

## **Professional Engineering Pathways Study: The Value of a Community of Practice to Stimulate Use of Research Findings that Inform Practice**

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Cheryl Carrico is a part-time faculty Research Scientist for Virginia Tech and owner of Cheryl Carrico Consulting, LLC. Her current research focus relates to STEM career pathways (K-12 through early career) and conceptual understanding of core engineering principles. She is currently a Member-at-Large for the Pre-college Division of ASEE. Dr. Carrico's consulting company specializes in research evaluations and industry consulting. Dr. Carrico received her B.S. in chemical engineering from Virginia Tech, Masters of Engineering from North Carolina State University, MBA from King University, and PhD in Engineering Education from Virginia Tech. Dr. Carrico is a certified project management professional (PMP) and licensed professional engineer (P.E.).

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Dr. Matusovich is an Associate Professor in Virginia Tech's Department of Engineering Education. She has her doctorate in Engineering Education and her strengths include qualitative and mixed methods research study design and implementation. She is/was PI/Co-PI on 10 funded research projects including a CAREER grant. She has won several Virginia Tech awards including a Dean's Award for Outstanding New Faculty. Her research expertise includes using motivation and related frameworks to study student engagement in learning, recruitment and retention in engineering programs and careers, faculty teaching practices and intersections of motivation and learning strategies.

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Sheri D. Sheppard, Ph.D., P.E., is professor of Mechanical Engineering at Stanford University. Besides teaching both undergraduate and graduate design and education related classes at Stanford University, she conducts research on engineering education and work-practices, and applied finite element analysis. From 1999-2008 she served as a Senior Scholar at the Carnegie Foundation for the Advancement of Teaching, leading the Foundation's engineering study (as reported in *Educating Engineers: Designing for the Future of the Field*). In addition, in 2011 Dr. Sheppard was named as co-PI of a national NSF innovation center (Epicenter), and leads an NSF program at Stanford on summer research experiences for high school teachers. Her industry experiences includes engineering positions at Detroit's "Big Three:" Ford Motor Company, General Motors Corporation, and Chrysler Corporation.

At Stanford she has served a chair of the faculty senate, and recently served as Associate Vice Provost for Graduate Education.

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## **Abstract**

This paper provides an example of how an NSF-funded project, Professional Engineering Pathways Study [EEC-1360665, 1360956, and 1360958] or PEPS has incorporated a community of practice approach to disseminate the use of evidence-based decisions to design activities that assist engineering students in making career choices. The paper will discuss the elements of a community of practice, how it has been used in PEPS, and how other projects might use this approach to bring about other kinds of change.

Key words: Community of practice, educational reform

## **Introduction**

Whether we are trying to scale up an innovative teaching practice or inform instruction with our research, we all want others to adopt what we have found to be useful or instructive.

However, more often than not, we are frustrated because our ideas are not adopted. We know we need to go beyond presenting papers to change behaviors and long-held habits. But what other avenues are available to us? This paper aims to fill this gap, by presenting the idea of using a Community of Practice (CoP) as a mechanism for fostering educational change.

The paper uses our current project, Professional Engineering Pathways (PEPS) as the context for creating a Community of Practice. PEPS has been described in detail elsewhere [1] but a brief description is needed here as well. PEPS is a longitudinal mixed methods study that probes the career knowledge, beliefs, and career decision-making of engineering students as they pursue and enter their first positions after graduation. Students from six partner schools spread across the US were surveyed twice and a subset of those surveyed were interviewed. In addition to engineering students, advisors and career center professionals from the six partner schools were also interviewed and they played an important role by providing feedback on survey questions and by assisting the research team in distributing the initial survey. As we will see later in the paper, the advisors and career center professionals make up our initial community of practice and are, therefore, a central focus of this paper.

The paper will first describe a CoP, then discusses how we use the CoP approach in PEPS, and finally details how other projects might apply this approach to foster change.

Communities of practice

As defined by Jean Lave and Etienne Wenger [2]: “*Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.*” [3] They posit that a CoP consists of three components: a community – people who interact regularly and voluntarily; a domain – an area of shared concern or passion; and a practice – a set of shared behaviors, stories, cases or resources.

When one considers a CoP as a mechanism for fostering change, one’s goal is to change the behavior of a community or, in terms Lave and Wenger would use, to influence the practice of the community.

It is also important to understand how CoPs function. The structure of a CoP is represented in Figure 1 as three concentric circles that signify the **core**, **active** and **peripheral** groups of the community [2]. The core group (inner most circle) helps to shape the direction of the community. Within the core, a small subgroup or perhaps one person, takes on role of the community coordinator and makes sure the community keeps running. The active group is made up of the “regulars” who interact on an ongoing basis but do not necessarily lead the community. The outermost circle represents the peripheral group – those people who interact now and then. Outside the circle are outsiders who are not yet part of the community.

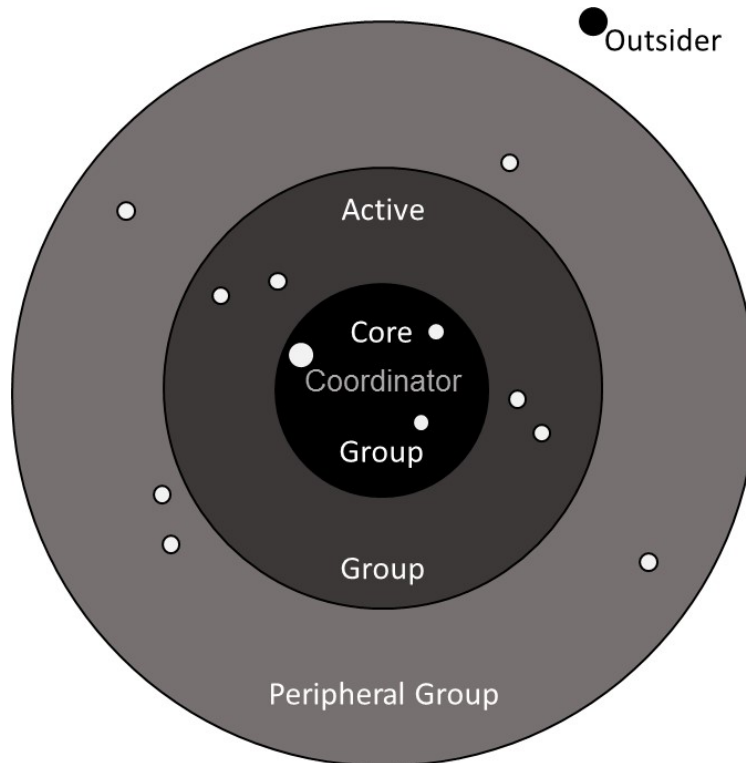


Figure 1. The structure of a Community of Practice (adapted from [4])

For a community to be healthy, the flow of membership across levels needs to be consciously fostered with core and active members moving out and outsiders and peripheral members moving into active and core groups. An important responsibility of core and active members is to welcome “newcomers” into the community.

How are we building a CoP in PEPS?

Now that we have described a CoP, it is time to discuss how we are using this concept PEPS.

Recall that there are three elements of a CoP: the community, the domain, and the practice. When building a CoP, one must intentionally reflect on all three elements. The easiest place to begin is with the domain – because the focus of one’s CoP should be aligned with the domain that is at the heart of one’s project. In PEPS, the domain is career decision-making in engineering students. One must also determine what group of people one’s project is hoping to influence. The answer to that question will provide a guide to locating potential members of the community. In PEPS, our focus is people who influence engineering students’ career decisions – academic advisors and career center personnel. Finally, one must consider the practice one wishes to impact. In the PEPS CoP, our aspiration is to encourage the use of data about students’ career decision making to inform advising or career center programs or activities.

When forming a CoP, it is also necessary to be intentional about how new members move into and through the community. In PEPS, the research team constituted the initial core group [5]. However, we needed to quickly recruit members for a potential new core group. Who among our six partner institutions would be good candidates for the new core? The research team needed to have individual conversations with each partner to learn about their interests and to elicit suggestions for activities that would bring the group together in a meaningful way. The research team also needed to ascertain which partner(s) might have the time, interest, and background to be a potential community coordinator. During our discussions with partners, a few people volunteered to step forward as potential community coordinators.

At an early meeting, an idea was put forth by one of our partners that a symposium at an important and well-attended professional conference could be a meaningful initial CoP activity. Each partner institution would be invited to participate in the symposium where they would discuss what they had learned from PEPS, and how they had used those results to alter their services. Thus the activity would serve as a vehicle for reinforcing the practice that PEPS hoped to reinforce. By working together to propose and then present the symposium, the six partner institutions to create a set of shared cases that would bring them together as a group and a CoP [with a community, a domain, and a practice] begins to solidify.

As the new community forms, the PEPS research team must support the new core while allowing them the autonomy to make their own decisions. The PEPS researchers are providing support by hosting a webinar where partner schools will get a chance to meet

each other and learn about the results of the PEPS results for their respective institutions. This webinar becomes the first step for planning the joint symposium that will be the first product of the new CoP. At the symposium, information about the new practice (using research-based decisions to inform the design of career services and programs) will be shared with a larger group of people interested in the domain, and the symposium becomes an opportunity to recruit new community members from the audience. With time, the community will grow, active members will move into the core and the practice of the broader community changes.

What are ways others can use the CoP to foster change?

If you would like to try to foster a CoP to bring about change, there are essential questions that must be answered about the practice, domain and community:

- What practice is our project hoping to change?
- What is the natural domain that is interested in this practice?
- Where will we find people who are passionate about that domain who could potential be members of the community?

Use your answers to these questions to recruit an initial core group who are interested (hopefully *extremely* interested) in the domain and who will make the time to interact regularly. According to Lave and Wenger, a true community must form voluntarily. So any group that is totally orchestrated by one's project is not a true community. But a community can be fostered by bringing groups of like-minded people together, giving them time to meet, providing potential topics to seed their interests, and providing ad hoc spaces for pairs or small groups to have conversations. [4]. These spaces can be physical or virtual [6].

Once a core has been identified, ask the core what kind of activity would be meaningful to them and others who share their interest in the domain. It is **crucial** that the initial activity is something your project can support, but the core group must truly own the activity. As time passes, your project will withdraw support and let the core and active groups totally take over. To use the metaphor of learning to ride a bicycle, the project must slowly take the training wheels off and let the core group ride on their own.

The process of forming a CoP takes time, but a CoP has the potential to bring about authentic and sustainable change. Moving forward, our project is investigating the benefits and challenges of using a CoP approach.

## References

[1] S. Brunhaver, C. Carrico, H. Matusovich, R. Streveler, P. Boylan-Ashraf, and S. Sheppard, "Professional engineering pathways study: A longitudinal study of early career preparedness and decision-making," *Proceedings of the Annual ASEE/IEEE Frontiers in Education Conference, El Paso, TX, October 21-25, 2015*.

[2] J. Lave, and E. Wenger, "Situated learning: Legitimate peripheral participation," New York: Cambridge University Press, 1991.

[3] Wenger-Trayner website: <http://wenger-trayner.com/introduction-to-communities-of-practice/> retrieved April 28, 2017.

[4] E. Wenger, R.A. McDermott, and W. Snyder. *Cultivating Communities of Practice: A Guide to Managing Knowledge*, Brighton, MA: Harvard Business Press, 2002.

[5] R.A. Streveler, C. Carrico, S. Sheppard, H.M. Matusovich, S.R. Brunhaver and H. Chen, H., "Professional Engineering Pathways Study: Using a community of practice model to propagate findings and engage the community", *Proceedings of the American Society for Engineering Education Annual Conference, Columbus, OH, June 25-28, 2017*.

[6] E. Wenger, N. White and J. D. Smith, *Digital Habitats: Stewarding Technology for Communities*, Portland, OR: CPSquare, 2010.