



Editing Engineering Education Research Handbooks & Institutionalizing an Academic Field

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 Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding agencies.

ABOUT ME

Professor

Department of Information Sciences & Technology

Director, Engineering Education & Cyberlearning Laboratory (EECL)

George Mason University

Previously positions:

Assistant - Associate Professor (2007-2013)

Department of Engineering Education, *Virginia Tech*

Affiliated Faculty: CS, ISE, STS, Center for HCI & CiBM

Education:

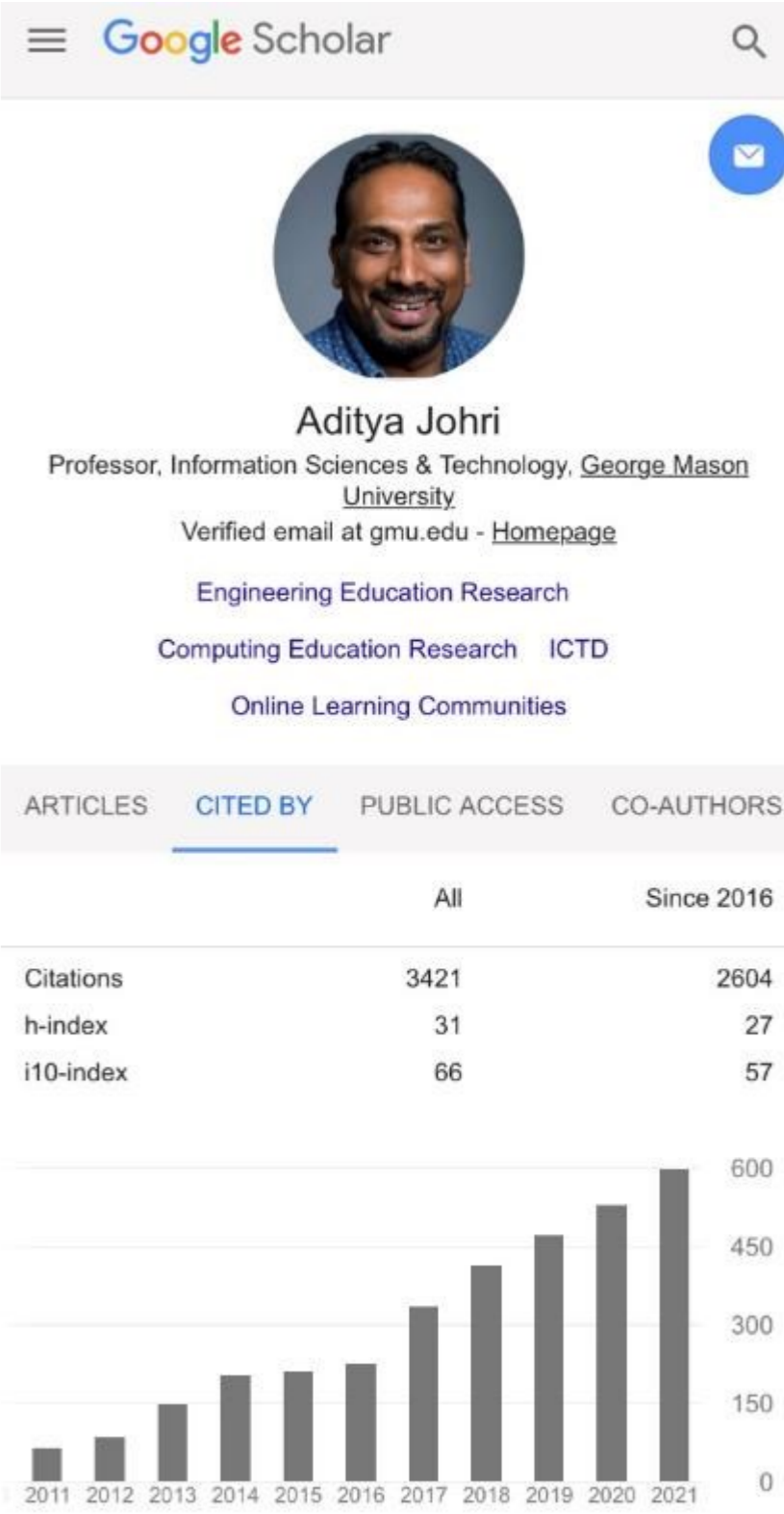
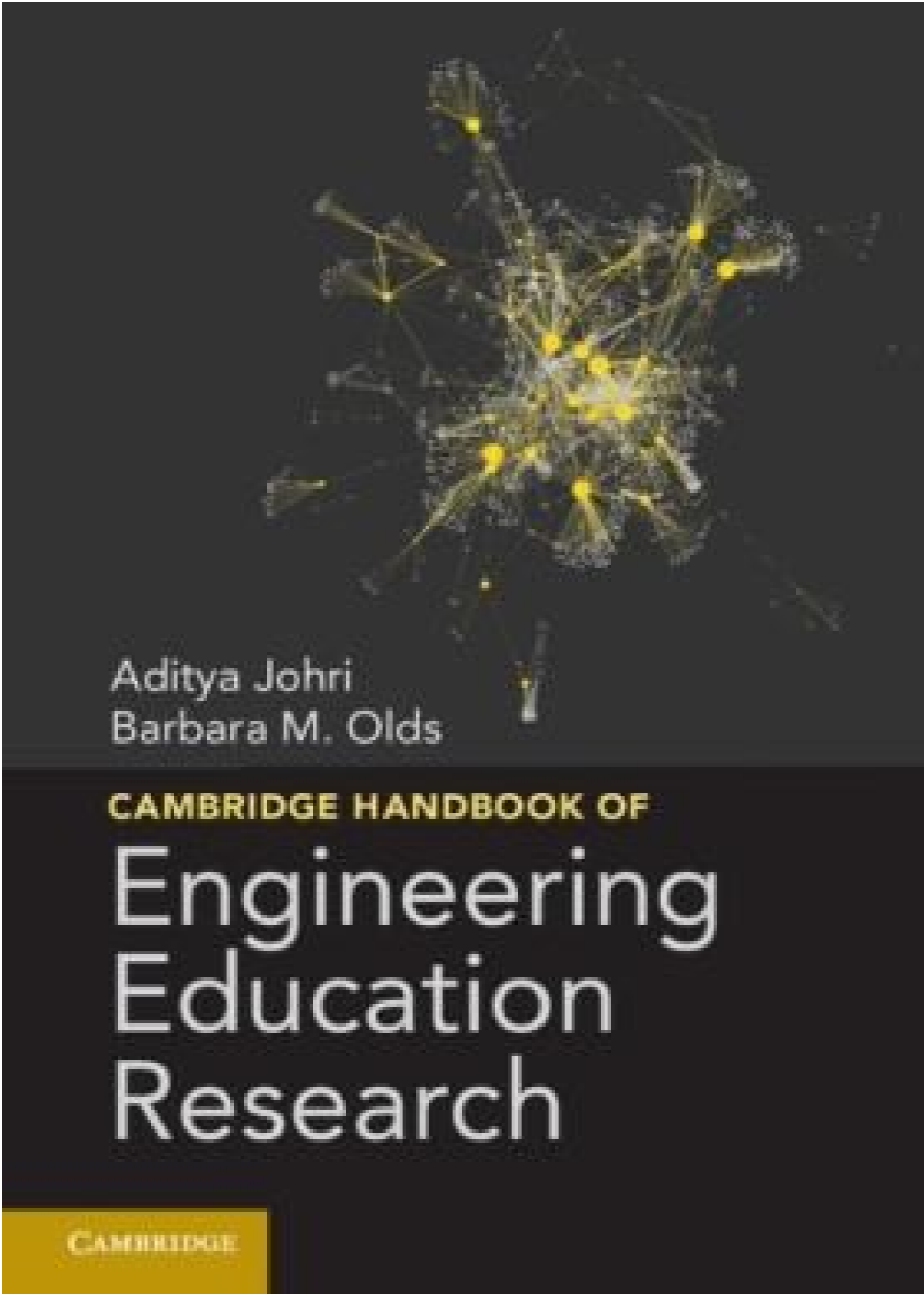
Ph.D., Stanford University, Learning Sciences & Technology Design

Undergrad: Mechanical Engineering

M.S. degrees: Mass Communication, Information Design, Creative Writing

RESEARCH

Interdisciplinary research program; publish largely in engineering education; serve on editorial boards of *Advances in Engineering Education & Engineering Studies*. Other publications in educational technology and computing journals and proceedings. (ACM CHI, CSCW, ICTD; CSCL, ICLS).



WHAT INFORMED MY INITIAL PERSPECTIVE

The Engineer of 2020 Report


A Vision of the Contexts for Engineering in 2020

Emergence of new fields, tools, and contexts
 Examples: bio-tech, digital systems; computer systems/tools; sustainable technology; **multidisciplinarity and interdisciplinarity**, social, political & economic, diversity; **global markets & contexts**; interaction of engineering and public policy

Attributes of the Engineer of 2020

- Strong analytical skills
- Practical ingenuity
- Creativity
- Communication competencies (oral, written, and cultural)
- Business, management, and leadership skills
- High ethical standards and professionalism
- Agility, resilience, flexibility

Diversifying the STEM student population



Engineer of 2020 (2003)

Engineering Education Research



Colleges and universities should endorse research in engineering education as a valued and rewarded activity for engineering faculty and should develop new standards for faculty qualifications.

EE2020 (2005)

JEE Research Emphasis

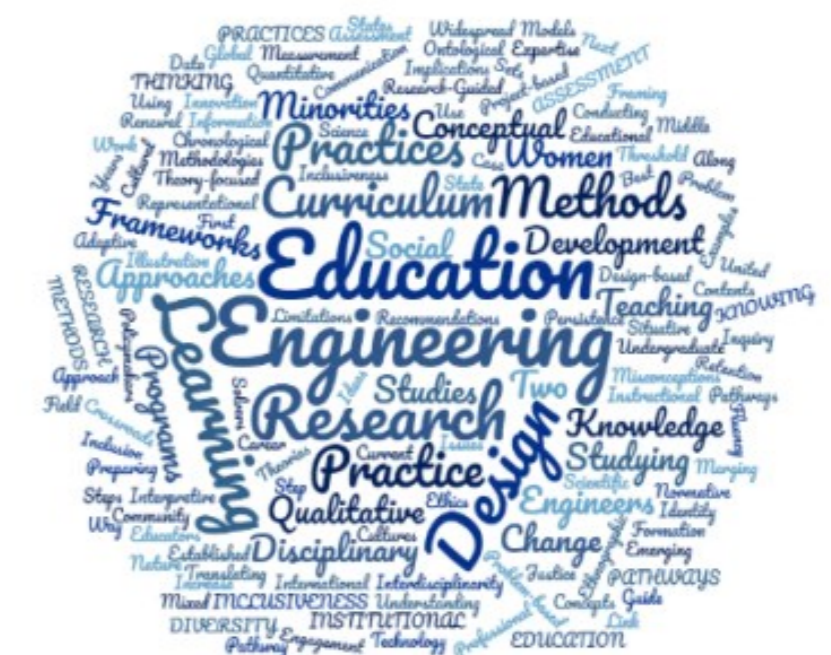


January 2005

- The State of the Art and Practice of Engineering Education Research
- Guest Editors
 Richard M. Felder, NCSU
 Sheri D. Sheppard, Stanford
 Karl A. Smith, U of Minnesota

Source: Jack Lohmann

JEE Special Issue (2005)



ENG ED COLLOQUIES (2006)

SCHOLARLY ENGAGEMENT WITH THE ENGINEERING EDUCATION COMMUNITY

REPORTS

Contributed to several NSF, NAE, and ASEE reports on different aspects of engineering education,

PUBLICATIONS

Co-editor of the research handbook. Write a regular column for ASEE Prism and have edited several journal special issues (JEE, AEE, Engineering Studies).

SOFTWARE

Co-developed iKNEER, (Interactive Knowledge Networks for Engineering Education Research), a interactive repository of engineering education papers and proposal abstracts. Subsequently developed DIA2, a portal to analyze NSF funding portfolio,

SERVICE

Serve as director of ASEE-ERM, and on editorial boards of AEE & Engineering Studies. Organized a doctoral consortium and participate as mentor in PEER. Part of the organizing team for EEC Awardees conferences.

Phase I Report
Creating a Culture for Scholarly and Systematic Innovation in Engineering Education
 Ensuring U.S. engineering has the right people with the right talent for a global society

IDA
 SCIENCE & TECHNOLOGY POLICY INSTITUTE
The Evaluation of Engineering Education Research: Emerging Issues and Promising Developments
 Workshop Report
 Asha Balakrishnan, Task Leader
 Bhavya Lal
 Pamela Edert Flatau

OPEN UP ENGINEERING EDUCATION RESEARCH
 It's time for a dialogue on sharing research data.

EXCHANGES OF INFORMATION ARE ESSENTIAL IF HIGHER EDUCATION INSTITUTIONS ARE TO REMAIN AT THE FOREFRONT OF KNOWLEDGE CREATION.

Growing capacity among CCLI Awardees (and precursor programs)
 Time Range: 1998 – 2011
 6,430 researchers received awards from CCLI as PI/coPI
 9,111 academic publications and NSF grant proposals were produced by these researchers
 16% researchers form the largest network
 1016

DIA2 can produce such insights on-demand

Advances in Engineering Education
 A Journal of Engineering Education

1. Guest Editorial: Data Sharing in Engineering Education
Aditya Johri, Mihaela Vorvoreanu, Krishna Madhavan
2. Data Sharing in Interpretive Engineering Education Research: Challenges and Opportunities from a Research Quality Perspective
Joachim Walther, Nicola W. Sochacka, Alice L. Pawley
3. Data Sharing from a Policy Perspective
R. Alan Cheville
4. Designing for Global Data Sharing, Designing for Educational Transformation
Robin S. Adams, David Radcliffe, Michael Fosmire
5. Extending Engineering Practice Research with Shared Qualitative Data
James Trevelyan
6. The Multiple-Institution Database for Investigating Engineering Longitudinal Development: An Experimental Case Study of Data Sharing and Reuse
Matthew W. Ohland, Russell A. Long
7. Development and Classroom Implementation of an Environmental Data Creation and Sharing Tool
Daniel S. Brogan, Walter M. McDonald, Vinod K. Lohani, Randel L. Dymond, Aaron J. Bradner
8. Transforming Education Research Through Open Video Data Sharing
Rick O. Gilmore, Karen E. Adolph, David S. Millman, Andrew Gordon
9. Data Sharing and Reuse within the Academic Pathways Study
George Toye, Sheri Sheppard, Helen L. Chen
10. Perceptions and Practices of Data Sharing in Engineering Education
Aditya Johri, Seungwon Yang, Mihaela Vorvoreanu, Krishna Madhavan

NAE Special Report (JEE 2006)

Special Report
**The Research
of Engineering**

I. INTRODUCTION

Rapid changes in the worldwide economy are creating a compelling rationale for us to educate future generations of engineers [1]. *Year 2020* [5], tomorrow's graduates will contribute expertise across multiple disciplines in a global economy that is fueled by rapid technological change. From a U.S. perspective, a continuing loss of young people to other professions, a shrinking workforce, and an engineering research and development budget that is not keeping pace with the nation's needs are early warning signs that the nation's future is at stake if we fail to take action. Our leadership is destined to erode unless we act now [6-8].

Meeting these and future challenges requires a fundamental change rather than incremental improvements. We must recruit and educate engineering students and government leaders from across the country. We have repeatedly remarked that system-wide changes in engineering education must be the path to long-lasting improvements in our engineering workforce. Such changes must include: change to improve the technical fluency of our graduates, increase interest in engineering and the engineering profession, increase the size of the engineering student body, and increase the productivity of the global engineering workforce. Such changes must include: principles, methodologies, and education that continuously build innovative curricula, improve engineering practice and meet the needs of the world. Ultimately, we assert that the only way to improve our educational system, research is performed and used in the disciplines, it will allow us to be more

¹As exemplified in recent editorials in the *Journal of Engineering Education* (Kerns, 2005; Gabriele, 2005; Haghghi, 2005; Smith, 2006) and in the Special Issue devoted to Engineering Education Research (Lohmann, 2005). Also see "Envisioning a 21st Century Strategy for the United States", A report to the Government by the National Academies Press, 2005.

October 2006

II. RESEARCH AREAS

The five research areas for the new discipline of Engineering Education consist of one or more interrelated strands of research that can be investigated independently or integrated with other areas of inquiry. The research areas include:

- Engineering Epistemologies
- Engineering Learning Mechanisms
- Engineering Learning Systems
- Engineering Diversity and Inclusiveness
- Engineering Assessment

h designing assessment instruments and methods that may be unique to engineering. Research on the value systems and effective models for engineering education. For example: What deters or encourages student participation in assessment? What are extrinsic and intrinsic motivations for assessment? How does assessment fit the institution? What are the implications of assessment for change? and What are emerging communities of diverse researchers for assessment? Ultimately, we need to understand the research needed by engineering educators to develop assessment methods and tools as well as define the research to accomplish this goal.

CALL TO THE NATION

of how to educate an engineer is becoming increasingly sophisticated. Our goal for developing the new discipline of Engineering Education has been to build from our collective knowledge a roadmap for organizing our efforts for education in the dynamic world of engineering practice. This requires collaboration between academia, industry, and government. We need the necessary leadership that will help us realize our vision. Our nation needs to make the critical investments that will transform today's educational system into a paradigm for engineering education and maintain its leadership role in addressing the future.

REFERENCES

Engineering Education: A Focus on Change, The National Academy of Engineering, 1995, <http://www.nsf.gov/pubs/stis1995/>

Gathering Storm, Committee on Science, Engineering, and Technology, National Academy of Engineering, 2006, <http://www.nap.edu/catalog/11463.html>.

Engineering for the 21st Century: The Industry View, The Institution of Mechanical Engineers, 2006, http://www.raeng.org.uk/news/21st_century_report.pdf.

Future: Engineering Education into the Future, Review of Engineering Education, Australian Academy of Engineers, Australia, 1996.

Year 2020, National Academy of Engineering, 2004, <http://www.nae.org/2020>.

Industry of the U.S. Engineering Research Enterprise, National Academy of Engineering, 2004, <http://www.nae.org/industry>.

Economy: Is the United States Losing Its Competitive Edge? National Innovation Initiative Summit and Report, 2004, <http://innovateamerica.org/>

"Engineering Education Research Colloquies," *Journal of Engineering Education*, No. 4, October 2006, pp. 257-258.

INSTITUTIONALIZING A FIELD (circa 2010)

Building legitimacy for EER as a worthwhile field of endeavor

Showcasing a strong rigorous/“scientific” foundation for EER

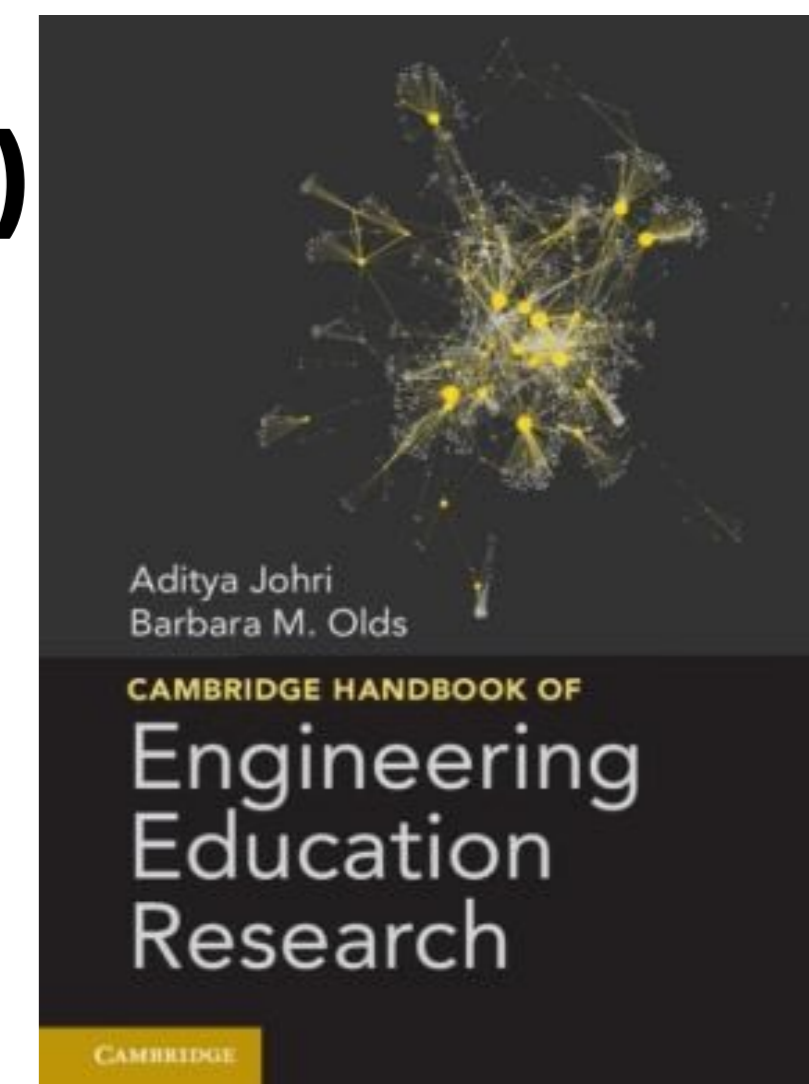
Creating recognition beyond scholarly community

Attracting new talent into the field

Forward looking and reflective (continuous process for any field)

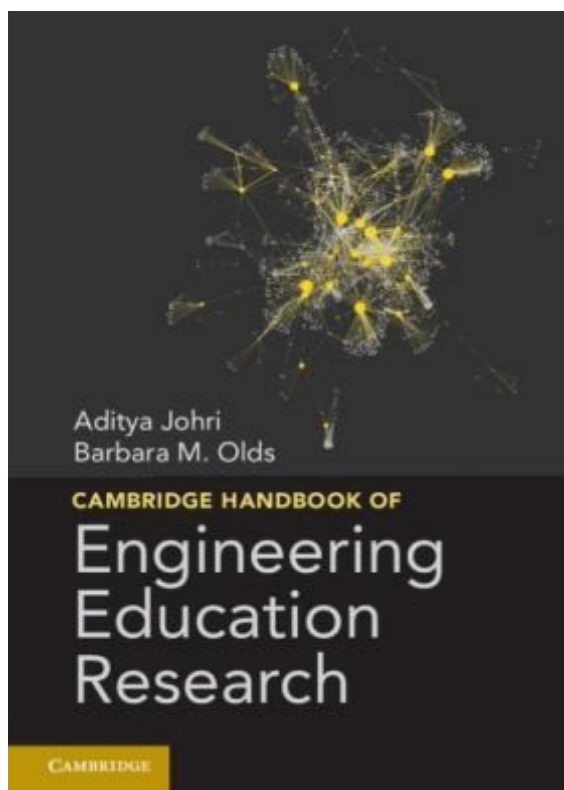
The field of Learning Sciences as a model as I was familiar with it through my graduate work (master’s and doctoral)

The Cambridge Handbook of The Learning Sciences (2005) (Ed. Sawyer)



CAMBRIDGE HANDBOOK OF ENGINEERING EDUCATION RESEARCH

70+ authors, 30+ chapters; Shaped NSF solicitation, NAE agenda, used as core volume for engineering education research courses; Best Book Award by AERA Division I (2014).



Guest Editors' Introduction

The Cambridge Handbook of Engineering Education Research and Reflections on the Future of the Field
Aditya Johri,^a Barbara M. Olds,^b
^aGeorge Mason University, ^bColorado School of Mines

Although the history of engineering education is long, starting over a century ago, engineering education research (EER) generally lacked definition as a discipline until the late 1990s and early 2000s. In a landmark issue of the *Journal of Engineering Education* in 2005, seven scholars in the field argued for a stronger theoretical and empirically driven research agenda (Hightower, 2005). Since then, engineering education has quickly emerged as a research-driven field. Subsequently, it has experienced a substantial increase in research output and has become an increasingly important field internationally as evidenced by the growing prestige and subscriber base of its key journal, the *Journal of Engineering Education*, as well as other outlets such as *Advances in Engineering Education*, the *European Journal of Engineering Education*, and the *International Journal of Engineering Education*. The strength of engineering education research and practice is also evident in the founding of Ph.D.-granting engineering education departments at several research universities and the growth of an international community of engineering education researchers who hold global meetings and increasingly collaborate with each other.

Despite the growth of the field, there was heretofore no comprehensive volume that provided an overview of the work done within EER and, more important, that reviewed the body of work that has developed within EER. The book we edited, the *Cambridge Handbook of Engineering Education Research*, published this April and already widely known as *CHEER*, aims to close this gap in the field. The only current text that comprehensively addresses some issues relevant to EER is John Heywood's *Engineering Education: Research and Development in Curriculum and Instruction* (2005). However, unlike Heywood's book that is focused on curriculum and instruction-related issues, *CHEER* focuses on recent theoretical and empirical developments in research on engineering education.

The idea for developing an edited volume emerged from conversations held in a range of venues, events, and meetings and from the personal experience of the editors and the authors, who felt that a comprehensive volume would be useful for a variety of purposes. Consequently, the editors approached Cambridge University Press (New York, NY) with a proposal for an edited volume that has resulted in *CHEER*. The authors of its chapters represent some of the leading scholars in the EER community across the world. Our goal was to publish an easily accessible volume that will be widely used by members in the field of engineering education and that will also support the needs of students, engineering faculty, and policy makers. Overall, this volume signals the maturity of the EER community—both academically and as a community of scholars.

Journal of Engineering Education © 2014 ASEE, <http://www.jeeonline.org/journal/>
July 2014, Vol. 40, No. 3, pp. 1-6 DOI: 10.1002/jee.20047

ON THE SHELF Reviewed by ROBERT TAYLOR

A CHEER FOR ENGINEERING EDUCATION
A new research collection offers provocative discussions of theory and practice.

Cambridge Handbook of Engineering Education Research, eds. Aditya Johri and Barbara M. Olds, Cambridge University Press, 2014, 743 pages.

"The growing number and strength of engineering education departments across campuses including at ASEE, the desire to be considered a separate discipline? This is one of several questions raised in the pages of the Cambridge Handbook of Engineering Education Research (CHEER). While some academics find the prospect of an academic discipline new to them, in this case, the editors have a solid rationale and both provide access to Chapter 12 that brings attention to the 'half' of engineering education and EER in which would be 'invisible' to engineering researchers and scholars." —Robert Taylor, *Journal of Engineering Education*

For readers hungry for more discussion on EER, both theoretical and practical, this volume serves as another primer. CHEER is a rich, multi-layered text that offers a wide range of perspectives on the field. It is a must-read for anyone interested in the history and development of the emerging field of engineering education research. In Chapter 1, editor Aditya Johri and Barbara M. Olds, who edited the book, provide a clear and concise overview of the field. The book is a valuable resource for anyone interested in the field of engineering education research. It is a must-read for anyone interested in the field of engineering education research. It is a must-read for anyone interested in the field of engineering education research.

367 pp., hardcover, Cambridge University Press, 2014, \$110.00, ISBN 978-0-521-87622-7

ENGINEERING EDUCATION LETTERS

Cambridge Handbook of Engineering Education Research
Donna S. Kawa^a
^aProfessor and Head, Computer Science & Engineering Department, Mississippi State University, USA, ^bResearch Scientist

Abstract
Aditya Johri and Barbara M. Olds, eds., *Cambridge Handbook of Engineering Education Research*, Cambridge University Press, 2014, ISBN 978-0-521-87622-7.

Review
The Cambridge Handbook of Engineering Education Research (CHEER) is written by a number of the most respected researchers in the field of engineering education research. It is edited by Aditya Johri from Virginia Tech and Barbara Olds of the Colorado School of Mines and NSF. Contributing authors from the gamut of big names in all aspects of engineering education research. The book begins with an overview of engineering education development by Jeffrey Fogel and Jack Lehmann. This beginning puts the material in the rest of the book into context, explaining the history of the field's development along with the major factors that have contributed to the growth of engineering education as a scientific field of inquiry. This chapter mentions, briefly, the worldwide history of the field, but concentrates primarily on its development within the United States.

The remainder of the book is divided into six sections covering important aspects of the field. At a total of over 700 pages, the book provides a great deal of information in the hands of each different aspect, the current state of the art in each area, and open research questions that still need to be answered. Each section has authors that are the current authorities in these fields and a rich bibliography that provides the background information and theories in more detail than can be covered in the text itself. I personally

National Academy of Engineering
Workshop on Pathways for Engineering Talent
Committee on Understanding the Engineering Education Workforce Continuum

Selected Background Literature

The literature items linked below are provided to give attendees from diverse communities and perspectives some basic background information on major themes and questions that will help them engage more fully in the workshop sessions. It is a short list by design, not intended to provide supporting literature for each of the workshop presentations.

1. Characteristics of Engineers and Engineering

Abt Associates Inc. (2004). Engineers in the United States: An Overview of the Profession. Engineering Workforce Project Report #2. Cambridge, MA: National Science Foundation.
This report serves as background for the data discussion the workshop will have. It analyzes data from the NSF's Scientists and Engineers Statistical Data System (SESTAT) during 1993 and 1999 and focuses on what degrees are held by those working as engineers and what areas engineering graduates are working in. The data distinguishes and compares across engineering disciplines and level of degrees held. The report demonstrates that while the majority (57%) of engineering graduates are employed in some engineering specialty, there are a number who work outside engineering jobs. The data shows that engineering

NSF / Professional Form

www.nsf.gov/pubs/2015/mf15607/mf15607.htm

NSF / Professional Form of Engineers: Revolutionizing engineering and computer science Departments (RED)

PROGRAM SOLICITATION
NSF 15-607

REPLACES DOCUMENT(S):
NSF 14-602

National Science Foundation
Directorate for Engineering
Engineering Education and Centers
Division of Electrical, Communications and Cyber Systems
Division of Chemical, Bioengineering, Environmental, and Transport Systems
Division of Advanced Cyberinfrastructure
Industrial Innovation and Partnerships

Directorate for Computer & Information Science & Engineering
Division of Computing and Communication Foundations
Division of Information & Intelligent Systems
Division of Computer and Network Systems
Division of Advanced Cyberinfrastructure

Directorate for Education & Human Resources
Division of Human Resource Development

Letter of Intent Due Date(s) (required) (due by 5 p.m. proposer's local time):
November 10, 2015

Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
December 15, 2015

PURDUE ENGINEERING EDUCATION

ENE 59500-030: Social Construction of Knowledge – Cambridge Handbook of Engineering Education Research and the EER Body of Knowledge
CRN 15463, 1-credit
Fall 2015
Wednesdays, 11:30 am 12:20 pm
ARMS 3109

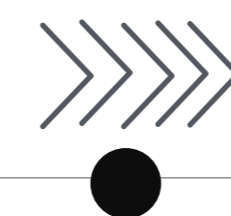
Instructors:
Dr. Ruth Szevelev (rszevelev@purdue.edu) - ARMS 1307, Office Hours: Wednesdays 1-3 pm
Dr. Michael Loui (mloui@purdue.edu) - ARMS 1331, Office Hours: TBD
Dr. Joyce Main (main@purdue.edu) - ARMS 1323, Office Hours: TBD

COURSE DESCRIPTION AND RATIONALE

The purpose of this course is to provide opportunities to socially construct knowledge around a shared topic of interest and for course participants to define and meet their own learning goals in relation to this topic. The topic for this course is the Cambridge Handbook of Engineering Education Research (CHEER) as a representation of the body of knowledge about engineering education research (EER).

Activities will involve collectively reading, discussing, critiquing, synthesizing, and communicating ideas around this topic. The focus will be on co-constructing knowledge in terms of (1) the central ideas of selected chapters in CHEER, and (2) the purpose of a "Handbook" as a representation of a field's body of knowledge. As such, the course explicitly links to the ENE Ph.D. Competencies: synthesize knowledge, communicate knowledge, create knowledge, think critically and reflectively, engage in professional development, and participate actively in a professional community.

ENGINEERING EDUCATION IN THE U.S. AND INTERNATIONALLY



1st GEN:
CENTERS

2nd GEN:
DEPTS

3rd GEN:
CENTER+


4th GEN:
DEPT EXP


5th GEN

INTERNATIONAL



Engineering Education Community Resource

last edited by  K. Yasuhara 2 weeks, 1 day ago

 Page history

This engineering education wiki is a resource created in 2011 by the [American Society for Engineering Education's Student Division \(ASEE SD\)](#), in collaboration with the [Center For Engineering Learning & Teaching \(CELT\)](#). The resource primarily consists of links to programs, centers, researchers, societies, publication venues, etc., intended to help in the exploration of engineering and, more broadly, STEM education. We hope that ultimately this wiki will encourage community members to expand this resource as a place to inform students and other interested individuals new to engineering education about the research happening in this field at institutions and centers all over the world.

FYI most site visitors do *not* need to request access to join this workspace. All site content is public. Only those interested in maintaining the wiki need to request access to join. If you want to suggest a simple addition or edit, feel free to email us (details below).

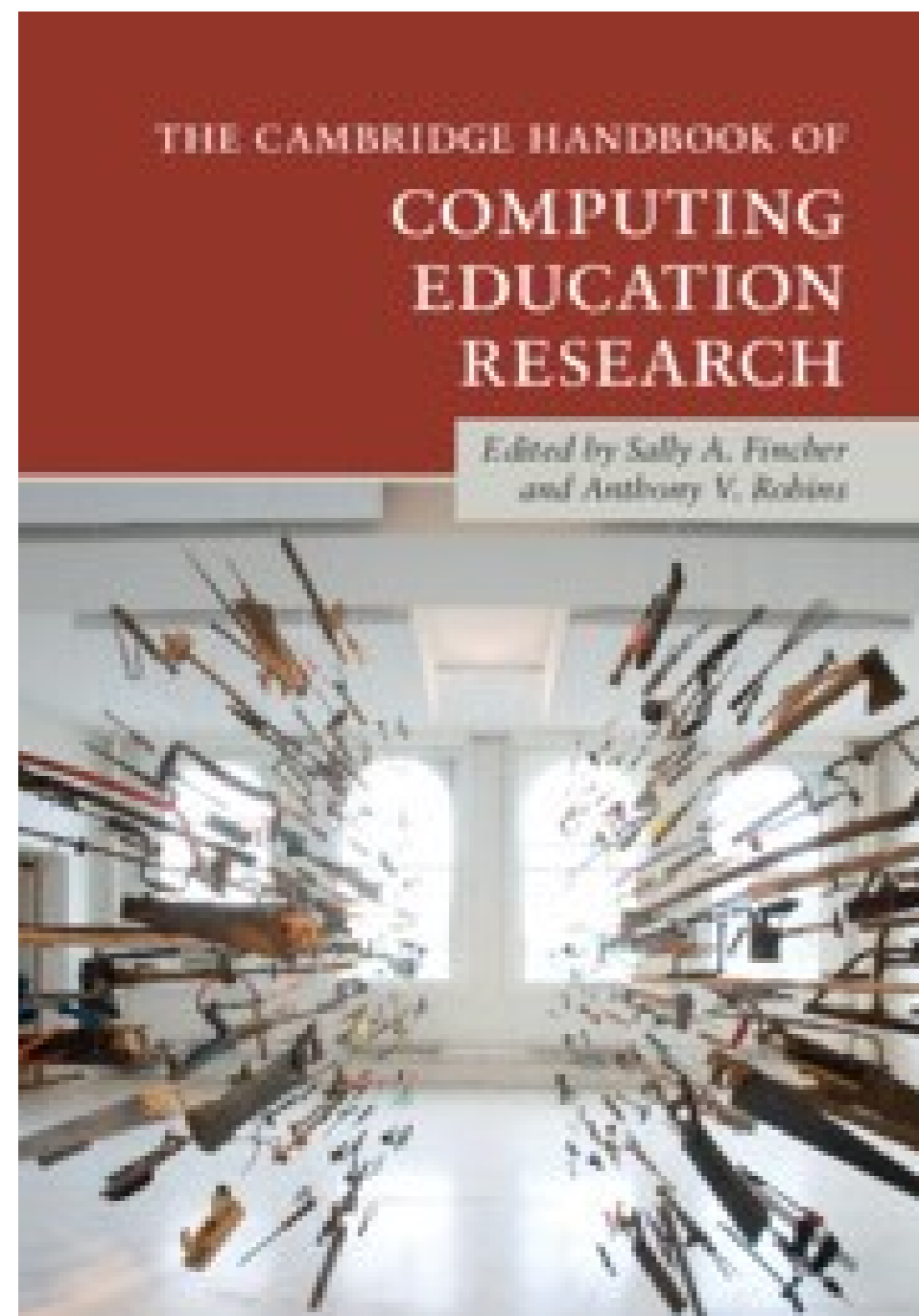
The resource currently consists of lists in the following categories:

- [Engineering/STEM Education Departments and Programs](#)
 - [Graduate level](#)
 - [Undergraduate level](#)
- [Engineering/STEM Education Centers, Institutes, and Research Groups](#)
- [Engineering Education Communities and Societies](#)
- [Engineering Education Research Publication Venues \(including Special Issues and Calls for Book Chapters\)](#)
- [Engineering Education Conferences](#)
- [Engineering Education Events \(including PhD program open houses and workshops\)](#) **(last addition: 2021/09/16)**
- [Engineering Education Accreditation Organizations](#)
- [Resources for Engineering Educators](#)
- [Engineering Education Scholarship and Funding Sources](#)
- [Engineering/STEM Education Job Postings](#) **(last addition: 2021/11/16)**
- [Research Briefs](#) - Engineering Education Podcasts
- [Domestique](#) - Support for developing NSF CAREER Proposals

These lists are works in progress. Your contributions help keep them current and complete. If you wish to add anything on this wiki, please contact the list maintainers by e-mailing engineeringeducationlist@uw.edu and providing a link to your addition (**Note: The wiki does not post files**):

[Adam Carberry](#), Associate Professor @ [Arizona State University](#).

CAMBRIDGE HANDBOOK OF COMPUTING EDUCATION RESEARCH



- Similar efforts in the field of computing education research (CER), as it moves from CSEd, a more practice-oriented community, towards a research-driven field. Changes in journals as well (what they are called and the kinds of papers they accept).
- Both EER and CER are following models from others discipline-based education research (DBER) fields such as physics and mathematics education. CER is more international in nature and CER is different than EER in that for many CER contributors, use of technology or computing for education is often a part of their disciplinary work as well.
 - Development of tools is characteristic of a lot of CER (e.g., assessment, programming).
 - Use of tools found online, such as GitHub or online communities such as StackExchange also a large component of education and learning.
- In the U.S., many scholars involved in CER come from schools of education and preK-12 related research is quite common (compared to EER).
 - Many researchers come from fields such as Learning Sciences and Cognitive Science and have been funded by NSF programs such as Cyberlearning.
- In the U.S., some new engineering education departments are “engineering and computing education” departments as the integration between the field is gaining momentum.
- What can the disciplines/fields learn from each other?

International Handbook of Engineering Education Research (IHEER/Routledge)

Update of previous handbook (Cambridge Handbook of Engineering Education Research, 2014) with new content not covered earlier; Almost a decade during the first and second volumes; work on the first started in 2010.

Open access model funded through U.S. National Science Foundation.

Rather than just research, focus also on educational practice and a lot more international than previous version as engineering education field has grown a lot across countries (it is still a little U.S. centric as it has been hard finding authors).

Around 100 authors of which 10% were authors of chapters in volume one.

Process: community-wide survey to get feedback on topics and suggested experts who could write the chapters (~150 complete/usable responses).

Conference inspired review model; 18 Associate Editors helping with the process; EasyChair for managing the process; AEs will also assist with virtual seminar/discussion of chapters through a series of talks.

The Process and Field Building

The process of putting together a volume like this, if done in the right way, is a field building exercise on its own.

It creates collaborations and a network; it brings those on the margins/periphery towards full participation.

It leads to future collaborations among contributors, many of whom have not worked together before.

Leads to new ideas that then results in new papers and projects.

Showcases field maturity to stakeholders.

Process

- Step 1: Figure out what you want to do and if you really want to do it (why?); talk to people, other scholars who have edited handbooks before.
- Step 2: Find an editor and get feedback on the overall idea (publishers' webpage, conferences, acknowledgement sections of similar books); this is a tricky thing as you don't really know the person and a lot of trust is required. Easier to trust university presses as opposed to the big ones (for me!).
- Step 2.5: Try to get a sense of authors, chapters, and abstracts before Step 3 for a smoother process but a proposal doesn't necessarily need that. Every publisher has a template they will send you (you need to be able to justify the need for a book).
- Step 3: Write the book proposal and send it to the editor who will send it out to get reviewed (this process varies but usually 5-10 reviewers are solicited through a single-blind process; reviewers, of course, know editor and proposed authors).

Process

- Step 4: Recruit authors, create a timeline, put together a system for article submission and review; this is a very time-consuming process and often the biggest bottle-neck for the editor (if you really want to do a comprehensive job; for non-handbook edited volumes you can also just invite people you know from within the community). Arrange reviewers.
- Step 5: Send authors instructions including formatting, references, indexing so that the chapter is in as good a shape as possible; try to do it from the first draft itself or there will be a lot to take care of later.
- Step 6: Set a strict timeline to complete everything and send it to the publisher (they will not start their process until everything is completed at your end); they are often likely to comeback with more changes and/or formatting issues.
- Step 7: Plan for post-publishing discussions, events, reviews, etc.; Make a list of people you'd like to send the book to who can influence its uptake.

**THANK
YOU!**

