

## **AC 2007-2681: STORYTELLING IN ENGINEERING EDUCATION**

### **Robin Adams, Purdue University**

Robin S. Adams is an Assistant Professor in the Department of Engineering Education at Purdue University. She also leads the Institute for Scholarship on Engineering Education (ISEE) as part of the Center for the Advancement of Engineering Education (CAEE). Dr. Adams received her PhD in Education, Leadership and Policy Studies from the University of Washington, a MS in Materials Science and Engineering from the University of Washington, and a BS in Mechanical Engineering from California Polytechnic State University, San Luis Obispo. Dr. Adams' research is concentrated on design cognition and learning (particularly iterative cycles in design), interdisciplinary thinking, conceptions of engineering, building capacity in engineering education research, and strategies for connecting research and practice.

### **Cheryl Allendoerfer, University of Washington**

Cheryl Allendoerfer is a Research Scientist at the Center for the Advancement for Engineering Education (CAEE), based at the University of Washington. Within CAEE, she works on the Institute for the Scholarship of Engineering Education (ISEE). She received her Ph.D. in curriculum and instruction and MA in cultural anthropology from the University of Wisconsin-Madison, and a BA in sociology/anthropology from Carleton College. Her research interests include multicultural education, identity construction, and interdisciplinarity.

### **Tori Rhoulac Smith, Howard University**

Tori Rhoulac Smith began her appointment as an Assistant Professor in the Department of Civil Engineering at Howard University in 2003. In this position, she fulfills a number of research, service, and both graduate and undergraduate course instruction roles. Dr. Rhoulac Smith's primary area of research is in traffic operations and multimodal school transportation systems. She engages not only in transportation engineering research, but regularly conducts engineering education research projects and serves as the campus coordinator for the Learning Communities for Scientific Academic Achievement (LCSAA) program at Howard, which promotes scholarly teaching and the scholarship of teaching and learning. Dr. Rhoulac Smith is a member of the Institute of Transportation Engineers (ITE), Transportation Research Board (TRB), Tau Beta Pi Engineering Honor Society, and American Society for Engineering Education (ASEE). Prior to joining the Howard faculty, Dr. Rhoulac Smith earned Master of Science and Doctor of Philosophy degrees in Civil Engineering from North Carolina State University in Raleigh, with a concentration in transportation systems. Her baccalaureate studies were completed at Howard University in the Department of Civil Engineering.

### **David Socha, University of Washington**

David Socha studies the human side of software development. He currently is Software Project Manager on the UrbanSim project, and a Lecturer at the Computer Science & Engineering department, both at the University of Washington, Seattle where he received his Ph.D. in 1991. After his Ph.D. he spent 11 years in the software industry, 6 of those managing teams of software developers, before joining UrbanSim.

### **Dawn Williams, Howard University**

Dawn G. Williams is an Assistant Professor and Master's Program Coordinator in the Department of Educational Administration and Policy at Howard University. She serves as a researcher on the longitudinal study conducted by the Center for the Advancement of Engineering Education (CAEE) as well as a team member for the Institute for Scholarship on Engineering Education (ISEE). Her primary research interests lie in K-12 educational policies targeted for urban school reform.

**Ken Yasuhara, University of Washington**

Ken Yasuhara is a Ph.D. candidate in Computer Science & Engineering at the University of Washington at Seattle and a graduate research assistant with the Center for the Advancement of Engineering Education. His interests include recruitment/retention, gender equity, and mixed-methods education research in computer science.

# Storytelling in Engineering Education

## Abstract

Storytelling has a long tradition. In education and psychology, stories support learning and cognitive development and are an inquiry method for eliciting folk knowledge. In organizational and professional settings, stories are being used to facilitate change and innovation. A common thread is that stories are an effective tool for eliciting insider knowledge, engaging communities of learners around shared practices, and building new knowledge. We have been exploring the use of storytelling in engineering education. One aspect of our work is conducting research on pathways (stories) for becoming interdisciplinary engineering education researchers. Another aspect of our work is using stories to make visible what we as a community are learning about engineering education. In 2005 we designed and implemented an interactive session at the Frontiers in Education (FIE) conference called “*Communities in Practice – What are We Learning*”. The goal of the interactive session was to make visible and shared what we as a community are learning – a form of knowledge that is typically outside the realm of public presentations and publications. We did this by creating an interactive “poster story forum” on challenges experienced in engineering education research and strategies for success. In this paper, we provide an overview on storytelling, describe our use of stories for building community in engineering education, and summarize results from the evaluation of our interactive FIE storytelling session.

## Introduction

The engineering education research community is evolving. Some evidence of this is the growth of capacity building programs such as year-long mentored or collaborative research experiences<sup>[1-4]</sup> and departments of engineering education (e.g., Purdue University, Virginia Tech). At a smaller scale are workshops and interactive sessions at engineering education conferences that focus on research skill development<sup>[5-7]</sup>. Venues for disseminating engineering education scholarship are also changing such as the recent transformation of the *Journal of Engineering Education* into the premiere journal for engineering education research<sup>[8]</sup>. Central to these changes are conversations around envisioning engineering education as a new professional discipline<sup>[9-11]</sup>. These conversations focus on such issues as frameworks for new disciplinary endeavors<sup>[12]</sup>, guidelines for rigorous research<sup>[13]</sup>, and research agendas<sup>[14]</sup>.

One challenge emerging from all these conversations is how to share what we as a community are learning about the process of conducting engineering education research, ways to make an impact on engineering education, and strategies for successfully navigating an engineering education career. As an interdisciplinary endeavor, engineering education research is evolving through practice and the community is at a point of time where this kind of focused dialogue and community building are crucial. By making knowledge visible and explicit we are helping

formulate and test emerging ideas that define us as a profession and a community – an important process for allowing standards of practice to emerge and evolve <sup>[15-17]</sup>. For example, new researchers may want to learn about ways to get started, strategies for overcoming common stumbling blocks, or ways to navigate tenure and promotion challenges; more experienced researchers may want to examine how their ideas are evolving, delve deeper into specific research issues, or how to use their research to make an impact. Common sources for accessing this kind of knowledge have been formal presentations or publications. However, these often provide only superficial accounts of the rationales behind research, career, or impact decisions. Informal situations such as meetings, conferences, brown bag sessions, gatherings at the local “water cooler”, and blogs are also places to meet and share knowledge. However, these conversations are rarely formalized and shared broadly. Some exceptions are efforts to formally support reflective practice and dialogue such as the *Annals of Research on Engineering Education* website <sup>[18]</sup>. On this website researchers may discuss such issues as formulating research questions and assessing rigor. Each of these situations plays a crucial role in promoting the long term health of engineering education as a profession.

We have been exploring the use of storytelling in engineering education. One approach has been to use storytelling and personal narratives as a guiding strategy for conducting research on pathways for becoming interdisciplinary engineering education researchers <sup>[19]</sup>. For this example, stories are a device for diagnosing and interpreting identities and identity pathways <sup>[20-21]</sup>. Another approach has been to use stories to make visible what we as a community are learning about engineering education <sup>[22]</sup>. For this example, stories are a device for providing entry for new engineering education researchers to participate in a community of practice as well as advance engineering education research as a professional endeavor. This idea was instantiated in an interactive session “*Communities in Practice – What are We Learning*” at the Frontiers in Education Conference in 2005. This was a well attended and successful workshop that has encouraged us to offer future versions.

A question guiding these activities is “what are ways to support storytelling in engineering education, and what are the benefits?” In this paper we unpack the design, rationale, and benefits of our “*Communities in Practice – What are We Learning*” session. This includes an overview on the affordances of storytelling, a description of our techniques for eliciting and sharing stories, summary results from evaluating the session, and future plans for promoting storytelling in engineering education research.

### The affordances of storytelling

Storytelling has a long tradition as a method for communicating ideas and images. As a linguistic and “transactional” activity, storytelling supports meaning making through discourse, narrative, and the process of translating private experiences into publicly negotiated forms <sup>[23-26]</sup>. As such storytelling has been associated with developmental models of learning, identity formation <sup>[21, 27]</sup>, and “folk psychology” which asserts that culturally shaped notions, stories, and narratives organize experience <sup>[28-29]</sup>. Storytelling is also associated with the methodology of oral histories and self-studies as illustrated in *The Journal of the Oral History Society* <sup>[30]</sup>. Oral histories involve the systematic collection of living people’s testimony about their own

experiences and often focus on enabling stories of people who have been hidden from history or silenced.

Storytelling is also prominent in organizational and professional settings. For example, Amsterdam and Bruner<sup>[31]</sup> investigated significant Supreme Court decisions and uncovered the ways in which “legal storytelling” plays a role in presenting and arguing cases. Steve Denning has taken the lead on bringing the tradition of storytelling to organizational settings. Drawing on his own experiences he describes how storytelling can be a highly effective strategy for igniting action, organizational change, and knowledge transfer<sup>[32-33]</sup>. Denning claims that stories are persuasive and stretch our capacity to empathize with others. Stories convey a sense of where we come from and where we are going, bring people together, and provide a way for sharing experiences. Based on his experiences he argues that storytelling enables individuals to imagine new perspectives and worlds, understand abstract ideas and implications when seen through the lens of a well-chosen story, communicate complicated ideas, and handle leadership challenges for which conventional command-and-control techniques are impotent<sup>[32, 34]</sup>. Stories can also stimulate innovation. Nussbaum et al<sup>[35]</sup> describe how innovation practices used by prominent companies have moved from Six Sigma thinking to new design strategies. At the core of these strategies are a focus on understanding consumer culture and storytelling as ways to increase chances for successful innovation.

From a pedagogical perspective, educators have use storytelling and autobiographical writing to promote a deeper understanding of personal learning processes and goals<sup>[36-38]</sup>, multicultural awareness<sup>[39]</sup>, and healthy self-concepts<sup>[40]</sup>. The motivation for many of these efforts builds on research that provides evidence for how stories are effective for reaching learners with educational messages, connecting new knowledge with lived experiences, and assimilating it within existing narratives of meaning<sup>[41]</sup>. An interesting example is described in the book *GATT-Fly*<sup>[42]</sup> which uses storytelling as a liberatory and participatory pedagogy to communicate central ideas around techniques for investigating and engaging in controversial topics. An example of storytelling in informal settings is *StoryCorps*<sup>[43]</sup>, a program on *National Public Radio* that provides ways for people to share stories and engage in public discourse.

Storytelling has also made headway into engineering education. For example, Smith<sup>[44]</sup> describes the importance of stories in teaching and learning with a particular focus on ways to use stories in engineering education. Through various examples he highlights the ways in which stories can help promote cultural literacy, learning how to listen and self-educate, forming meaning around lived experiences, and celebrate diversity. Some of these ideas are evident in the ways design educators use storytelling to develop insights about users<sup>[45-46]</sup> and how design programs such as Stanford’s d.school use storytelling as a core methodology. Turns and her colleagues<sup>[47]</sup> have developed a website to support engineering educators in addressing their own teaching challenges. On the NEXT (Narratives supporting EXcellent Teaching) website, stories serve as a device for identifying with engineering faculty in similar challenging situations and learning how they resolved them as well as guiding faculty in resolving their own teaching challenges. Similarly, Huber<sup>[48]</sup> summarized the stories of four scholars who achieved prominence in teaching in four disciplines (psychology, chemistry, mechanical engineering, english) to illustrate the ways in which individuals seek balance and connectedness when engaging in the scholarship of teaching and learning in schools for which this work may be

professionally risky. As another example, Ambrose et al <sup>[49]</sup> profiled 88 women scientists and engineers to question assumptions about engineers, engineering, and engineering careers. Stories are also being used as part of a “scholarship of impact” to create pathways for enabling impact in engineering education <sup>[50]</sup>.

These examples illustrate how eliciting and sharing stories can be incredibly effective for (1) providing pathways for building community knowledge, sharing transformative experiences, and promoting inclusiveness, (2) connecting to the human side of engineering education research, (3) illustrating successful strategies such as ways to counter resistance to reform or make an impact, and (4) supporting the process of developing and engineering education research identity.

### Storytelling in engineering education research

To take advantage of the affordances of storytelling we designed and implemented a 120 minute interactive session called “*Communities in Practice – What are We Learning?*” for the 2005 Frontiers in Education Conference in Indianapolis <sup>[22]</sup>. Our primary goals were to advance engineering education by (1) creating collaborative knowledge that can move the profession forward, (2) fostering learning and professional development within a community of practice model, (3) strengthening social networks and counteracting isolation, (4) facilitating greater coherence within the community, and (5) providing strategies for supporting reflective practice. We also wanted to provide an avenue for ISEE Scholars, who had been collaborating locally for the past year, to engage and participate in the broader national community.

TABLE 1. Interactive Session Design

Phase I (10 min)	Goals: acclimate to interactive story format and calibrate to assess existing knowledge  Format: <ul style="list-style-type: none"> <li>• What are you learning about engineering education research? Epiphanies? Challenges? Strategies?</li> <li>• Pair/Share with neighbor</li> </ul>
Phase II (10 min)	Goals: provide an overview of this session (rationale, goals, process)  Format: <ul style="list-style-type: none"> <li>• Slide presentation by session authors</li> </ul>
Phase III (45 min)	Goals: share ISEE Scholars’ stories and promote dialogue through “sticky notes”  Format: <ul style="list-style-type: none"> <li>• Poster walk</li> </ul>
Phase IV (45 min)	Goals: enable community knowledge by making it visible, shared, and explicit  Format: <ul style="list-style-type: none"> <li>• Introductions at table</li> <li>• Use story posters and sticky notes as a starting point to share stories on getting started, moving forward, dealing with challenges, finding rewards, giving advice, and being successful.</li> <li>• Assign a reporter to document “table stories” of challenges and difficulties to share with broader audience</li> </ul>
Phase V (10 min)	Goals: illustrate and summarize what we accomplished as a group and discuss future opportunities  Format: <ul style="list-style-type: none"> <li>• Presenters debrief and elicit feedback and ideas for future opportunities</li> </ul>

# the secret life of engineering education researchers

**my research...or "what this poster is about?"**  
My research questions are motivated by the growing gender gap in undergraduate computer science, especially because Professor Okamoto in the field is creating an exciting niche.

**the struggles...and strategies**  
I'm not a social scientist, not getting the background I need but have a strong passion. Some career advice and motivation are helpful, but there are limits on that, and I'd like a good idea to get advice. The real struggle is on the other side: not being fit.

**risk-taking...or "what this poster is about?"**  
There are many struggles and fun in conducting engineering education research, especially in a graduate student. Conventional presentations of research focus on theory, methods, data, analysis and implications...but what's the story behind the data?

**life before the institute**  
...or "how my research almost never happened"

**the joys**

**Finding My Research Home: Being Free to do Research My Way**  
David Socha, PhD

**What is software design?**  
How can software design be taught?

**Applied Design Research**  
Dialog, Read, Experiment, Interact

July 19, 2004 - end of day 2 of ISEE workshop  
I am unengaged. My mood had been sinking for two days. I don't want to do the qualitative research methods being taught here. "Why am I here?" wonder. "Was joining ISEE a mistake?"

What is software design?  
Is software design different from designing other things?  
Is software design different from designing other things?

**IS MY WRITING THAT BAD?**  
Understanding Technical Writing Challenges in Civil Engineering  
Tori D. Rhoulac, Ph.D. \* Department of Civil Engineering \* Howard University

**Research Results**

**ABSTRACT:**  
An engineering student really is bad at writing as they are made out to be. "What really is the problem?"

At the 2004 Summer Session, L...  
...attended with only one year of experience in academics...  
...had an interest, but no experience in engineering education research...  
...proposed research topics based on my experience in the classroom...  
...selected one topic on which to focus...  
...received invaluable feedback from others...  
...formulated the topic into a formidable research question.

Immediately After the Session, L...  
...was motivated and went right to work...  
...had my Traffic Engineering 1 students anonymously review 2 of the technical reports submitted for normal class requirements...  
...collected 11 oral reports for inclusion in the research project.

By the End of 2004, L...  
...had no more other advice than the research "best source system"...  
...completed my evaluations of the opportunity for discussion of projects with other ESE scholars...

Between the Summer and Fall of 2005, L...  
...continued active planning to complete the research...  
...solicited my evaluations of the opportunity for discussion of projects with other ESE scholars...  
...secured an industry representative to evaluate the reports...  
...analyzed the data from the student, instructor, and industry evaluations...  
...prepared for preliminary discussion of results.

**CONCLUSIONS/ LESSONS LEARNED:**  
Concerning Engineering Education Research...  
- Select A Good CP Personal Interest (provide motivation)  
- Be Sure Data Can Be Relatively Easily Collected (provide encouragement through feasibility)  
- Form A University CP/Student Schedule (meet the ISEE)  
- Regular meetings keep you on track  
- Dependable on collaboration on other projects result  
- Examples of others can be invaluable for...  
- Dependable on your research assistant  
- Regular data review (to establish long questions)  
- Dependable on your research assistant  
- Dependable on your research assistant

Concerning Technical Writing Research...  
- Develop A Personal Schedule With Deliverables (provide structure to ensure project is actually completed)  
- Lack of proficiency for student writing may be due more to lack of conceptual knowledge than to lack of skill in writing mechanics  
- Instructions may need to be "grade harder" where grammar and syntax are concerned  
- Many students are prepared by their graduating year to meet multiple writing expectations.

FIGURE 1. Examples of story posters (clockwise from left: Ken Yasuhara, David Socha, and Tori Rhoulac Smith) [51].

The implementation strategy involved using storytelling techniques over 5 phases of activity (see Table 1). To start the dialogue and anchor the session, six story posters were provided by 8 Scholars of the 2004 Institute for Scholarship on Engineering Education (ISEE) [51]. The content of the posters focused on sharing insider knowledge regarding driving passions and goals, processes such as getting started and moving forward, difficulties experienced and ways to overcome them, and what they were learning about research. Although formats differed (see Figure 1), posters featured stories of engineering education research experiences such as the “dirty details” of designing and conducting research, building research community, designing effective learning environments, and bridging engineering and education perspectives. These story posters (1) provided an anchor for session activities, (2) functioned as an interactive space for

promoting dialogue by inviting the audience into the ISEE Scholars' private worlds (Phase III in Table 1), (3) modeled strategies for eliciting stories from the audience participants as well as the kinds of stories that could be shared more publicly (Phase IV in Table 1), and (4) leveraged what has become an ISEE practice of using posters to create public spaces for feedback and dialogue around designing research studies [1-3].

The first two session phases (Phases I and II) served to acclimate the audience to the idea of story posters and the ways in which storytelling can help advance engineering education. First, we asked participants to reflect for a couple of minutes on what they've been learning about engineering education research. Then we asked participants to turn to a neighbor and share aspects of their "story". This was followed by a mini presentation describing the session goals and activities. For Phase III we conducted a "story poster walk" where the audience was invited to visit the ISEE Scholars' story posters and to use sticky notes to place comments, questions, or reflections on the posters themselves (see Figure 2). Comments on the sticky notes ranged from asking for more kinds of information (e.g., "What do you mean by this?") to associative statements (e.g., "I did this, too!") to sharing new knowledge (e.g., "I tried something like this and found another way that worked better...").



FIGURE 2. Example result from story poster walk (Tori Rhoulac).



Following the story poster walk, participants were encouraged to select a poster that would serve to anchor discussions around stories of engineering education research – both those of the ISEE Scholars and of the participants (see Phase IV). Therefore, the story posters supported a two-way exchange of ideas by first modeling the concept of sharing stories, and then engaging others to share their own stories. Participants at each table were given a list of prompts to help them elicit and explore their own stories such as: how does your story fit with your passion? What kinds of difficulties have you experienced and how did you deal with them? What advice would you give? During this period, participants at each story poster table were asked to document their discussions to share them with the broader audience. A particular focus was on identifying challenges, strategies, advice, and epiphanies. In the paragraphs below we provide examples of what happened at the tables for the posters referenced in Figure 1. Data presented in these examples are drawn from the “report out” notes, the content of the sticky notes posted on the posters, and reflection stories Scholars wrote after the session completed.

At Ken Yasuhara’s table, his poster entitled “The celebrated life of engineering education researchers” resonated with many of the attendees and provided a trigger for sharing experiences around becoming engineering education researchers (see summary in Table 2). One kind of story that emerged involved how people (both within and outside of engineering education research) can confuse engineering education research with “doing more teaching” or “teaching better” – rather than distinguishing them as unique (though intimately related) activities. One person at the table shared their struggles with how there were “tons of books on qualitative methods, educational psychology, etc.” but far fewer on how to successfully navigate academic career pathways as an engineering education researcher. Another shared a story that suggested a direct connection between navigating careers and “the essence of community”, and how those less-discussed struggles often prompt communities to form in order to “provide mutual support, empathy, and guidance.” The group also discussed what could be learned from successes in other disciplines such as ways to adapt research methods from other disciplines and ways to gain legitimacy. As a group, those at the table came to realize the importance of choosing research questions that “matter to teachers, the wealthy, the powerful, students” and envisioning engineering education research “with impact beyond local contexts, not just doing it for its own sake.” This led to co-developing strategies around choosing research questions as well as publishing findings in such a way that their relevance is clear to those who can leverage the practical implications (e.g., “connecting questions and findings directly to teaching practices or producing generalizable findings with implications beyond the local, studied context”).

The issue of legitimacy prompted sharing other kinds of stories and triggered conversations regarding arguments that might be effective in convincing traditional engineering faculty to understand and respect engineering education research. For example, one person shared a story of how an engineering faculty member negatively critiqued a graduate student’s dissertation on education-related work, which prompted a discussion on the importance of building and maintaining “community momentum” within engineering education research. As a group they could identify individuals at every level of the “academic pecking order (from non-tenure track instructors and junior faculty all the way up to deans, presidents, and national leaders)” that could play a role in increasing the legitimacy of engineering education research. Tenured faculty were believed to be especially well-positioned to effect change, for example by openly advocating engineering education research efforts in tenure and promotion meetings. At the

same time some in the group voiced concerns over singling out tenured faculty out as being particularly obligated to lead the effort and noted that some of these tenured faculty are experiencing their own challenges of reinventing themselves as engineering education researchers. At one point the discussion turned to the question of whether an increase in enrollment could enable or even motivate departments to create more opportunities for faculty to pursue interests in teaching and learning. Another person wondered where these new faculty would come from, at least until program like Purdue’s are replicated. A final outcome of sharing stories was changing the title of Ken’s poster to “The celebrated life of engineering education researchers (We can dream)!”

TABLE 2. Example Story Debrief (provided by Ken Yasuhara)

- |   |
|---|
| <ul style="list-style-type: none"> <li>• Confusing engineering education research with doing more teaching or teaching better</li> <li>• “The real struggles are the ones that there are no books for.”</li> <li>• Learning from successes in other disciplines</li> <li>• Choosing research questions that matter to teachers, the wealthy, the powerful, students; envisioning engineering education research with impact beyond the local context, not just doing it for its own sake</li> <li>• Community momentum: Tenured faculty need to change promotion and tenure criteria?</li> <li>• For whom is it “safe” to do engineering education research? Post-tenure faculty who reinvent themselves after careers built on traditional research?</li> <li>• Good education → more students → more \$ for departments → more positions for faculty with education interests...but where are the candidates?</li> <li>• Better students → faculty happier with teaching them an informed, detailed vision of how engineering education can be improved</li> <li>• Ways of motivating engineering departments to value engineering education research: <ul style="list-style-type: none"> <li>○ Engineering education research → ... more efficient teaching → more time for research (be it traditional or otherwise)</li> <li>○ More students enrolled in engineering → more revenue</li> </ul> </li> </ul> |
|---|

At David’s table (“Finding my research home: Being free to do research my way”) stories were triggered by the idea of “finding home.” Through sharing stories they came to realize how intentional they were in their behavior to seek dialogue with those “who care about what we are doing” and to respect “differences and different points of view.” One person shared his story about how finding a home was finding a way to think about scholarly approaches to understanding engineering teaching and learning that acknowledged his preference for working at the interface between research and practice and teaching – a kind of “play” that is “not just an activity, it’s a state of mind that brings new energy and sparks creativity.” One challenge shared about engineering education research was managing the tension between appreciating qualitative approaches that can have power and deep meaning and worrying “whether the results will be accepted by those who have not had your epiphany.” For this person, it helped if you “can think of ways to frame your work so that it’s relatable to others with different points of view.”

For this group, discourse and reflective practice were central. On a piece of paper they wrote: “research process ← → learning process” where the goal is to keep “designing and be open to new possibilities, feedback, learning, innovation, service, etc.” There was a shared sense that storytelling can play an essential role in “documenting feelings and attitudes, and not just technical activities” and helping you to think and innovate by “shift(ing) people’s stories.” There was also storytelling around efforts to understand engineering education as a system. The system description they shared with the larger group included a high inertia to change, teaching practices that were detrimental to learning, a reward system that works against good teaching in

practice, and an orientation towards change that was in contrast to industry. By the end of the session they created a model of the ecosystem of engineering education research that included a wide range of groups with different values that unfortunately may not interact frequently. These groups included engineering educators, engineering education researchers, industry folk, students, K-12 students, and the broader public interested in improving innovation.

At some tables, challenges, strategies, and epiphanies focused on particular research topics. For example, at Tori Rhoulac's table the focus was on a shared passion about the technical writing skills of engineering students. When reflecting on the conversation at the table, Tori described the story poster ("Is my writing that bad?") as a forum for exchanging personal experiences, both positive and negative, around teaching technical writing, observing student writing challenges, and ways for developing writing skills. As a group they came to understand that competency in technical writing is difficult for all students (undergraduate and graduate) and is a particularly important challenge for engineering education. Through sharing stories they came to realize that one part of the problem is that many campuses do not provide the necessary resources to prepare students to communicate clearly in their future careers, and that many remedies are often ad hoc or vary from class to class. They discussed how the assign-collect-grade approach can be frustrating for students because it doesn't give students the opportunity to receive feedback prior to grading or to see examples of "good writing" prior to submission of assignments. The group also considered how students are getting mixed messages about technical writing competency as syntax (grammar and mechanics) is often ignored in grading, as instructors consider only technical content. What became clear to this group was that "freshman English is not the 'be all and end all' for language competence", that "students must learn, relearn, and unlearn until their senior year as part of a continuous process", and that "there is a need to change the culture concerning the importance of technical writing and engineering education research."

The benefits of storytelling were also realized at Tori's table as opportunities to conduct collaborative, technical writing research between universities were discussed. The development of community around this engineering education research topic was also apparent in the sharing of resources and exchange of contact information for continued dialogue.

At the end of Phase V, we asked people to share stories from their table with the broader audience. Some story themes were common across tables such as the challenges and strategies for navigating new vocabulary, ideas, and techniques. Other stories were more personal epiphanies that seemed to resonate with others in the audience. Some examples of these include "formulating questions IS research", "doing this is like going through a second PhD process", and "at what point to you stop studying it and do something about it?" Finally, the presenters brought the session to a close and asked for feedback on the session and ideas for future opportunities.

What are affordances of storytelling in engineering education?

Observations during the session suggest that storytelling is an effective mechanism for building community and shared knowledge in engineering education research. The session had the highest attendance across all the FIE interactive sessions for that year, and the volume in the

room could be heard down the hallways. About 50-60 people participated in the session, and approximately half of these were women. Based on the e-mail addresses provided, participants came from all regions of the United States and some came from other countries such as Sweden. The content of the discussion debriefs (see example in Table 2) suggest that our storytelling approach was effective for engaging people in discussions and producing collective knowledge around engineering education research. In addition, the ISEE Scholars commented that they found the session very energizing and affirming, and were interested in building on this idea for the future.

The session was formally evaluated by the ERM division. This involved a written evaluation form that included closed and open ended questions regarding how audience participants experienced the session. Closed-ended questions were on a 4 point scale (very high, high, average, low) that rated (1) quality of session, (2) importance of topic, and (3) good use of time. Open-ended questions focused on the ways in which the session was interactive or used novel approaches, what was learned, opportunities for improvement, and suggestions for future steps. Although more than 50 people participated in the session, only 39 evaluations were completed. A summary of the closed-ended evaluation responses are provided in Table 3. As shown here, the session was highly rated which substantiated some of our observations.

TABLE 3. Closed-ended evaluation question results (N=39)

	<b>Very High</b>	<b>High</b>	<b>Average</b>	<b>Low</b>
Q1: Quality of Session	66% (25)	29% (11)	5% (2)	-
Q2: Importance of topic	72% (28)	23% (9)	5% (2)	-
Q3: Good use of your time	69% (27)	23% (9)	8% (3)	-

Themes from the open-ended questions were analyzed in terms of the following session goals (1) creating collaborative knowledge, (2) fostering professional development and learning, (3) building networks and community, and (4) providing strategies for reflective practice. The following paragraphs highlight participants’ comments and suggest that the session design was effective in meeting intended goals.

Creating collaborative knowledge: The group debriefs illustrate that one of the session outcomes was collective knowledge around engineering education research and specific research endeavors. In the evaluation form, participants talked about how stories were effective for centering and organizing discussion “on the process rather than results”, as “catalysts for looking at big issues in engineering education”, and promoting dialogue in a “collaborative public space”. One participant stated their appreciation of the personal disclosure of private information and the potential risks involved. Participants also commented on how the variety of research illustrated in the story posters session set up new insights on teaching and research and the value of discussing “research questions with other interested folks” and “listening to others’ perspectives.” Some commented on the opportunities the session afforded such as providing “feedback to researchers on work in progress” and “building knowledge through sharing stories & constructing new knowledge.”

Fostering professional development and learning: Most participants commented on the highly interactive nature of the session – such as “truly interactive – great discussion at my table about

an issue I am really passionate about” and “active and interactive.” Participants also described how the activities promoted opportunities for learning. Some commented on the opportunity to “pick a topic (one of six posters) and have an in depth session around the topic”, and others commented on the flexibility of the session such that they could “dig in” on a personal interest and “process ideas about that one within an adhoc micro-community.” Many talked about the richness of the conversations (“there was a rich dialogue”) and the “progressive group interaction” which allowed “opportunity to benefit from the experiences of others through small-group discussion.” Throughout many of these comments was a realization that storytelling allowed “making the personal, public”.

Building networks and community: Networking and community were frequently observed in the participants’ comments and often this illustrated how participants valued the importance of community building. Some comments focused on the value of connecting with like-minded people around personally important issues: “it’s nice to connect with people who are interested in the same issues of engineering education”, “focus groups...like-minded people”, “good way to network with others in the field.” Others commented on the value of meeting new people: it’s “great to get up close & personal with ‘new’ engineering education researchers” and appreciating “discussions and opportunities to meet engineering educators around the nation.” Some comments suggested that the session functioned in a way that many conference participants expect of the conference itself: “very interactive, talking about community and also building it ☺” and “plenty of time for the kinds of conversations that usually take place in conference hallways”. Anecdotal data from conversations with participants after the session suggests there may be some truth in this observation. In particular a number of participants commented on how the session provided an experience they’d been looking for at this conference – more formal community building activities.

Providing strategies for reflective practice: Many participants commented on the self-reflective properties of storytelling, and storytelling as a pedagogical strategy. For example, one person commented on the process of “going around to posters, reading others’ sticky notes, and writing notes of my own...It’s a very affirming process and also one that promote critical thinking and reflection.” Others commented on how stories created an “open dialogue about the struggle of engineering education research” and how stories “make[s] you think outside of the box.” A number of participants commented on how stories were effective for getting at insider knowledge and promoting feedback. For example, one person commented on “the power of posters as a mechanism for sharing stories and gathering feedback”, and another commented on how the posters got “behind the scenes.” Some even commented on the benefits they’ve experienced using posters in their own teaching and the insights gained “about different ways to use posters for teaching and learning.” One person commented that the session could be improved by providing a set of instructions for others to use storytelling techniques.

Participants also commented on areas for improvement and ideas for taking storytelling into the future. Many of the suggestions speak to the realities of learning from the first implementation of an idea such as better facilitation of the discussions, providing more time and space for discussion, using technology more effectively, and having the opportunity to join more than one discussion. A few participants desired a greater focus on the community of practice question. Regarding future efforts, many called for more community building efforts and finding ways to

help people stay in touch and collaborate. One person thought the format might be useful for reporting “upward” to administrators and funding agencies. Finally, at least one participant requested that we publish the method and the usefulness of storytelling in engineering education, and others requested that we hold another session.

## Discussion and future work

There are many affordances to storytelling. Prior work has illustrated that storytelling plays an important role in learning, meaning making, facilitating change and innovation, and effective pedagogy. For new engineering educators, storytelling can provide an important pathway into a community of practice, access to community knowledge, and opportunities to co-construct community knowledge. As such, an underlying premise of this paper is the value of using storytelling in engineering education to make explicit knowledge that can advance engineering education as a profession. We described one example of storytelling - interactive story posters - as a pedagogy that focused on building community and intellectual capacity in engineering education research. Evaluation results suggest both a need for and the value of a community of practice storytelling forum for sharing stories about the challenges and strategies of navigating engineering education research and careers. Perhaps the most valuable lesson learned is the extent to which participants wanted to share and hear stories – and that this was not something generally experienced at engineering education conferences. This is a sentiment that also emerged during another workshop on engineering education research<sup>[52]</sup>. This need for community is also emerging in preliminary research on pathways for becoming engineering education researchers<sup>[19]</sup>. Simply put – our stories matter – and storytelling provides a vehicle for scholarly discourse that makes explicit our implicit knowledge, promotes reflective practice, and provides entry points into a community of practice.

As illustrated through our interactive session, the process of sharing and co-creating new stories is relatively straightforward. One skill involves eliciting stories. This is a process that is surprisingly similar to any interviewing process. Useful elicitation questions include: how did you get started, what difficulties have you experienced and how did you deal with them, what did you find rewarding, what has surprised you, and what advice might you give? Other guides for eliciting stories may include resources for uncovering oral histories<sup>[53]</sup>. Another skill involves telling stories. Because stories are very personal, it may be useful to start off with sharing your story with someone you trust who is a generous listener. However, it may be difficult to articulate your own story. Here, the elicitation questions above may be “turned inward” as a way of accessing your own insights in a way that facilitates a process of reflective practice<sup>[55-56]</sup>. Images or ideas that have influenced your thinking can also be ways to access stories that may be so internalized that they are difficult to share. There are also guides and resources that may be useful for learning how to tell your own story<sup>[34, 37]</sup>. A final skill involves discourse practices such as learning how to listen, how to understand different points of view, how to communicate across different points of view, and how to look for connections across perspectives.

Given the success of this experience, we are planning on taking the storytelling idea forward and hope that others will be motivated to build on the ideas presented in this paper. We will be running another interactive session at the 2007 Frontiers in Education Conference<sup>[54]</sup> that builds

on the success of this experience but focuses on what we are learning about investigating issues of diversity and the global engineer. We look forward to seeing more examples of storytelling in engineering education!

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