

Higher Education Research and Engineering Education Research: Comparative Perspectives

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1 INTRODUCTION

Higher Education is a sector of growing importance in many societies. The sheer size of the sector is one of the reasons why higher education has increasingly found itself the object of research in the last decades. The ever increasing demands and expectations from internal and external stakeholders require a rich and solid knowledge base [1,2]. Engineering Education, as one of the major sub-fields within higher education, has, similar to other professional fields, developed its own journals, meeting places and traditions [3,4]. Both fields have been described as interdisciplinary or multidisciplinary, comprising a mix of disciplinary perspectives and approaches. However, increasingly the fields have been established, shown not only in terms of journals and conferences, but also in chairs, dedicated research units etc. [5].

Higher Education Research (HER) was established as a research field in the 1960s and 1970s. The first dedicated research units were established already in the 1950s in the US. The Center for Studies in Higher Education (CSHE) at UCLA, Berkeley and the Center for the Study of Higher and Postsecondary Education (CSHPE) at University of Michigan, Ann Arbor were both founded in 1957. In Europe, a starting point was in 1964 when the Society for Research into Higher Education (SRHE) was founded in London. Many of the research issues raised were linked to the preconditions for, and the consequences of, a huge expansion of higher education. [6] Ever since, there has been a significant expansion of HER, shown in growing number of e.g. researchers, journals and societies. [7] Over time, there have been ongoing discussions whether higher education research is a field of study, community of practice or (an emerging) discipline. One of the leading higher education scholars, Ulrich Teichler, has described it as "a field of knowledge, study and research" [8]. He has also, among others [9], emphasised its close relation to the

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sector, as "closely intertwined with policy and practice" [10]. Another researcher on higher education, Malcolm Tight, has identified the following two clusters of research:

- Quality, system policy, institutional management, academic work and knowledge
- Teaching and learning, course design, student experience [9]

Methodologically and theoretically, higher education research has been described as eclectic but clearly dominated by the social sciences. Whereas the teaching and learning cluster is led by educational researchers, the policy and management cluster hosts scholars from e.g. economics, sociology, history and public policy.[2]

Engineering Education Research was established by the professional organisations such as the American Society for Engineering Education (ASEE, established in 1893) and the European Society for Engineering Education (SEFI, established in 1972). There are similar professional organisations within this field all over the world, fostering promotion and quality development of engineering education. For nearly all the engineering education societies there are annual conferences, topic specific divisions and journals. Engineering Education Research (EER) as a society has grown out of these professional organisations with the shared mission to establish a more consistent research approach as many of journals were previously dominated by case descriptions without proper research methodology. [15]

In the US the first community was formed during the 1990s, supported by networking funding from the National Science Foundation (NSF). In Europe, EU projects funded some of the first European networks. SEFI established its first working group in 2007. The ASEE journal, Journal of Engineering Education, and the SEFI journal, European Journal of Engineering Education, have played major roles in raising the research bar by explicitly formulating research criteria which have been discussed in the EER communities.

Along with the development of journals, research centres have been established and professors have been appointed. Currently, more than 150 PhD students are enrolled within EER. There is an ongoing discussion on what EER actually is: a discipline, a field, a community or a meeting place. This is accompanied by the development of taxonomies on what EER covers. In 2006, discussions in the US resulted in consensus on five main areas: Engineering Epistemologies, Engineering Learning Mechanisms, Engineering Learning Systems, Engineering Diversity and Inclusiveness, and Engineering Assessment. [14] One aspect that has been emphasised is the closeness to the field and impact on practice. There is a growing number of journals established in the fields of engineering education and EER. According to the Danish bibliometric list of journals, there are 18 journals specifically focusing on engineering education followed by numerous journals within technology and science education.

In this paper, we compare these two different yet related research fields – HER and EER – in order to identify similarities and differences in research focus, theories, methods and implication for practice and policy. We ask the following research

questions: Which research issues are in focus? Which theories and methods are used? How are the results reported? What is the relation to educational policy and practice? Although much work has been undertaken within each of the fields, as described above, a systematic comparison of journals across fields has not been undertaken earlier.

2 METHODOLOGY

We have chosen four leading journals, two from each field, and analyse the last five latest online published articles in 2013. The articles were downloaded in February 2014. The higher education journals are high ranked, both included in the Thomson index. They are selected also because they are broad journals including both teaching and learning issues and policy/management related contributions. The two engineering education research journals have made significant contributions to the shaping of the profile of a new research field. The Journal of Engineering Education is listed in the Thomson index.

We have built our analytical model on the taxonomy developed by Malmi et al. [11] and an analysis of journals [12], which we have adjusted to the empirical field of both higher education and engineering education. From studies of higher education journals, we have added the category “level of analysis” [13].

In this paper we have applied the analytical model on each of the four journals with the objective to find out if the model works. However, the limitation is that we only have analysed five papers from each journal and our analysis is therefore based on a limited empirical material.

3 FINDINGS

In the following we will first report on the findings from each journal and then undertake a comparative analysis.

The five articles from Studies in Higher Education have a size between 15-25 pages (word limit 7000 words) and they are written by 2-3 authors. There is a mix of empirical and theoretical articles and for the empirical articles there is also a strong theoretical point of departure. There is a mix of methodologies and methods used. However, only three of the articles include considerations of data analysis and raise explicit research questions. Three of the articles have explicitly discussed impact for practice or policy.

Also Higher Education comprises articles which are typically 15-18 pages (word limit 7000), written by 2-3 authors. All five articles in this study are empirical, including both comparative analyses across institutions and higher education systems and single case studies. The analytical levels in scope range from course/programme level to international comparisons.

The Journal of Engineering Education stands out as the journal with the most extensive articles (guidelines for authors suggest 8000-10000 words) and the biggest variation regarding format. The dominating article nature is empirical case reports. In all but one article there are explicit theories, frameworks or concepts used. The level

of analysis is without exception the category “the course or group of students and their teachers”. The typical research questions are, simplified and summarised, on how to improve curriculum design in order to enhance student learning and the efficiency and effectiveness of teaching. This is addressed in case studies, primarily with some kind of experimental design. Most studies are based on quantitative methods and analysis. There are explicit discussions on implications for policy and practice in the end of each article.

European Journal of Engineering Education has the shortest articles (word limit 8000 words) and the five articles were dominated by empirical studies with a lack of theoretical underpinning. All five articles were studying the course level. There is a variation in the methodology but only in two articles explicit research questions were found.

We have summarised our findings in *Table 1*.

Table 1. Analysis of five original articles from four leading journals

Journal	Studies in Higher Education	Higher Education	Journal of Engineering Education	European Journal of Engineering Education
Number of authors	2-3	2-3	2-4	1-3
Number of pages	15-25	15-18	19-36	11-25
General nature of the article <i>Empirical</i> <i>Case report</i> <i>Position article / Proposal</i> <i>Theory article</i>	Empirical Theory articles	Empirical Case reports Comparative studies	Empirical Case reports	Empirical articles and 1 case report
Theoretical background, on which the article is built	Strong theoretical background Literature reviews	Varied, explicit in 3 articles	Existing and varied	Explicit theories in 3 articles
Level of analysis • the individual, student or academic; • the course or group of students and their teachers;	Different levels Institutional or	Different levels Programme Institution (2)	The course or group of students and their teachers	All at course level

<ul style="list-style-type: none"> • the department or centre, a larger group of academics and students in a particular subject area or discipline; • the institution, university or college; • the region (part of a country or a group of institutions); • the nation or country; • the system or idealized arrangement of higher education; and • the international level, involving a consideration of two or more national systems. 	<p>general theoretical</p>	<p>International (2)</p>		
<p>Types of research questions</p>	<p>Research questions are explicit in three articles, otherwise more implicit</p>	<p>Research questions are explicit in only one article.</p>	<p>Explicit research questions in four articles</p>	<p>Only explicit research questions in two articles</p>
<p>Type of research paradigm or general research design</p> <ul style="list-style-type: none"> • Action Research • Case Study • Constructive Research • Delphi • Ethnography • Experimental Research • Grounded Theory 	<p>Variation Survey Theoretical Ethnographic Case study</p>	<p>Case studies (2) Survey research (2) Comparative study</p>	<p>Case Study Experimental research</p>	<p>Only mentioned in two articles Case study and Phenomenographic</p>

<ul style="list-style-type: none"> • Phenomenography • Phenomenology • Survey Research 				
Type of collected data and subjects of study Qualitative or quantitative data	Three studies with both qualitative and quantitative One with only qualitative	Four qualitative one quantitative	3 both quantitative and qualitative, 2 quantitative only	Quantitative – 2 articles Both quantitative and qualitative – 2 articles Qualitative methods 1
Methods used to analyse the data	Explicit in three articles	Not explicit	Explicit in all articles	Explicit in 2 articles
How these aspects of the research process have been reported in the article.	Text, tables, citations and figures	Text, tables e.g. by citation from interviews	tables, figures, pictures, text	Text, tables, figures, citations
Number of references and journal self referencing	36-112	17-54	48-106	21-59
Implications for policy and practice	Explicit in 3 articles	Explicit in 3 articles	Explicit in all articles	Explicit in one article

4 DISCUSSION

This study is a pilot study preparing for a larger comparative study of journal articles in higher education research and engineering education research. Hence, we will not claim that the analysis of the five articles from each journal is significant for the journals. However, the comparative analysis reveals some interesting findings.

Initially, we can conclude that most articles are written by a small group of researchers, typically 2-3 people. Single authorship is rare and the number of authors does not exceed four. Empirical case studies dominate across all journals although the higher education journals also include theoretical papers. Theoretical foundations vary a lot and there is no dominating theory. Theories are sometimes more in the form of reviews of earlier research and more implicit. Also the formulation of research questions and aims displays a considerable variation. In most articles, there are no explicit research questions. Both qualitative and quantitative methods are used, often in the same paper. Only one engineering education article is qualitative only. The levels of analysis are more varied in the higher education journals, ranging from course level to international systems. In engineering education journals, the course level is clearly dominating. Discussions on implications for policy and practice are

rather common, explicit in three out of five higher education journal articles and in all five articles in *Journal of Engineering Education*. Somewhat surprisingly, only one article in *European Journal Engineering Education* discussed policy and practice implications. This is especially surprising as EER claim a close relation to practice and that research should have impact on practice. One possible explanation regarding these five articles might be found in the fact that they all contain analyses of courses and that it might be difficult to draw broader conclusions from narrowly focused studies. However, there are single case studies in the other journals which also include practice implication discussions.

Based on the comparative analysis we can identify some implications for researchers in both fields. Inspired by higher education research, engineering education researchers might consider moving beyond the single case studies, which typically describe successful innovative approaches to teaching and learning. There should be room for more comparative studies, across disciplines, institutions and higher education systems. Inspired by the *Journal of Engineering Education*, higher education researchers could put more emphasis on the descriptions of methodology and research design.

This pilot study has also shown that the developed taxonomy worked well for analysis of both higher education journals and engineering education journals. In our future work we will consider adding to the final category also implications for research. The ways in which researchers discuss, conclude and address their research questions would give valuable information on the nature of academic work within each of the fields.

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