Enhancing Engineering Education Research Capacity through Building a Community of Practice

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Abstract

This paper focuses on the NSF-funded Rigorous Research in Engineering Education (RREE) workshops and how the Community of Practice (CoP) model of Wenger, McDermott, and Snyder was used to create a partnership that produced the RREE workshops. Specifically, the paper will discuss how organizational partnerships were formed, how the RREE workshops were structured to promote a CoP among workshop participants, and implications of this work for others who would like to use the CoP model to expand their own communities.

Introduction

Calls for embracing more rigorous research in engineering education are emerging with increasing frequency. For example, the Journal of Engineering Education is repositioning itself as an archival journal for scholarly research in engineering education [1]. The journal now provides a forum for reporting on research that meets criteria such as those set forth by Diamond and Adam [2] and updated by Diamond [3]:

1. Requires a high level of discipline-related expertise
2. Is conducted in a scholarly manner with clear goals, adequate preparation, and appropriate methodology
3. Is appropriately and effectively documented and includes a reflective critique that addresses the significance of the work, the process used, and what was learned
4. Has significance beyond the individual context
5. Breaks new ground or is innovative
6. Can be replicated or elaborated upon
7. Is judged to be meritorious and significant by a rigorous peer review process.

In response to calls such as this and the urgent need for rigorous engineering education research conducted by engineering faculty knowledgeable about the state-of-the-art in education research methods, the National Science Foundation has funded "Rigorous Research in Engineering Education: Creating a Community of Practice" (DUE-0341127). The goals of this project are to:

- Create and present workshops for engineering faculty on conducting rigorous research in engineering education. Five-day workshops are held in Golden, Colorado each summer from 2004 through 2006 to train faculty participants. For more details see the project website [4].
- Sustain the development of this project through establishing a community of practice. The foundation for this aspect of the project is the work of Wenger and his colleagues. [5, 6]

Furthermore, we aim to collaborate with projects and initiatives that have similar goals, such as:

- Center for the Advancement of Engineering Education (CAEE) Scholarship on Engineering Education Institutes

- Center for the Advancement of Engineering Education (CASEE) Annals of Research on Engineering Education (AREE)
- Departments of Engineering Education
  - Purdue – Department of Engineering Education
  - Virginia Polytechnic University – Department of Engineering Education
  - Utah State University – Department of Engineering and Technology Education

The RREE workshops are positioned to assist in building engineering education research capacity in the engineering faculty community. More rigorous engineering education research is being called for by many national reports and commissions, including the National Research Council (NRC) reports "How People Learn" [7] and "Scientific Research in Education" [8].

A unique aspect of the Rigorous Research in Engineering Education (RREE) workshops is that they establish a structure and mechanism for training faculty to conduct rigorous engineering education research through a collaboration of engineering educators, learning scientists, and faculty developers (those who assist faculty enhance their teaching). The collaboration is a result of partnerships between three groups who could be considered, in Wenger's words, to be "intellectual neighbors":

- **Engineering educators** (the American Society for Engineering Education [9] – the lead on this project),
- **Learning scientists** (specifically the Education in the Professions Division of the American Educational Research Association [10]), and
- **Faculty developers** in higher education (the Professional and Organizational (POD) Network in Higher Education.[11])

During the RREE workshop, participants work on a research question and research plan. The deliverable of the workshop is a draft of a small-scale research plan. This plan is to be refined and carried out (with the help of a research mentor) during the following academic year. For more detailed information about the content of the workshop please see the project webpage [4].

This project is aimed at strengthening the base on the cyclic model of the relationship between knowledge production and improvement of practice in STEM education (See "Mathematical Proficiency for All Students" [12]). That is, it is focused on helping faculty conduct research on student learning and teaching practices, which we expect will lead to new educational materials and teaching strategies.

The paper uses Wenger, McDermott and Snyder's model of a community of practice (CoP) [5] to describe (1) how this collaboration arose, (2) how the RREE workshops were structured to create a community of practice, and (3) implications of this work for others who might want to build other communities of practice. The CoP approach is being embraced by many organizations, including for example, the American Association of Higher Education, and is receiving increased web support [13].

The Community of Practice Model

Wenger et al. define a Community of Practice (CoP) as a unique combination of three fundamental elements: a *domain* of knowledge which is defined by a set of issues; a *community* of people who care about this domain; and the shared *practice* that they are developing to be effective in their domain [6, p. 27].

We propose that the engineering education research community is a community that is still forming. Clearly, there is a growing group of people who care about engineering education research. We see the domain of knowledge in engineering education as ripe for rapid expansion. Knowledge about how people learn engineering (and about how people learn, in general) and about best practices in educational research, are areas that would benefit by more contact with educational researchers in other arenas. One of the desired outcomes of this project is the opportunity for practicing engineers to make professional connections with education researchers and with faculty development professionals.

Wenger et al. also describe the structure of a CoP (See Figure 1). A core community (often with a community coordinator, who helps to keep the "plates spinning") is composed of those who are most active in the community. Active members (who participate in a variety of activities) are also part of the community as are peripheral members (who we have called "affiliated") who occasionally participate. There are also "outsiders" who are not yet part of the community.

Our project made use of the CoP structure by (1) determining groups that might not be within the Engineering Education CoP but have much to contribute to this community, (2) contacting the core groups of these potential "partners" and finally (3) creating a new core group, containing members of the partner groups. How these connections came about will be further explained in the next two sections of this paper.

Finding "partner" organizations: How these collaborations arose

How does one "find" organizations that are not now linked to the CoP, but would be beneficial additions to the community? This process begins by the willingness of members of the initial CoP to be "boundary crossers" and join other organizations. In our case, all of the three authors were already members of at least one of the proposed partner organization (ASEE and AERA). And two of the authors were members of all three communities (ASEE, AERA, and POD).

Once these partner communities or organizations have been identified, then discussions can begin with the respective core group(s). The core group is generally the governing body (elected officers and board members, and executive committee members.) These discussions begin very informally, and may require years to fully establish. It is useful for these discussions to be focused on the creation of a common task. In this case the discussion was centered around the joint creation of workshops on engineering education research (which eventually became the RREE workshops). Buy-in from the core groups of the partner communities is essential, and therefore the project must be viewed as benefiting not only the initial CoP, but the partner groups as well.

For the RREE workshops, the core groups involved were the President of ASEE and the Board of Officers of the Education and Research Methods (ERM) Division of ASEE, the Executive Committee of AERA Division I (Professions Education), and the Executive Committee and Core Committee of POD. Initial discussion of this project began with the ERM core group in 2001, and discussion with AERA and POD began in early 2002. This advance work was needed for the RREE workshops that were launched in August 2004.

As one can see, advance work in this phase is lengthy due to the time between opportunities for face-to-face meetings (which usually occur at annual meetings or conferences) and the time needed for organizations to make decisions. But the time spent is well worth the effort as powerful partnerships can be created.

Once the connections between organizations were made, there were also efforts to create events that would allow for further mixing of groups. Lave and Wenger [5] state the need for "old-timers" in a community to welcome and mentor the "newcomers". ASEE already has events like the new educators' event, and the ERM Brouhaha. Likewise, POD also has a "newcomers" event during the first evening of their annual conference. In AERA Division I, the Division Vice President's reception was re-caste as a way for newcomers to meet the established core group in an informal setting.

Connections between organizations can also be further by links between organizational websites, information about the other organizations in organization publications, and special sessions (of presentations) at the respective conferences.

How the RREE workshops were structured to create a Community of Practice

When connections between the core groups of the three organizations (ASEE, AERA, and POD) had been established, mechanisms needed to be created that would maintaining the links between organizations, and would allow input on the RREE workshops from all three organizations. The mechanism that was created was the formation of a new executive committee for the RREE that would have members from ASEE, AERA, and POD. The RREE workshops were also structured so that a team of facilitators would present the workshops. The team consists of at least one member from ASEE, at least one from AERA, and at least one from POD.

Up until now we have been concentrating on the way the organizations came together to form a newly expanded engineering education research CoP. However, a very critical outcome of the RREE is that the workshop participants also become members of this new CoP. In order to facilitate the creation of a CoP among workshop participants, the RREE workshops are structured so that they contain several important features. Wenger et al., stress the need for members of a community to have a variety of informal spaces where they can meet in ad hoc pairs or small groups for further discussion. To further this aim, a workshop location was selected that allows for small group exercise and reflection (the hotel is located next to a stream and bike/walking path) and there was time scheduled in the middle of the day for assimilation and reflection, and unstructured discussion. A reception kicked off the event on Sunday evening. And daily common meals (breakfast, lunch and dinner) kept the interaction flowing. The

workshop room was set up with round tables, so that participants would sit with (changing) groups during the workshop. The workshop itself was designed to be very interactive.

Two optional "field trips" also allowed for more informal group time. A group of participants toured a nearby facility over the noon-hour one day, and about 20 participants attended an evening baseball game.

The deliverable at the end of the five-day workshop is an individual engineering education research plan from each participant. Later in the project participants are paired with mentors who will help guide them through the research process and keep them connected to the CoP. The mentors are members of all three partner organizations (ASEE, AERA, and POD).

Implications

We end with some recommendations for those who may want to use the Community of Practice model to further their own communities.

- As Lave and Wenger point out, the "core" or "active" members of a community have a tendency to become rather insular and "inbred." The commonly lamented phenomenon of "preaching to the choir" results when the active members of a community are not refreshed by those from the affiliated ranks, or even from "outsiders" who are not yet members of the community. To refresh the community, it is important to be looking for other groups who are potential intellectual partners. Members of this group can then become vital new blood for the CoP.

- Once potential partners have been identified, begin discussions with the core group of the partner(s). Find a common task or project that will benefit both the existed CoP and the partners who will enter the community.

- In order to keep the energy and membership flowing between all the organizations, create mechanisms to welcome and mentor "newcomers." These mechanisms are likely to be in part informational (such as webpages or organization publications) as well as social (welcoming events and special sessions at conferences and annual meetings.)

- Although the time and effort required to forge and maintain new partnerships is considerable, it allows for a vital, diverse community. Forming new partnerships also allows for the effects of the new CoP to be widely disseminated and have a broad impact. The benefits of expanding CoPs are well worth the cost in time and energy.

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Biosketches

RUTH A. STREVELER is the Director of the Center for Engineering Education at the Colorado School of Mines and Associate Research Professor in Academic Affairs. Dr. Streveler received her Ph.D. in Educational Psychology from the University of Hawaii at Manoa. She also holds a Master of Science in Zoology from the Ohio State University and a Bachelor of Arts in Biology from Indiana University at Bloomington. She is co-principle investigator of three NSF-sponsored projects: *Developing an Outcomes Assessment Instrument for Identifying Engineering Student Misconceptions in Thermal and Transport Sciences* (DUE - 0127806), *Center for the Advancement of Engineering Education* (ESI-0227558), and *Rigorous Research in Engineering Education: Creating a Community of Practice* (DUE-0341127).

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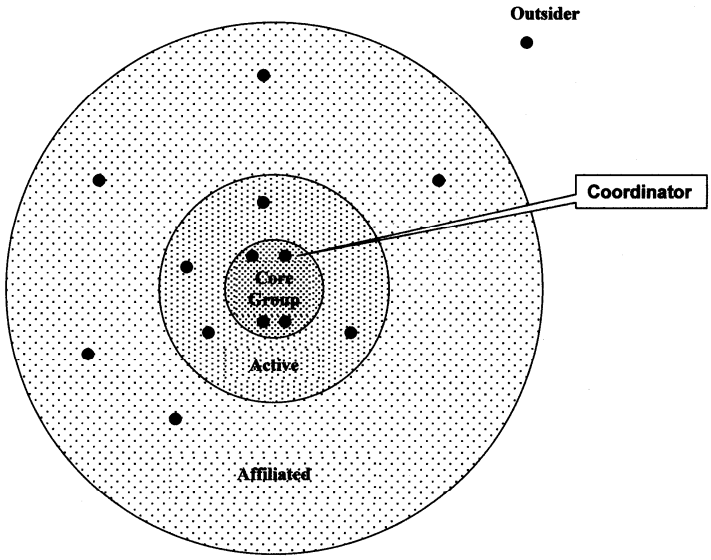

Figure 1. Structure of a Community of Practice (adapted from Wenger et al., [6, p. 57])