



# 049

## Standards for Quality of Research in Engineering Education

### A prolegomenon

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#### 1. DO WE NEED QUALITY CRITERIA IN EER?

In recent years research studies into critical factors for learning in engineering education (EER) have started to emerge in Europe and worldwide [1, 2]. In a review by Case and Light [3], it was “argued that methodological decisions need to be more explicitly represented in reports ... in engineering education research”, and in the review and meta-analysis conducted by Koro-Ljungberg and Douglas [4], it was found that the issue of methodology has received limited explicit discussion in EER-literature and that many studies lacked epistemological consistency. As will be suggested below methodological and perspective awareness and epistemological consistency are important aspects of quality.

The conception of quality in scientific work is fundamental, and determines what researchers judge as reliable knowledge in their field. Although quality criteria are used daily in research, extensive reviews discussing research quality, especially in EER, are lacking. Borrego and Bernhard briefly discuss different views on quality in their review [2] and specifically discuss method-led versus problem-led research as well as their different views on quality. When a thorough discussion is lacking it poses the risk that the criteria applied tend to be isolated to the individual and that each individual has more or less well thought-out ideas about what is ‘good’ and what is ‘bad’. Also, it could lead to an unquestioning acceptance of one research paradigm, or epistemology, which is often the dominant paradigm. This can lead to an inappropriate matching of research questions to methodologies, a confusion of reliability with validity, and a lack of transparency in the criteria being applied for what constitutes quality in research. We are of the view that although what we communicate in this paper will be relevant to quantitative re-

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search, we will focus on qualitative research since it is the area that induces the most controversial discussions about quality in contemporary EER.

## 2. A PROLEGOMENON TO QUALITY CRITERIA FOR EER

We tentatively propose the criteria in table 1 in extension of those proposed by Larsson [5].

Table 1. Tentative quality criteria for (qualitative) engineering education research.

Quality of a study in general	Quality of the results	Validity of the results
<ul style="list-style-type: none"> <li>• <i>Perspective awareness</i> All studies have a perspective.</li> <li>• <i>Acknowledging different knowledge traditions and cultures</i> Respect and awareness of the perspective of other researchers.</li> <li>• <i>Upholding ethical values</i> How can the study contribute to enhancing the human condition?</li> <li>• <i>Informed by theory and other literature describing prior work</i> A researcher cannot perform significant research without first understanding the literature in the field.</li> <li>• <i>Research question</i> Worthy topic: Relevant, timely, significant, interesting.</li> <li>• <i>Internal consistency in a study (Including epistemology with methodology)</i> Harmony should exist between the research question, assumptions about the research and the nature of the phenomenon to be studied, data collection, and methods of analysis.</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Richness in meaning</i> Capture the essentials and at the same time maintain the nuances. Highlight what is unique to the specific phenomenon at hand.</li> <li>• <i>Structure</i> Interpretations should have a good structure. It should be possible to follow the reasoning.</li> <li>• <i>Contribution to theory development and new knowledge</i> How well does one relate to earlier theory? What is the original contribution of the study; something decisive or just a note in the margin?</li> <li>• <i>Presentation of results</i> Presentation relevant to proposed audience, clear and precise language, and a good balance between different parts of the presentation.</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Discourse criterion</i> In the criterion validity is viewed as a conversation about the world (or reality). The quality of argumentation and interplay of meanings.</li> <li>• <i>Heuristic value</i> To what extent will a reader be convinced by the presentation of the study in seeing a particular aspect of reality in a new way?</li> <li>• <i>Empirical anchoring</i> The relation between reality and interpretation.</li> <li>• <i>Consistency (including epistemological and theoretical underpinnings)</i> The interplay between part and whole.</li> <li>• <i>Pragmatic criterion</i> Consequences of what the results brought about (for example in relation to teaching). This is an aspect of what is also called ecological validity.</li> </ul>

Some of the mentioned criteria could be considered contradictory and the right balance has to be established, while depending on the type of study, certain criteria are more important than others. The most imperative aspect of quality may be that we pose good research questions. In the full paper we will discuss these criteria in more detail. In order to develop high-quality EE research in the future, we argue that it is necessary that the EER-community begin to discuss quality criteria in earnest. We hope that our paper can serve as a genesis for such a discussion. ■

## REFERENCES

- [1] Baillie, C., and Bernhard, J., (2009), Educational research impacting engineering education, *European Journal of Engineering Education*, Vol. 34, pp. 291-294.
- [2] Borrego, M., and Bernhard, J., (2011), The emergence of engineering education research as a globally connected field of inquiry, *Journal of Engineering Education*, vol. 100, pp. 14-47.
- [3] Case, J., and Light, G., (2011), Emerging methodologies in engineering education research, *Journal of Engineering Education*, vol. 100, pp. 186-210.
- [4] Koro-Ljungberg, M., and Douglas, E. P., (2008), State of qualitative research in engineering education: Meta-analysis of JEE articles, 2005-2006, *Journal of Engineering Education*, vol. 1997, pp. 163-175.
- [5] Larsson, S., (2005) Om kvalitet i kvalitativa studier [On quality in qualitative studies], *Nordisk Pedagogik*, vol. 25, pp. 16-35. English version available at <http://www.leeds.ac.uk/educol/documents/000000821.htm>