available, the verification can be done using alternative method
  - experimental vs. simulation,
  - simulation vs. analytical

Reviewer's Expectation

- For high impact journal, results MUST SHOW **certain amount of improvement** in the field of research.
  - Not sufficient to say "this is an alternative approach/ solution" to the problem.
  - Note that improvement not necessary in technical terms. It can be in others aspects of the problem, e.g. cost, ergonomics, simplicity, etc.

- Depending on subject, results can be combined with discussion.

Presenting Results

- **Highlight** and **detail** the improvement in strongest possible way.
  - Try to relate that the improvement is due the idea/ solution that you have proposed.
- **Mention** the limitations of the result, if any
  - Do not hide
  - But do NOT excessively highlight them
  - Careful with the choice of words, not to be apologetic or self-degrading
  - Find excuses for the limitations, if you can.

Selecting Results to Include

- Select results that **in-line with the story line**
  - Show relevant results that support the idea/solution/ hypothesis
  - Choose the best results (if several sets are available)
  - Avoid any errors of logic, established laws, facts
  - Good quality Figures and Tables
- Its best if **comparative work** can be shown together (side by-side)
  - from other papers, standard documents
  - if not available, verification can be done using your own simulation, analysis

Forms of Results

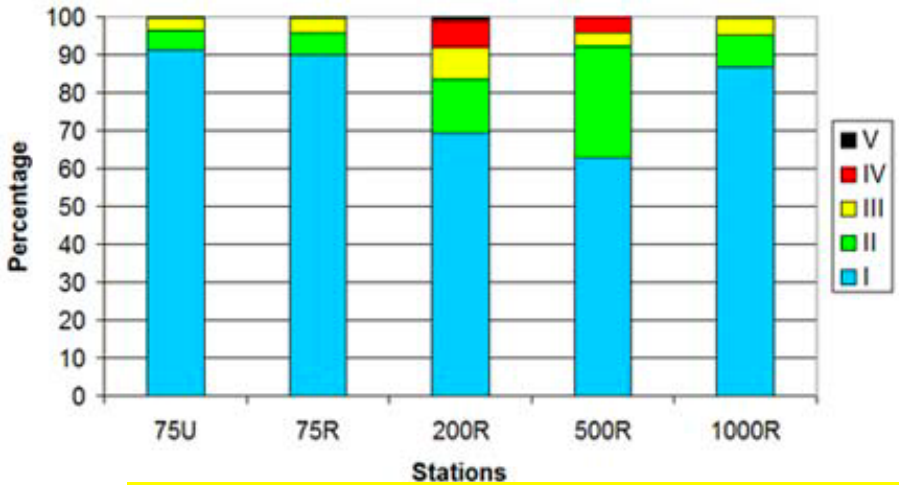
For effective presentation, raw data (results) need to be transformed into

- Text (Explanation)
- Graphs
- Pictures, photographs
- Oscilogram/Waveforms
- Tables

Use variety of forms,
but do not duplicate (i.e. same content presented in different form)

Should you use Table or Chart?

	ECOLOGICAL GROUP				
Station	I	II	III	IV	V
75U	91.3	5.3	3.2	0.2	0.0
75R	89.8	6.1	3.6	0.5	0.0
200R	69.3	14.2	8.6	6.8	1.1
500R	63.0	29.5	3.4	4.2	0.0
1000R	86.7	8.5	4.5	0.2	0.0



Use Table if you wish to stress numbers accurately

Use Figure if you wish to compare gradients, trends, highlight differences.

Note:
Never include vertical lines in a table.

Source: https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously

Tables

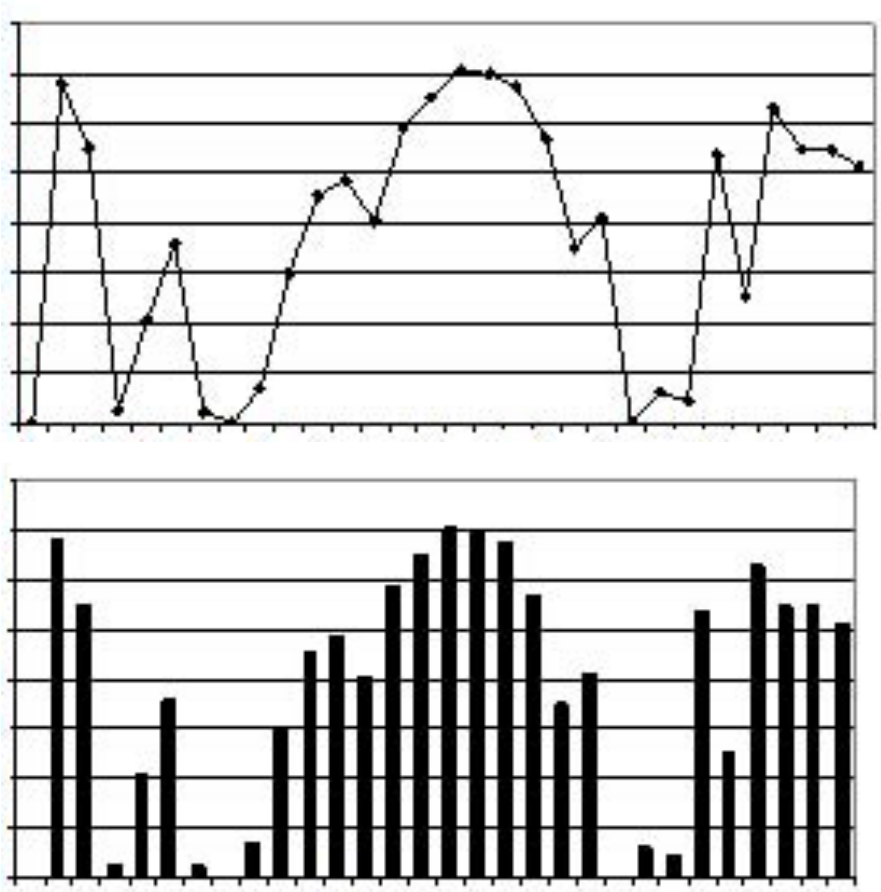
- Pay attention to details

Depth	Gravel	Sand	Mud
5 m	3,42%	81.41%	15,17%
50 m	2,5%	58.42%	39.08%
100 m	0,0%	32.5%	67.5%

Water depth (m)	Gravel (%)	Sand (%)	Mud (%)
5	3.4	81.4	15.2
50	2.5	58.4	39.1
100	0.0	32.5	67.5

Source: https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously

Lines and Histograms

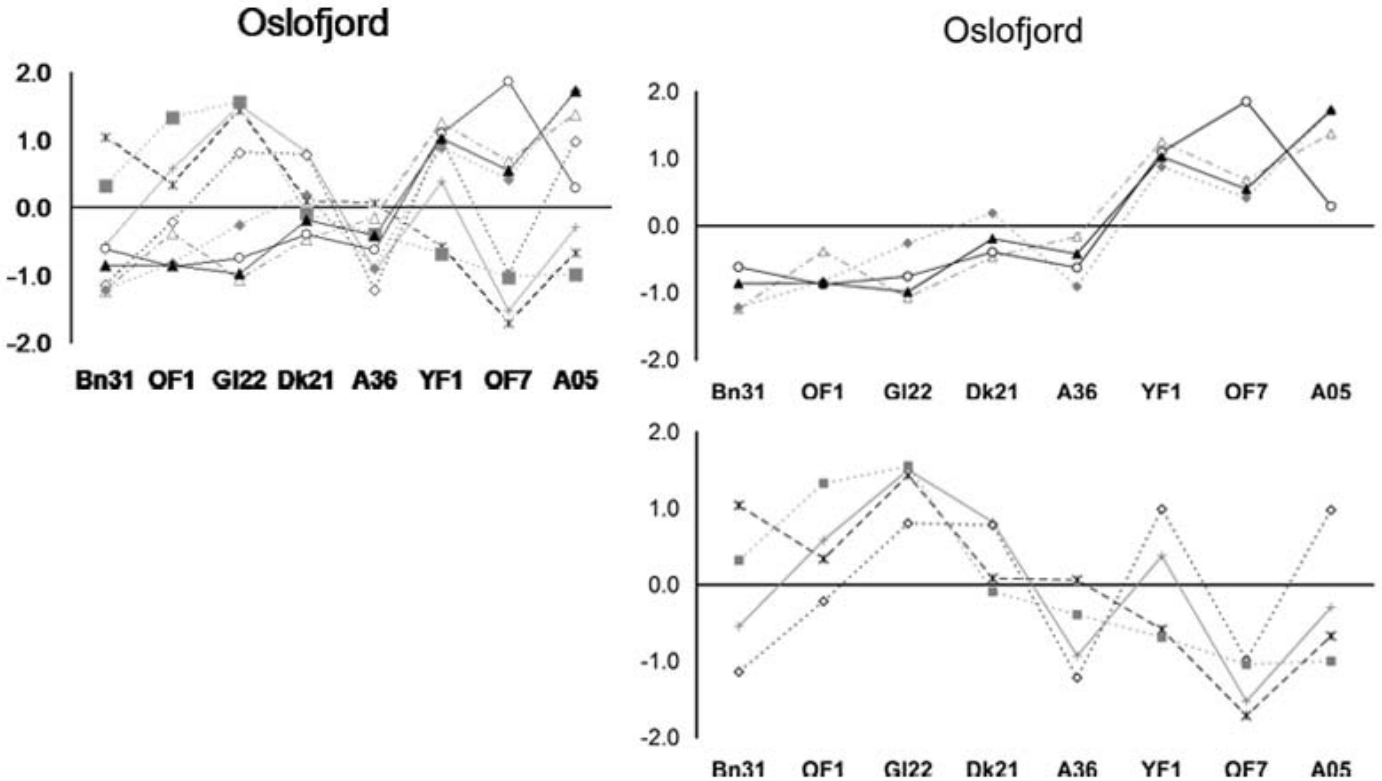


Lines joining data only can be used when presenting time series or consecutive samples data

Histograms:
When there is no connection between samples or there is not a gradient.

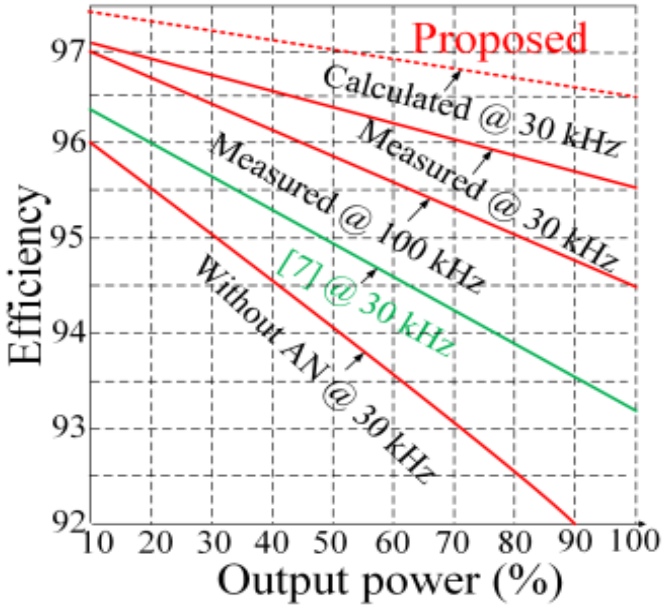
Source: https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously

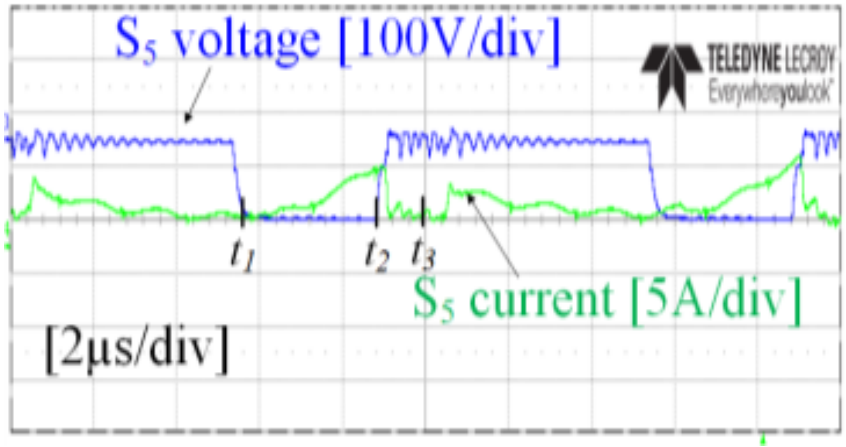
Do not "clutter" chart with too much data



Source: https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously

Adding Additional Information in Figure





Information can be added in the figure to IMPROVE understanding. Make sure they are readable

Capitalize on the figure CAPTION to clarify important issues related to the figure

Notes on Figures and Tables

- **Legends**: must be self-explanatory. Don't use common names: x, y etc.
- **Tables**: Never include long boring tables. Put them in supplementary material.
- **Photograph**:
  - scale marker, or scale bar, good resolution (check with Guide for Authors)
- **Color figures**:
  - For print publication: only when necessary (costly).
  - For on-line publication: its ok.

Notes on Figures and Tables

- Figures must redrawn using software such as VISIO.
- Copy-paste does not have the required **quality**.
- Figures, pictures that are taken from other sources: **must be cited**.
- Large portion of materials form other sources: Need **permission** from publisher

DISCUSSIONS

Purpose of Discussion

- To **interpret** the meaning of results
  - Giving some sense to to the data
- To **relate** the results with bigger picture/ concept/ideas
  - Avoiding isolation (silo)
- To **compare/evaluate/benchmark** the results with similar work
  - Justifying the superiority/performance/ benefits of your work

Steps in Writing Discussions (in order)

1) Begin by **stating the finding**
   - ❖ It should be a direct, declarative, and brief proclamation of the results.
2) Explain the **meaning of the finding**
   - ❖ Describe significance of the data
   - ❖ Results and their importance seem obvious to you, but not for others.
3) Relate the finding to those of similar studies
4) Consider **alternative explanations** of the findings
5) Acknowledge limitation, if any

Example

Fig. 1 indicates that by using a smaller control step-size, the steady-state oscillation is reduced by 50%. This is a significant improvement, because to date, the best achievable results is only 20% [Roland et. al, 2015]. In a practical system, this translates to a lower mechanical vibration that leads to longer shaft life-time. This large reduction is not unexpected, considering the fact that the the system is designed based on optimization of the poles and zeros. Despite the improved steady state oscillation, there is an increase in the overshoot of about 2%. However, this value has no significant effect on the overall transient performance of the system, as concluded by [Walker, 2016].

Check, how good is this Discussion?

Begin by stating the finding

Fig. 1 indicates that by using a smaller control step-size, the steady-state oscillation is reduced by 50%.

Relate the findings to those of similar studies

This is a significant improvement, because to date, the best achievable results is only 20% [Roland et. al, 2015].

Explain the meaning of the findings

In a practical system, this translates to a lower mechanical vibration that leads to longer shaft life-time.

Consider alternative explanations of the findings

This large reduction is not unexpected, considering the fact that the the system is designed based on optimization of the poles and zeros.

Acknowledge limitation, if any

Despite the improved steady state oscillation, there is an increase in the overshoot of about 2%. However, this value has no significant effect on the overall transient performance of the system, as concluded by [Walker, 2016].

Excellent discussion!

What to Avoid when Writing Discussions?

1. Statements that go beyond what the results can support.
   - ❖ Over-exaggerating

2. Unspecific expressions
   - ❖ Be specific
   - ❖ Example: Don't use "higher temperature", "at a lower rate", "highly significant". Quantitative descriptions are preferred (35^0C, 0.5%, $p<0.001$).

What to Avoid when Writing Discussions?

3. Sudden introduction of new terms or ideas
   - ❖ Stick to main ideas presented the introduction

4. Speculations
   - ❖ Allowed, but must be based on fact, rather than imagination.
   - ❖ Need extra caution, not to violate principles

Writing styles: to discuss results

1) The discussions of the results begin with…

2) The data highlights the need for…

3) The finding of the present study suggest (indicates, reveals) that…

4) The results from the study provide the evidence…

Writing styles: to discuss results

5) The single-most surprising result can be seen in Fig. A …

6) Among the plausible (logical, possible) explanation for the variation in the results are …

Referring to previous work to support your findings

The results…

- **are consistent** with [1] and suggest that…
- **are in agreement** with the data given in [2]…
- **are in accord** with the conclusions…
- **are in line** with previous researchers…
- of this study **are in keeping (is in agreement)** with the previous observation, which…
- further **support** the idea proposed in [3]…

Watch out the keywords in colour!!

Referring to previous work to support your findings

The results…

- **agree** with the findings of other studies…
- **confirm** the relationship between…
- **match** those observed in earlier studies…
- **corroborate** the finding of others…
- **mirror** those of the previous studies that have examined…
- **support (justify, acknowledge)** previous research on the same…

Watch out the keywords in colour!!

When results are contradicting

1) The results are found to be non-compliance to the standard…

2) In contrary, the results turn out to be not as expected…

3) This finding is unexpected, considering that…

4) The results are somewhat surprising, despite the fact that…

When results are contradicting

5) The results is not as anticipated…

6) However, the observed difference between the two samples are not very significant…

7) The discrepancies within the data can be attributed to…

8) The most striking results to emerge from the data is that the …

More contradictions

9) Interestingly, the correlation between A and B is not as expected…

10) The non-conformance between the two sets of data requires more in-depth explanation of the experiment procedures…

CONCLUSION

Conclusions: Important Elements

- Restate the aims of the paper
- Highlight the findings of the work
  - Re-enforce the originality of the work
- Summarize the achievements.
  - Make sure they are consistent with the objectives/hypothesis.
  - Try to enhance its significance/importance
- Suggest future work (if any)

Restatement of aims

- This paper has argued that …
- This essay has discussed the reasons for …
- In this investigation, the aim was to assess …
- The main goal of the current study was determine …
- The purpose of the current study was to define …
- This project was undertaken to design and evaluate …
- The present study was designed to quantify the effect of …
- The aim of this study was to investigate the effects of …
- Returning to the question posed at the beginning of this study, it is now possible to state/say/conclude that …

Some key words to be used

Summarizing the research findings

- This study **has identified** that …
- This research **has found** that …
- This work **indicated** that generally …
- The investigation **has concluded** that …
- The enquiry **has shown** that …
- The analysis **revealed** that the …
- These experiments **confirmed** that …
- The second major findings was that …

Summarizing research finding: Writing Styles

1) The most critical finding from this study is that …
2) The relevance of the work is clearly supported by the current findings…
3) The main findings can be summarized as follows:
4) From the work, the following conclusions can be made: 1)…, 2)…
5) In summary, the study unveils the followings:…
6) The following is a summary of conclusions:…
7) It can be concluded that…

Significance of the finding: Writing Styles

1) The evidences (results, data, observations) from this study suggests (indicate, imply) that…

2) These findings enhance (improve, assist) our understanding (believe, hypothesis) that…

3) This research is envisaged to serve as a base for future studies and …

Significance of the finding: Writing Styles

4) The current findings add to a growing body of literature on…

5) The study has gone some way towards enhancing our understanding of…

6) The present study, however, makes several noteworthy contributions to the field of…

Recommendations for further work: Writing styles

1) This work has open up up several questions that need of further investigation. Further work needs to be done to establish whether …

2) It is recommended that further research to be undertaken in the following areas:

3) Further experimental investigations are needed to estimate …

Recommendations for further work: Writing styles

4) What is now needed is a study involving …

5) Further research might explore/investigate..

6) Further research in this field/regarding the role of X would be of great help in…

7) Further investigation into the issue need to be carried out…

Recommendations for further work

8) A number of possible future studies using the same experimental set up are apparent.

9) As an extension to the work, It would be interesting to assess the effects of …

10) More information on the issue might reveal greater degree of accuracy on this matter.

Recommendations for further work

11) If the debate is to be moved forward, a better understanding of the issue needs to be developed.

12) These findings provide the following insights for future research …

Building the Conclusion: Example

- The objective of this study was to understand the effects of… (restating the aim)
- The investigation has concluded that… (summarizing the finding)
- The observations from this study suggests that… (significance of finding)
- This work has open up up several questions that need of further investigation. Further work needs to be done to establish whether … (recommendation for future work)

Building the Conclusion: Example

The objective of this study was to understand the effects of ozone gas to sanitize the (growth) medium for mushroom cultivation. The investigation has concluded that there is a linear relationship of the amount of ozone (in g/m3) to the time taken for mushroom harvesting. The observations from this study suggests that it is possible to increase the yield of mushroom output by installing an ozone generator to clean the medium before replanting. This work has open up up several questions that need of further investigation. Further work needs to be done to establish whether there is a need for an precise injection of ozone gas in order to reduce its side effects on the farm operator.

Do not underestimate the importance of a good conclusion.

Writing the Acknowledgements

- Thanking the people who have contributed to the manuscript but not to the extent where that would justify authorship.
  - E.g. people who provide technical technical assistance, editing, proofreading.
- Funding agencies, grant or fellowship.
  - Include the grant number or reference.

Some Notes on References

- In the text, you must cite all publications on which your work is based.
- Avoid excessive self-citations.
- Avoid excessive citations of publications from same country/region (?).
- Minimize personal communications.
- Do not include:
  - unpublished observations, manuscripts submitted but not yet accepted for publication, publications that are not peer reviewed, articles not published in English.

References

- Conform strictly to the style given in **the Guide for Authors.**
- Presentation of the correct format is the responsibility of the author, not the editor.
- Make their work easier; they will appreciate the effort.
- Use software, such as EndNote or Mendeley.

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