

# A structured approach to evidence-based software engineering in empirical software engineering research for students

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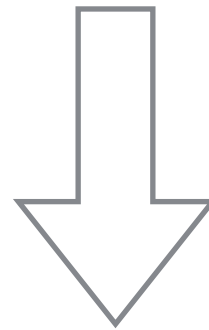
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# Original Question

How can students compare software in experiments?

# Issues with EBSE found by Rainer et al. [RHB06]

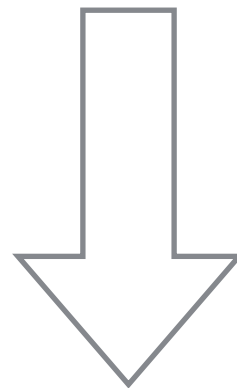
- “Students had problems constructing well-formulated EBSE questions.”
- “Students used limited criteria for identifying the best or better evidence [...]”
- “Students used a very limited number of search terms.”
- ...



Many students lack knowledge about scientific working and experiment design.

# Original Question Revised

How can students compare software in experiments?

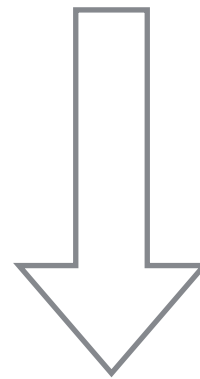


How to support students in scientific working and experiment design?

# How to support students in scientific working and experiment design?

- Evidence-Based Software Engineering (EBSE)
- Scientific Method

Tools not tailored for students

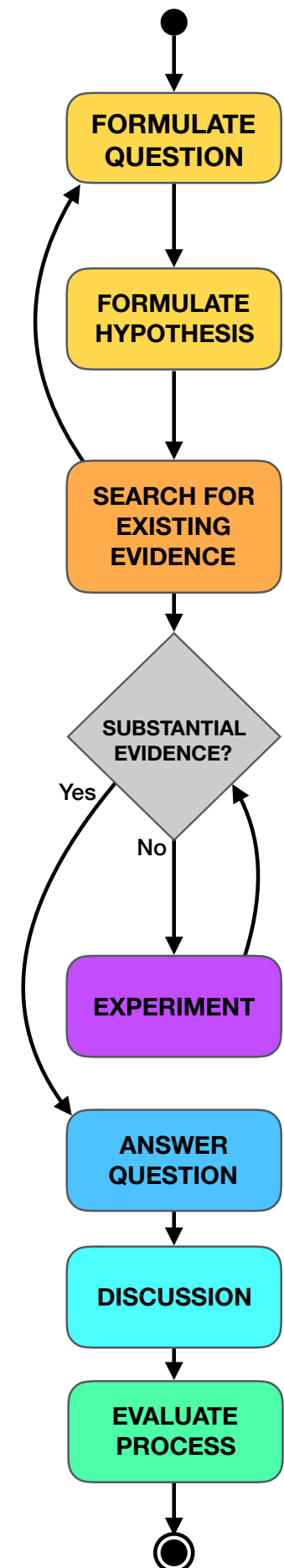
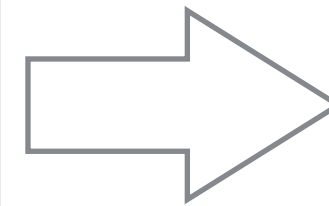


Process and guiding documents for students.

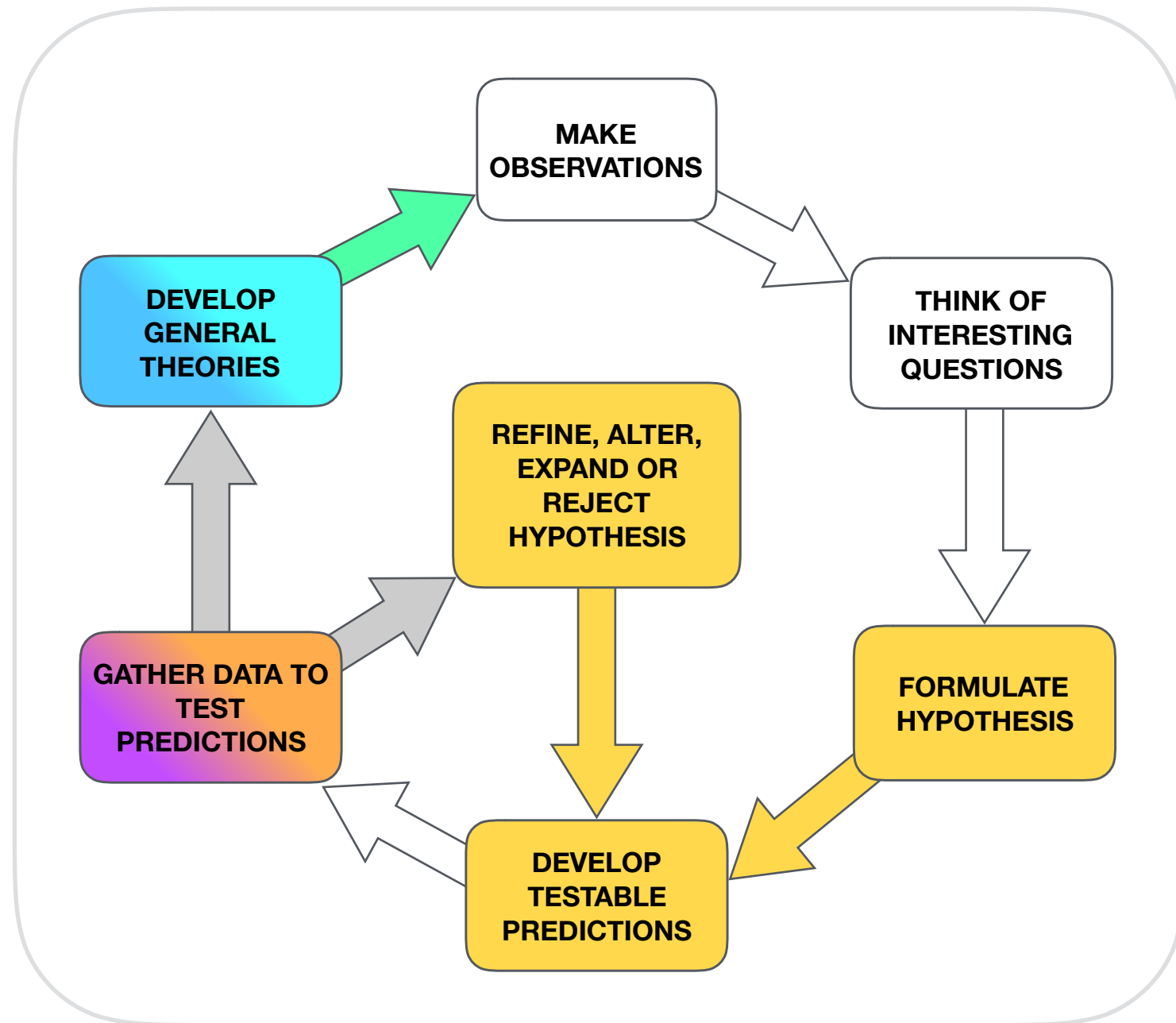
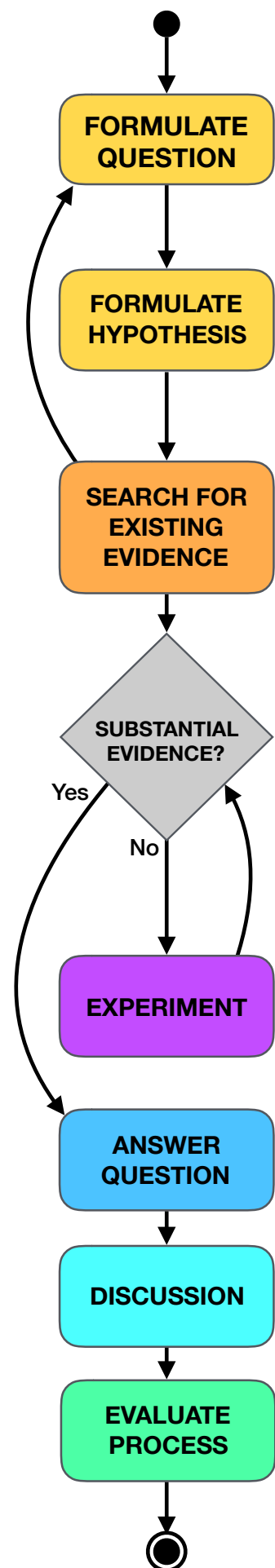
# Process and documents as guidelines for students

## EBSE Process Steps:

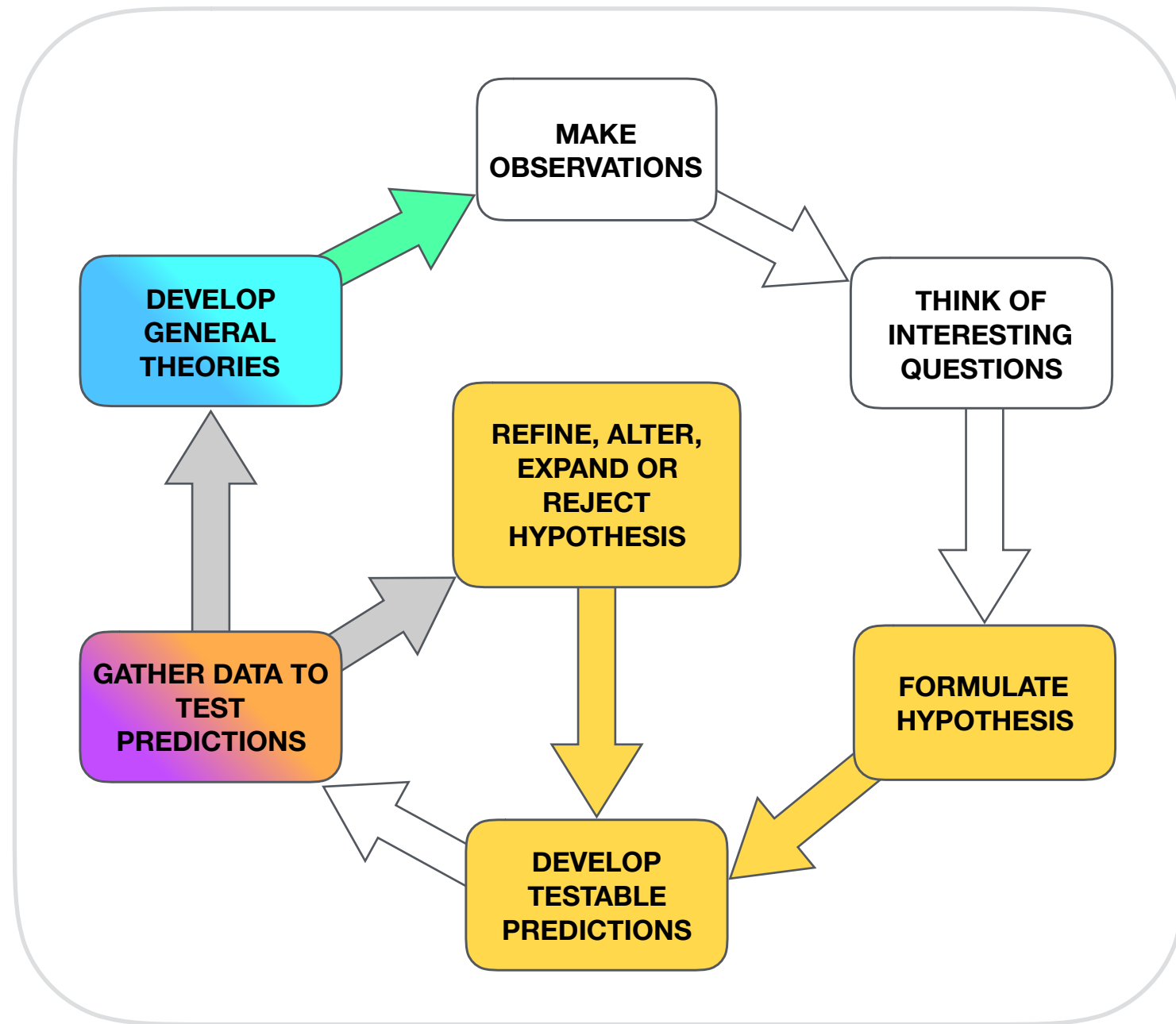
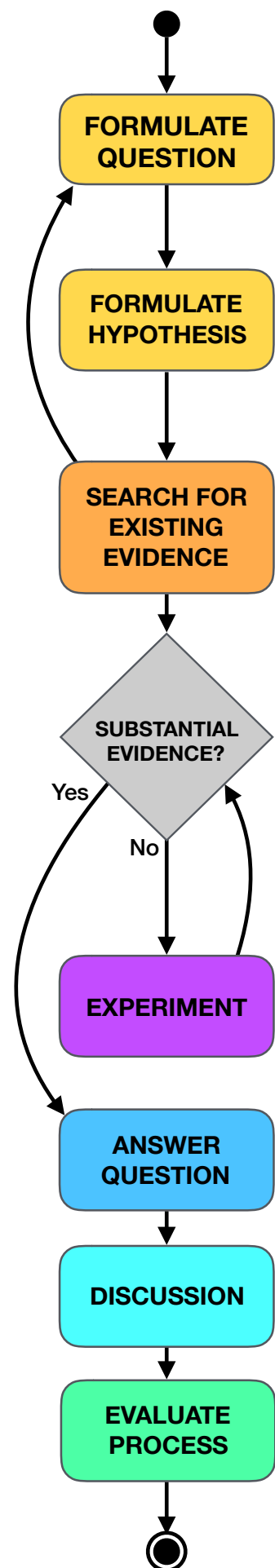
1. Ask an answerable question.
2. Find the best evidence that answers that question.
3. Critically appraise this evidence.
4. Apply the evidence (and critical appraisal).
5. Evaluate the performance in previous steps.



# Mapping on Scientific Method



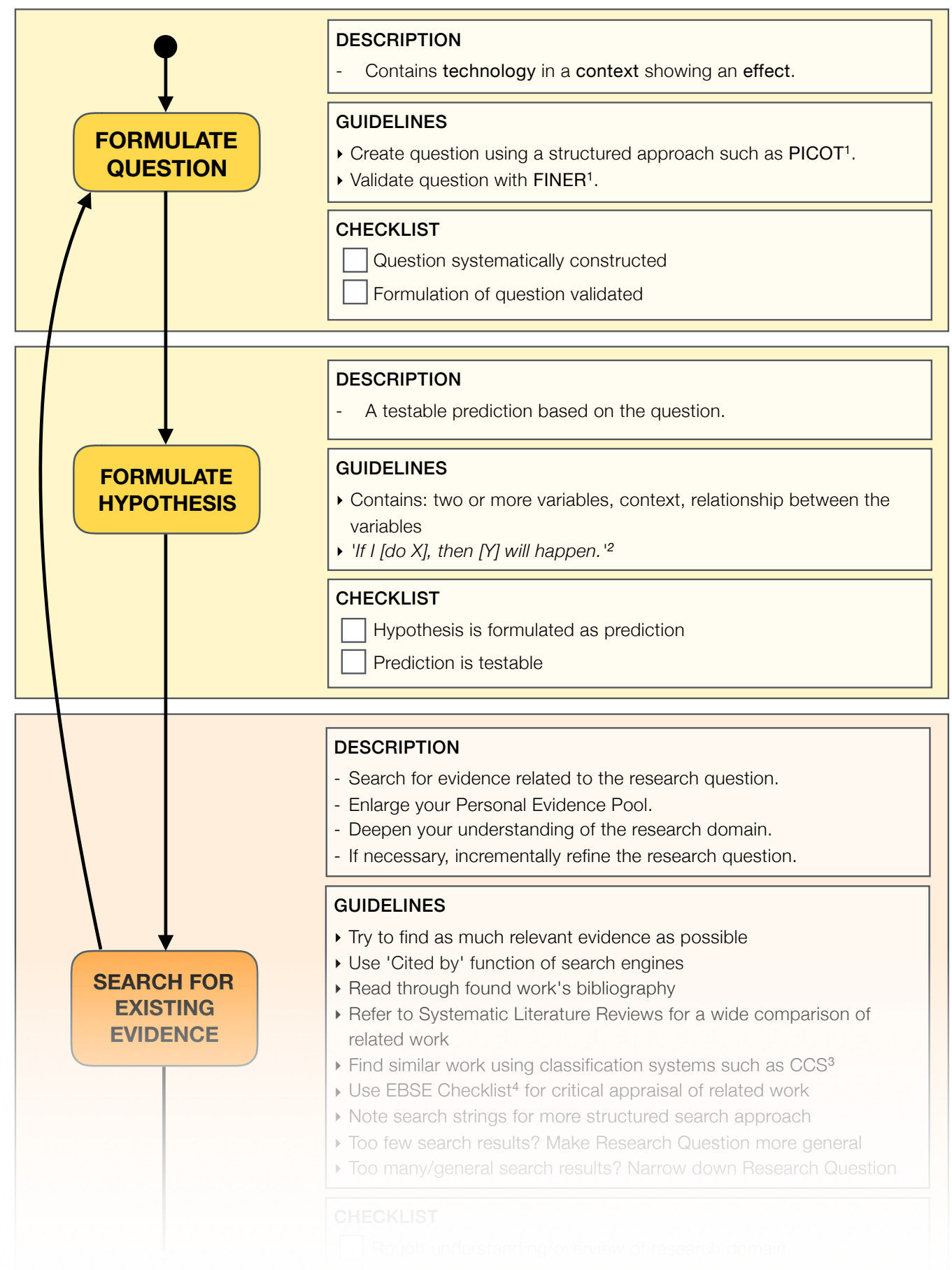
# Mapping on Scientific Method



Focus on experimenting, therefore unrolled respective nodes.



# Checklist Overview



# Checklist Details

```
graph TD; Start(( )) --> FQ[FORMULATE QUESTION]; FQ --> F[FORMULATE]; F -.-> FQ;
```

**FORMULATE QUESTION**

## DESCRIPTION

- Contains **technology** in a **context** showing an **effect**.

## GUIDELINES

- ▶ Create question using a structured approach such as **PICOT**<sup>1</sup>.
- ▶ Validate question with **FINER**<sup>1</sup>.

## CHECKLIST

- ☐ Question systematically constructed
- ☐ Formulation of question validated

**FORMULATE**

## DESCRIPTION

- A testable prediction based on the question.

## GUIDELINES

# Checklist Tools

<b>P</b> opulation	What specific population are you interested in?	<b>F</b> easible	<ul style="list-style-type: none"> <li>▶ Adequate number of subjects</li> <li>▶ Adequate technical expertise</li> <li>▶ Affordable in time and money</li> <li>▶ Manageable in scope</li> </ul>
<b>I</b> ntervention (Technology)	What is the investigational technology/ intervention?	<b>I</b> nteresting	<ul style="list-style-type: none"> <li>▶ Getting the answer intrigues investigator, peers and community</li> </ul>
<b>C</b> omparison Group	What is the main alternative/ baseline to compare with the intervention	<b>N</b> ovel	<ul style="list-style-type: none"> <li>▶ Confirms, refutes or extends previous findings</li> </ul>
<b>O</b> utcome	What do you intend to accomplish, measure, improve or affect?	<b>E</b> thical	<ul style="list-style-type: none"> <li>▶ Amendable to a study that institutional review board will approve</li> </ul>
<b>T</b> ime	What is the appropriate follow-up time to assess outcome?	<b>R</b> elevant	<ul style="list-style-type: none"> <li>▶ To scientific knowledge</li> <li>▶ To clinical and health policy</li> <li>▶ To future research</li> </ul>

<b>After Action Review (AAR)</b> <ul style="list-style-type: none"> <li>▶ What was supposed to happen?</li> <li>▶ What actually happened?</li> <li>▶ Why were there differences?</li> <li>▶ What did we learn?</li> </ul>	<b>Postmortem Analysis (PA)</b> <ul style="list-style-type: none"> <li>▶ What went so well that we want to repeat it?</li> <li>▶ What was useful but could have gone better?</li> <li>▶ What were the mistakes that we want to avoid for the future?</li> <li>▶ What were the reasons for the success or mistakes?</li> </ul>
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## REFERENCES

**FINER, PICOT:** Farrugia, P., Petrisor, B.A., Farrokhyar, F., Bhandari, M.: Practical tips for surgical research: Research questions, hypotheses and objectives. Canadian journal of surgery. Journal canadien de chirurgie 53(4), 278–281 (2009)

**Checklist, AAR, PA:** Dybå, T., Kitchenham, B.A., Jorgensen, M.: Evidence-based software engineering for practitioners. IEEE Software 22(1), 58–65 (2005)

# Briefing Form

- Concept Idea
- Guideline for summary
- Easier to search existing work
- Reminder for design aspects

<b>QUESTION</b>
<hr/> <hr/> <hr/> <hr/>
<b>HYPOTHESIS</b>
<hr/> <hr/> <hr/>
<b>EXPERIMENT</b>
<b>VARIABLES</b>
<b>Dependent</b>
<hr/> <hr/> <hr/>
<b>Independent</b>
<hr/> <hr/> <hr/>
<b>Control</b>
<hr/> <hr/> <hr/>
<b>Technique</b>
<hr/> <hr/> <hr/>
<b>Statistical Results</b>
<hr/> <hr/> <hr/>
<b>CONCLUSION</b>
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# Discussion

- Should be evaluated using students' thesis
- Digitalize Briefing Form

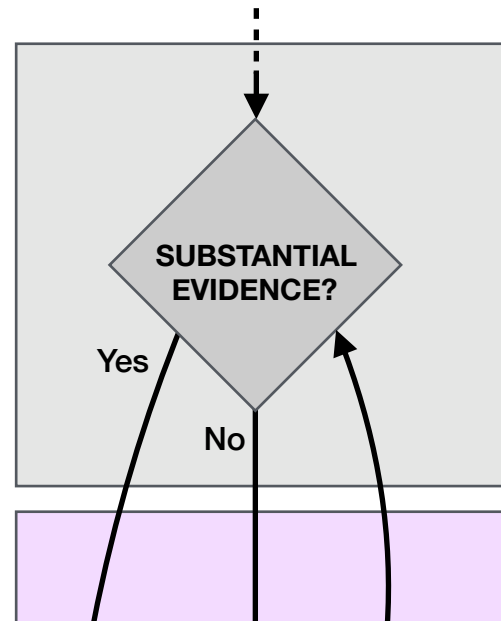
# Sources

- Scientific Method: Garland, Jr., Theodore. "The Scientific Method as an Ongoing Process". U C Riverside. ([http://idea.ucr.edu/documents/flash/scientific\\_method/story.htm](http://idea.ucr.edu/documents/flash/scientific_method/story.htm))
- FINER, PICOT: Patricia Farrugia, Bradley A. Petrisor, Forough Farrokhyar, and Mohit Bhandari. Practical tips for surgical research: Research questions, hypotheses and objectives. Canadian journal of surgery. Journal canadien de chirurgie, 53(4):278–281, 2009.
- PMA, AAR: Tore Dybå, Barbara A. Kitchenham, and Magne Jorgensen. Evidence-based software engineering for practitioners. IEEE Software, 22(1): 58–65, 2005.
- [RHB06]: Austen Rainer, Tracy Hall, and Nathan Baddoo. A preliminary empirical investigation of the use of evidence based software engineering by under-graduate students. 10th International Conference on Evaluation and Assessment in Software Engineering (EASE 2006), 2006.

# Checklist

Document:

- State graph



- Checklist for progress

► Use After Action Review and Postmortem A

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**CHECKLIST**

- ☐ AAR done
- ☐ PMA done
- ☐ Conclusions drawn for future processes

- Hints and Tools

**After Action Review (AAR)**

- What was supposed to happen?
- What actually happened?
- Why were there differences?
- What did we learn?