

Assessing Scientific Thinking and Research Knowledge in Experimental Psychology Graduate Students

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Context

2-year masters program in Experimental Psychology

Year 1: Formal written proposal of empirical (experimental) thesis +
proposal presentation to faculty committee

Year 2: Collect data, analyze, write up final thesis

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Student Learning Outcomes

1. Students will develop knowledge and skill in research design.
2. Students will develop scientific writing skills

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Challenges

1. Students work very closely with advisors on drafts of thesis
2. Sometimes students do not pass their proposal meeting with committee

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Solution: Create a Proposal Exam

One hour, closed book exam, two weeks before proposal meeting:

In no more than two single-spaced pages, answer the following:

- What is the research question you are asking?
- What prior empirical work or theories led you to your research question?
- How does your research question address a gap in this prior empirical or theoretical work?
- How does your design allow you to investigate your research question(s)?
- What will participants or animal subjects in your study do?
- How will you measure the variables in your study?
- What do you expect the results of the experiment to be and how will those results help answer your research question?

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What We Do With the Proposal Exam

- Faculty committee votes pass/fail.
 - If pass → proposal meeting
 - If fail → more work, re-take exam
- Assess student learning outcomes
 1. Students will develop knowledge and skill in research design.
 2. Students will develop scientific writing skills

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Rubric Created for Assessment Purposes

Proposal Exam Rubric				
Scientific Thinking Items	Advanced (3.1-4)	Effective/Developing (2.1-3)	Less Effective/Introductory (1.1-2)	Poor (0-1)
	Key concepts are clearly defined. Studies are described in enough detail so that their relation to other studies and to the relevant theoretical and methodological issues can be understood by the reader. It is clear whether information presented is a hypothesis, a result of a specific study, or a general conclusion. There are no significant gaps regarding expected information. The focus is on the research, rather than the researchers. Use of citations is appropriate.	Key concepts are clearly defined. Studies are generally described in enough detail so that their relation to other studies and to the relevant theoretical and methodological issues can be understood by the reader (although some sections could be more specific). It is usually clear when information presented is a hypothesis, a result of a specific study, or a general conclusion (though some statements may need clarification). There are no significant gaps regarding expected information. However, the review may include unnecessary information. Use of citations is appropriate.	Definitions of key concepts are unclear or limited. Some of the reviewed literature seems to be inappropriate or not well-linked to the topic. It is usually not clear whether information presented is a hypothesis, a result of a specific study, or a general conclusion. Literature may not be reviewed in enough detail for the reader to be sure of its relation to other studies, or it may be one-sided, omitting contrasting viewpoints. There are gaps regarding expected information. The review may discuss key concepts from the literature without citing adequately.	Too few studies are cited for the reader to be confident that that literature has been adequately reviewed. Much of the reviewed literature may be inappropriate or not reviewed in enough detail for the reader to be sure of its relation to other studies, or to the relevant theoretical or methodological issues. Definition and discussion of key concepts is insufficient. There are significant gaps regarding expected information.
Introduction: Literature Review				
Introduction: Literature Advancement	There is a specific, clear description of what is missing from the literature or what researchers do not yet know. A clear explanation of how the proposed study will answer this question or fill this research gap is included. Specific limitations related to issues, variables, populations, or methods are mentioned.	The description of what is missing from this literature or what researchers do not yet know could be stated more specifically or clearly. An explanation of how the proposed study will answer this question or fill this research gap is included, but it could be more specific. Specific limitations related to issues, variables, populations, or methods are mentioned.	The description of what is missing from this literature or what researchers do not yet know is vague and non-specific. There is little justification why the proposed study will be important to this literature, or the author makes a vague call for more research without precisely specifying the gap in terms of variables, populations, or methods.	The description of what is missing from this literature or what researchers do not yet know is absent or very unclear. There is no discussion of why the proposed study will be important to this literature, or the author makes a vague call for more research without any specificity.
Hypothesis	Hypotheses are all clearly stated with specific dependent variables identified, and directional predictions follow from the previous literature. They are testable. It is clear how expected	Hypotheses are all clearly stated and directional predictions follow from the previous literature. They are testable. It is clear how expected	Hypotheses are stated, but they need to be more precise regarding what is measured and what are the directional predictions. Hypotheses do not	

	how expected outcomes connect to overall research question.	outcomes connect to overall research question. The dependent variables could be more clearly identified.	clearly follow from the literature, or the predicted results do not clearly relate to the research question.	dependent variables are not discussed. Predicted results appear unrelated to research question.
Design & Method	The design and methods of the study are clear and complete and appropriate to test the hypothesis. Variables are appropriate and operationalized properly. Description of procedures is well-organized and with sufficient detail.	The design and methods are appropriate to test the hypothesis, but need to be more clearly described. Variables are appropriate and operationalized properly. The description of the procedure is mostly complete but some minor details may be missing. The procedure could be explained more effectively.	Design and methods are not complete or the operationalization of the variables is not clear. Measured variables may not be appropriate for the research question. The procedure is difficult to follow because of organization or clarity problems. Major details may be absent.	Design and methods are not appropriate for the hypothesis; variables are not operationalized or not appropriate for the research question. The description is disorganized, unclear, or many major details are absent.

Proposal Exam Rubric – Writing Item				
	Advanced (3.4)	Effective/Developing (2.3)	Less Effective/Introductory (1.2)	Poor (0-1)
Writing Quality	Writing is clearly and logically organized with only relevant information presented. There are no errors of usage, grammar, nor of sentence construction. All terms are clearly defined.	Writing is less clearly and logically organized. Most to all of the information is clearly relevant. Some minor errors of usage, grammar, or sentence construction. Terms are not clearly defined.	Ideas are poorly organized, either within or across paragraphs. Irrelevant information is presented. Some errors of usage, grammar, or sentence construction. Terms are not clearly defined.	Writing is sufficiently disorganized, or there are numerous grammatical errors, so as to significantly impair the reader's ability to understand the ideas. Relevance of ideas may be difficult to ascertain given the poor quality of the writing.

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Analytic Goals

1. As faculty, can we reliably use the rubric?
2. How are students performing?

Method

3 faculty members applied rubric to 11 proposal exams taken between May 2016 and September 2017

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Results: Qualitative Faculty Reporting

- General satisfaction
- It aided in assessing whether students ready to defend proposal before committee

Problem

- Not all students who pass proposal exam go on to pass full proposal defense

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Quantitative Analysis: Reliability

Inter-rater Reliability using Intra-Class Correlation Coefficient (ICC)

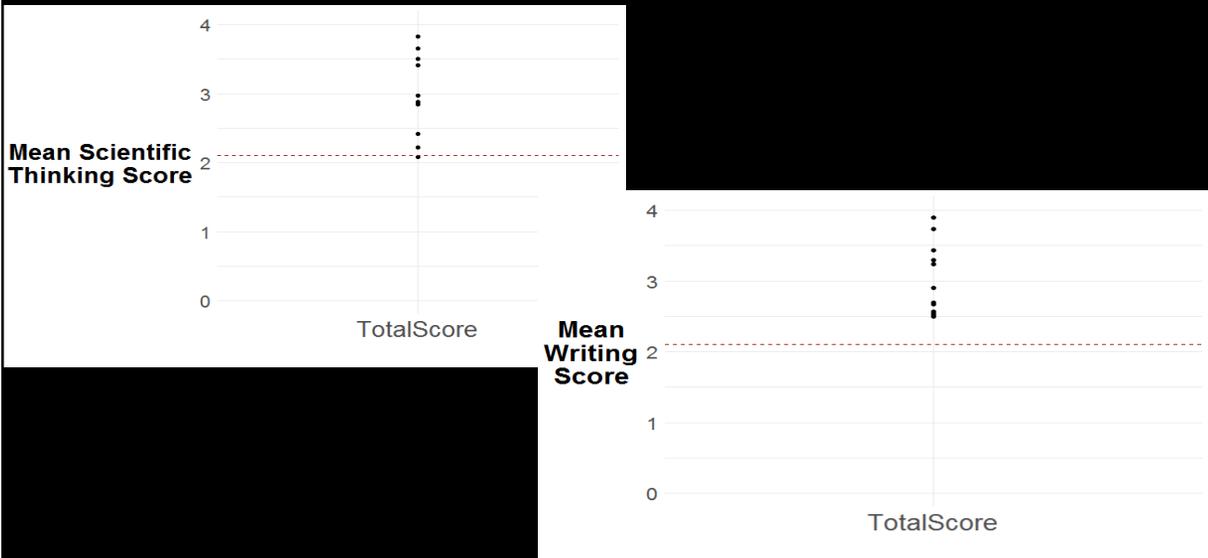
ICC for scientific thinking items: 0.73 (moderate to good reliability)

ICC for writing item: 0.24 (poor reliability)

Koo & Li (2016)

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Quantitative Analysis: Student Scores



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Conclusions & Action

- Scientific thinking items have adequate reliability, writing item does not
- Students showing effective scientific thinking skills
- Need to re-work writing portion of rubric

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