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Knowledge Transfer of Evidence-Based Instructional Practices in Faculty Communities of Practice

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Abstract

Communities of practice (CoP) have evolved from interactions between novices and experts to being applied as managerial tools for improving an organization's outcomes. Cultural differences, assumptions, and preferences affect the way members access and share knowledge within CoP. Communities of practice take several forms including informal groups developed by practitioners to provide a forum for discussion; supported groups sponsored by management aiming to build knowledge and skills for a given competency area; and structured groups developed and managed by an organization aiming to advance the organizations business strategy.

With an increased focus on the diffusion of evidence-based instructional practices (EBIPs, also referred to as research-based instructional practices (RPIPs)) in science, technology, engineering, and mathematics (STEM) education, the implications of knowledge transfer in CoP can increase the understanding of how to facilitate the spread and adoption of these instructional techniques. This paper utilizes Wenger's work on C*ultivating Communities of Practice* to define CoP as "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." Within post-secondary STEM education, this paper recognizes communities of practice as the formal construct of individual departments related to a specific content area, and micro-communities of practice as those reflecting collaboration of smaller cohorts of STEM faculty, in-person and virtually.

This study addresses the following research questions: 1) How do engineering faculty involved in a community of practice engage in knowledge transfer? 2) How does knowledge transfer of specific evidence-based instructional practices occur in an engineering faculty community of practice?

Conducted within a large research project aimed at exploring stages of pedagogical change, this work utilizes a qualitative methodology. Nine faculty in a first-year engineering department participated in hour-long semi-structured interviews exploring use of EBIPs and collaboration. Interviews were analyzed using thematic coding to explore the formation, interaction, and process of knowledge transfer in these communities.

Findings indicate that faculty engagement lies along continua from unstructured to structured and from organizational to peer interaction. Knowledge transfer of EBIPs is commonly focused on four main modes: peer feedback, formal meetings and workshops, reviewing research and literature, and informal faculty conversations.

Introduction

While there is a large emphasis to reform education, professional development programs are typically low in attendance and faculty that do not attend indicate that these programs have low relevance to their own teaching, recognizing that contextual constraints are important [1,2].

Additionally, Felder et al. [1] indicate that many instructors are unaware of alternatives to traditional lecturing, as this is the way they were taught following their own belief structures and continuing with the signature pedagogies associated with their STEM discipline [3]. In response, several authors have recently noted the need for faculty communities of practice that focus on teaching effectiveness and supporting the adoption of new and Evidence-Based Instructional practices (EBIPs) [4]. These practices, also referred to as Research Based Instructional Strategies (RBIS) include strategies that facilitate active learning, group learning, self-regulated learning, and real-time assessment [5]. EBIPs refer to those instructional practices that have been "studied in well-designed investigations that collect convincing evidence showing that the practice can be effective in promoting learning" and justifying why the practice is effective [6]. This paper focuses on the knowledge transfer of EBIPs due to the current recognition of the need for educational change by global and national entities through educational research [6].

Communities of practice utilize formalized professional development experiences such as research conferences and workshops that guide a group of faculty to implement or address a common issue in either a physical or virtual environment [5]. However, faculty are also engaged in informal communities of practice where they work alongside colleagues who teach similar courses and are guided by a course monitor. These members can be mutually engaged in a common research project led by a common Principal Investigator (PI), or work in the same department guided by a department chair. By understanding how naturally occurring communities of practice interact and share teaching practices, we can begin to explore how EBIPs are diffused in these communities.

Communities of Practice

Communities of Practice (CoP) are informal groups of like-minded individuals with shared interests [7]. Communities develop their practice through problem solving, seeking experience, requesting information, reusing assets, coordination and synergy, discussing developments, mapping knowledge, and identifying knowledge gaps [5]. Li et al. [9] assert, CoP are "groups of people who share a concern or passion for something they do and learn how to do it better as they interact regularly."

These activities take place in person and virtually; participants network through various means to transfer knowledge in their subject matter of interest. What makes CoP successful is that their knowledge is developed by people; all members are willing to participate and use the community as a resource for new knowledge. Examples of CoP include cliques of students pledging in a sorority or fraternity, an engineering project team working on a new product design, and groups of teachers participating in a teacher education program.

CoP exist as [9]:

1. **Informal groups** – aimed to provide a forum for discussion among practitioners who are interested in a topic
2. **Supported groups** – sponsored by management and aimed to build knowledge and skills for a given competency area, and
3. **Structured groups** – developed and managed by an organization and aimed to advance the organizations business strategy

In their critique of Wenger's concept of CoP, Li et al. [9] note the concept of community was coined a learning theory used to promote self-empowerment and professional development. By 2002, however, CoP evolved and is now used as a management tool to improve an organization's competitive advantage (Figure 1). In the current academic environment, this approach is analogous to industry in that universities and colleges are seeking a competitive advantage to better support student knowledge and persistence. Therefore, knowledge concerning CoP focused on the diffusion of EBIPs can provide that competitive advantage to higher education in order to support student learning.

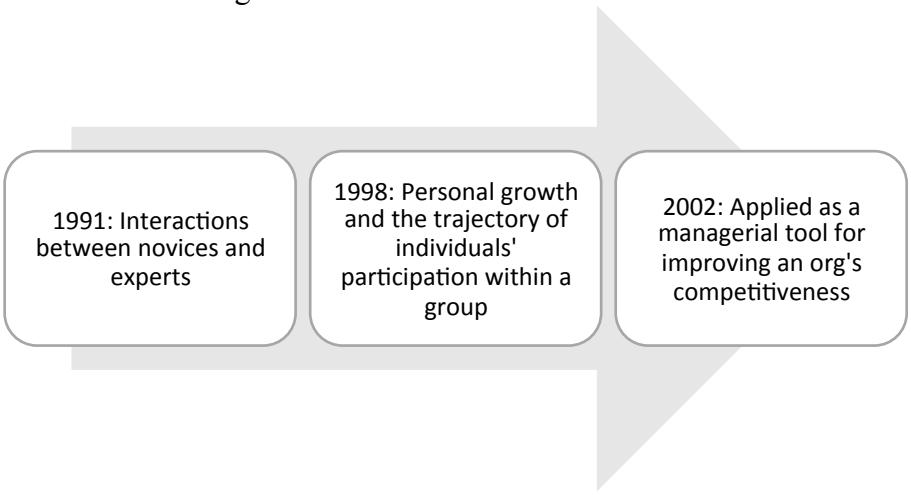

Figure 1: Evolution of CoP [9]

In their characterization of a virtual CoP, Sharrat and Usoro [10] identified several criteria for the identification and assessment of CoP that include: value congruence, sense of community, career advancement, competence-based trust, benevolence-based trust, integrity-based trust, perceived usefulness, and ease of use (Table 1).

Table 1. Characterizations of CoP [10]

Characterization	**Definition**
Value congruence	The degree to which a member's values are congruent with the community
Sense of community	The degree to which a member feels a sense of belonging in the community
Career advancement	The degree to which a member believes sharing their knowledge will positively affect their career
Competence-based trust	The degree to which a member believes that the community is knowledgeable and competent
Benevolence-based trust	The degree to which a member believes the community will act in their best interest
Integrity-based trust	The degree to which a member believes the community to be honest and reliable
Perceived usefulness	The degree to which a member believes that using the community of practice enhances their job performance
Ease of use	The degree to which a member believes that using the community of practice is free from effort

Lastly, the intentions of specific CoP vary from philanthropy to product design, however, CoP are ultimately developed to facilitate knowledge transfer [11].

Knowledge Transfer and Communities of Practice in Education

Within the context of EBIPs knowledge transfer refers to the acquisition of information about specific pedagogical practices, which is then situated within a person's epistemological beliefs about teaching and reflected within the context of his/her educational environment and courses through education, people, and experiences. CoP in higher education represent one means by which knowledge is transferred in the academic community [12]. In CoP members are "capable of adapting knowledge from one context to another" [13]. Additionally, faculty members use CoP as a resource for new knowledge. These members view their knowledge as "a public good, belonging not to them individually, but to the whole organization" [14]. Per Wenger's *Cultivating Communities of Practice* [15], CoP are important social structures suitable for knowledge sharing, i.e. knowledge transfer, in an organization. In the context of EBIPs, knowledge can be defined as being aware of what strategies exist and how they can be implemented in the classroom. This rationale supports that, in a faculty CoP focused on the practice of teaching, the usage or exploration of applying EBIPs could become engrained in the CoP.

Participating in CoP helps establish faculty members as experts in their field and promotes networking between professionals and learning and shared understanding of the latest theoretical and practical knowledge among members [14, 11]. With connections to a center for teaching and learning (CTL) representative, professional development efforts can be better tied to the CoP to support EBIP usage. An analogous comparison to this phenomenon occurred in a campus-level community of practice, where the inclusion of an education collaborator supported the use of scholarly methodologies to explore engineering education problems [16].

Knowledge transfer and dissemination of information in communities of practices takes place via person-to-person interactions, in structured meetings, during informal conversations, and virtually via various web-based platforms and compendiums. For example, Craft and Wijenaike's [17] knowledge transfer compendium is viewed as a tool for knowledge transfer that enhances and improves scholarship in teaching and learning practice through the sharing of research practice and knowledge. The compendium is a resource where a community of faculty leaders decides what information is relevant to their discipline, discovers and extracts information, and raises research questions for future investigation. This compendium is consistent with Daele's [18] assertion that CoP are "motivated to initiate a collective reification activity in relation to their professional practices." Another example of knowledge transfer in CoP in academia is the Women in STEM Knowledge Center (www.wskc.org). Developed by the Women in Engineering ProActive Network (WEPAN), the Women in STEM Knowledge Center provides a collaborative space for community members to transfer knowledge and resources related to cultural influences in STEM, individual beliefs and behaviors, diversity organizations, and programs for women and girls.

Knowledge transfer is also accomplished through faculty interaction. Wenger [15] asserts "members engage in joint activities and discussions, help each other, and share information." These interactions are essential to the success of a CoP.

The role of knowledge transfer in faculty CoP is critical for the modification and implementation of EBIPs. Borrego [4] identified that the situational characteristics of a faculty member's environment plays an important role in the nature of classroom instruction, and that faculty often modify EBIPs based on their interaction with and observation of their colleagues. Unfortunately, barriers exist preventing faculty members from using CoP for knowledge transfer. Cultural differences, assumptions, and communication preferences affect the way members access and share knowledge within CoP [14]. These barriers have been addressed using social exchange theory as a means to impact the frequency with which members contribute knowledge to their community [20].

Social Exchange Theory

Social Exchange Theory [20] was first introduced as a "two sided, mutually contingent, and mutually rewarding process" involving transactions and exchanges among individuals in social situations (informal, small group). The theory asserts individuals enter into relationships to acquire valuable resources [21]. The theory's concepts include rewards, resources, opportunity, outcomes, and payoff [20]. The concepts are drawn from several fields including sociology, psychology, microeconomics, and organizational behavior [22]. Using Social Exchange Theory [22] as a frame of reference, one expects to see the following observations among faculty CoP: actions/decisions by members as a result of their interaction within the CoP, transactions between members, and exchange relations (i.e. series of transactions between the same members). Cook [8] links social exchange with social status, influence, social networks, solidarity, trust, emotion, and collective action—each prevalent in CoP.

Today, Social Exchange Theory supports a host of multi- and interdisciplinary research agendas, including those of interest to STEM faculty and practitioners in higher education. For example, Fuller et al. [21] found that, based on Social Exchange Theory, faculty members feel bound to their university employer due to perceived organizational support. This organizational support is felt not only by tenure-track faculty, but non-tenure track (contingent) faculty as well. In Umbach's [23] study of the effect of contingent faculty on undergraduate education he notes, "social exchange theory suggests, contingent faculty are likely to reciprocate the support they receive from colleges and universities."

Research Questions

Social Exchange Theory provides the theoretical basis for knowledge transfer and adoption of EBIPs among faculty members in a CoP. Thus, this study explores the use of CoP for knowledge transfer of EBIPs, leading to the following research questions:

1. How do engineering faculty involved in a community of practice engage in knowledge transfer?
2. How does knowledge transfer of specific evidence-based instructional practices occur in an engineering faculty community of practice?

The first research question seeks to identify, holistically, how engineering faculty obtain knowledge concerning pedagogical issues, including: course structure, classroom management, and instructional techniques. The second research question seeks to describe which of those sources of knowledge transfer are used by engineering faculty to obtain specific knowledge of EBIPs.

Method

This study was conducted within a large research project focused on identifying driving and restricting forces to use EBIPs in STEM. Employing a qualitative methodology, this study examines the nature of CoP and their implications for the use of EBIPs through interviews with faculty participating in a naturally occurring CoP.

Participants

During the Spring and Fall 2014 semesters, 9 faculty (Table 2) involved in a naturally occurring CoP at a medium-sized, private, primarily undergraduate institution, participated in one-hour hour long semi-structured interviews. Participating faculty primarily teach courses housed within a common first-year engineering program; however, several of the faculty teach outside of the department as well and at the sophomore, junior, senior, and graduate level. Participants include both tenure-track and non-tenure track faculty. Non-tenure track faculty are dedicated solely to teaching while tenure track faculty are involved in research (including engineering education).

This sample was identified through the assistance of the local CTL and was selected due to their participation in CTL activities, professional engineering education conferences, and their varied use of EBIPs. The institutionally recognized application of these practices allows for a more thorough mapping of how knowledge is transferred about specific EBIPs within this context. The generalizability of the findings is then situated within this context, but can be used as insight within other contexts and further explored for its applicability in other faculty CoP.

Table 2. Profile of participating faculty ($N_{Total} = 9$)

Participant Demographics	**(N)**
Rank	
Associate Professor	3
Assistant Professor	5
Instructor	1
Tenure	
Tenured	0
Tenure Track	5
Non-Tenure Track	4
Education	
Ph.D.	5
M.S.	4
Sex	
Male	5
Female	4

Referencing Sharratt's [10] operational definitions characterizing a CoP (Table 1), the faculty involved in this study are justifiably a CoP because they feel a sense of community and individual members' values are congruent with the community as a whole, as evidenced by their interview responses.

Data Collection

The interviews, conducted one-on-one, were recorded and transcribed for data credibility, and limited to 1.5 hours to decrease the occurrence of interview fatigue. The interview protocol utilized a modified version of a semi-structured open-ended interview protocol developed and implemented by Cutler [24] in her assessment of the use of EBIPs, referred to in her work as Research-Based Instructional Strategies (RBIS) used in engineering statics courses. The semi-structured open-ended interview allows for consistency across the interviews through the use of formulated and specifically worded questions, while providing an opportunity to explore in-depth specific issues that may not have been covered in the interview protocol [25].

The interviews followed a pattern requesting faculty to describe a typical day in their course as well as a description of their teaching experience, interactions with colleagues, and an identification of which EBIPs they use, how they use them, and why they decided to use them:

1. How often do you talk to your colleagues who teach similar courses?
2. Are you coordinating with other faculty to use evidence-based instructional practices?
3. Have you participated in any faculty development programs?
    a. How have they impacted your teaching?
4. What drives you to implement new practices in your courses?
5. What are some restricting forces that impede the use of new practices in your courses?
6. Do you collaborate on research with other faculty?
    a. How do you see your research aligning with your use of evidence-based instructional practices?

In addition to the interview questions listed above, faculty members were asked to complete a brief paper survey during the interview indicating their use of the EBIPs previously used by Borrego at al. [4]. Participants were provided with a table (Table 3) that identified each group, specific EBIP associated with the group, and a description of each EBIP. Participants then indicated whether they currently used the strategy; had used it in the past, but no longer did so; were interested in using it; had used something similar to it but did not know the name; were familiar with it, but had not used it; had heard, but knew little else about it; or had never heard of it. This classification of EBIP was guided by the identified four main RBIS groups: active learning, group learning, self-regulated learning, and real-time assessment developed by Borrego et al. [4].

Table 3. Overview of RBIS groups and descriptions [4]

RBIS Groups	RBIS	Description of RBIS as presented in interviews
Active Learning	Active Learning	A very general term describing anything course-related that all students in a class session are called upon to do other than simply watching, listening, and taking notes
Group Learning RBIS	Collaborative/ Cooperative Learning	Asking students to work together in small groups towards a common goal; A structured form of group work where students pursue common goals while being assessed alone
	Think-Pair-Share	Posing a problem or question, having students work on it individually for a short time and then forming pairs and reconciling their solutions. After that, calling on students to share their responses
Self-Regulated Learning RBIS	Inquiry Learning	Introducing a lesson by presenting students with questions, problems, or a set of observations and using these to drive the desired learning
	Just-in-Time Teaching	Asking students to individually complete homework assignments a few hours before class, reading through their answers before class, and adjusting the lessons accordingly
	Problem-Based Learning	Acting primarily as a facilitator and placing students in self-directed teams to solve open-ended problems that require significant learning of new course material
Real-Time Assessment RBIS	Concept Test	Asking multiple-choice conceptual questions with distracters (incorrect responses) that reflect common student misconceptions
	Peer Instruction	A specific way of using Concept Tests in which the instructor poses the conceptual question in class and then shares the distribution of responses with the class. Students form pairs, discuss their answers and vote again.

Data Analysis

Each interview was transcribed by an undergraduate research assistant, validated for accuracy, and coded by the lead researcher. The coding of the data followed a phenomenographic methodology to identify the maximum variation in knowledge transfer opportunities used by the participants [26]. Phenomenography was used due to its recognition as being well suited for the exploration of pedagogical strategies [27]. The specified EBIPs were then examined for the participants' specific use of a knowledge transfer source to learn about the specific technique.

All analyses were evaluated for credibility and confirmability through negotiated agreement of two interviews outlined by Campbell et al. [28]. Through this process the lead researcher and PI coded the first interview, compared codes, discussed disagreements and reconciled the meanings and interpretation. The lead researcher and PI then coded another interview and calculated the inter-coder agreement, specified by Miles and Huberman [29], greater than 80%. The remaining interviews were then analyzed by the lead researcher.

Findings

The goal of this work is to first understand how engineering faculty engage in knowledge transfer in general, and then to describe specifically how knowledge transfer of EBIPs occurs within a faculty community of practice.

Research Question 1: How do engineering faculty involved in a community of practice engage in knowledge transfer?

Throughout the interviews faculty describe several interactions that were identified as lying on two axes: Peer/Individual to Organizational and Unstructured to Structured engagements (Figure 2). Within these axes reside specific faculty interactions noted when receiving knowledge about a specific EBIP (Figure 3) and general pedagogical techniques. Interactions that were noted as peer interactions typically involved their local CoP, whereas organizational interactions involved more of a universal community of practice of educators and engineering educators. Unstructured interactions commonly involved knowledge sharing that was unplanned, whereas structured interactions typically had a specific outline and process to the knowledge transfer. Unstructured can also be related to tacit and intentional informal learning as describe by Livingstone [30]. The most frequently mentioned types of knowledge transfer were unstructured among individuals within the community (peer feedback, informal faculty conversations, etc.) and formal professional development activities through the campus CTL and educational conferences related to the engineering discipline.

In the upper left quadrant lies *Unstructured-Peer* interactions that were characterized by participants as informal conversations, "pop-in" visits, and the observing of colleagues classes. Informal faculty conversations are rarely organized and occur in general areas such as departmental work spaces and faculty offices. They are often centered on an attempt to implement a specific EBIP or address an issue that was solved by an EBIP (i.e. low student engagement, better conceptual understanding, etc.). Similar to this was the "pop-in" visit or question. Participants recognized these interactions were to address a more timely and pressing issue that needed resolving or to share an immediate practice, as evidenced in the following excerpts from faculty interviews:

> "So, I've asked questions, a lot of times if I have questions I will go to [Colleague] and ask for things. For classroom management issues, I've gone to her before. Here's the situation I've had in class, what would you do if a student approached me about this? You know, this is my initial reaction, [Colleague], what is your advice? What is your guidance? How would you handle this? I've observed her, I've observed other faculty members, I've observed everybody in the department now but I've observed her the most because of [introduction to engineering] and got a lot of teaching approaches from her. How to answer questions during interactions and I was able to kind of modify that to my teaching approach. [Graphical Communications], you know, talking to [list of instructors] periodically. Hey how do you guys handle this? How are your students handling auxiliary views or sectioned views? How have you approached teaching them? If they have a real difficulty, what examples are you using? That kind of stuff."

> "If there was a particular issue I was having with students [having] a hard time grasping a particular concept and it was obvious the way that I was doing it just wasn't working, it just wasn't reaching a certain number of students, you know, I'd walk around and ask, 'Hey how are you guys teaching whatever?' In this section did you use auxiliary views, what is your approach? To see if they were doing something different that I could incorporate into my coursework."

Included in the *Unstructured-Peer* quadrant were the act of observing a new class. Several participants noted that when teaching a new course or implementing a new approach in the classroom that a colleague was already using, faculty would request to observe their class. Other than observing and taking a few notes, there was little structure to the practice with the outcome focused on seeing a topic or practice in action before having to do it themselves. An example of this interaction was also identified by a participant that learned of an EBIP during a conversation that was held at a conference (in this case the ASEE Annual Conference) with several peers:

> "That encouragement is in the form of just really seeing your peers doing it, it's in the form of [the] peer review process, even not just the current one but also the traditional one, you get a chance to see snapshots, I guess, of what other faculty in your department are doing in their classrooms."

Watson and Hewett [19] assert, "effective leveraging of knowledge resources through transfer and reuse of existing knowledge is an important aspect of most knowledge management systems." In academia, however, knowledge transfer that focuses on *Unstructured-Peer* interactions can be subject to a feeling of isolation and lack of community or ability to talk about a specific course. The following excerpt from an interview identifies how faculty perceptions about contextual barriers and the uniqueness of the course can limit knowledge transfer when asked if they were coordinating the practice with other faculty:

> "No because I am the only one that teaches that class."

> "No, I don't know. I never thought it was like...something that people did."

The ability for a CoP to function effectively and meet the characteristics described by Sharrat and Usoro [10] represent a strong barrier to knowledge transfer in the *Unstructured-Peer* quadrant. If a faculty member does not feel part of that community, then there is limited opportunity for peer-to-peer knowledge transfer.

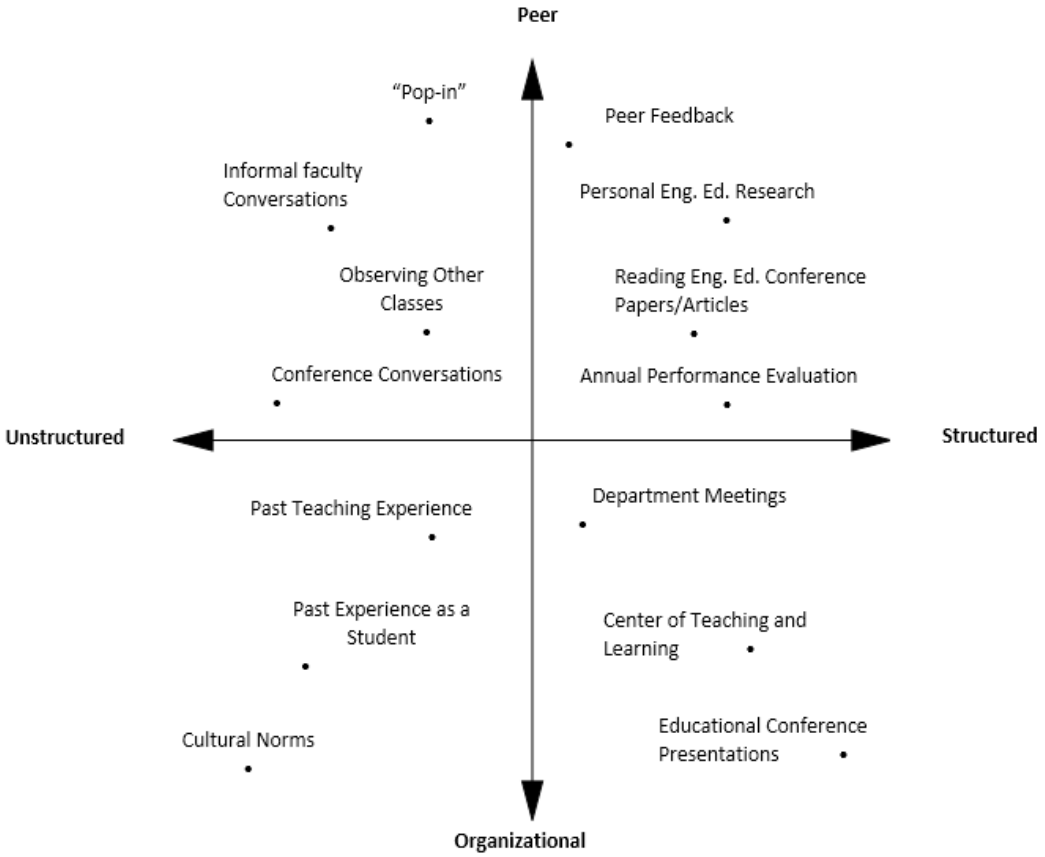

Figure 2. Identification of sources of knowledge transfer that support the use of EBIPs.

A more structured version of peer interactions that support knowledge transfer included peer feedback and annual performance evaluations from a department chair or educational expert, characterized as *Structured-Peer* interaction. Within these interactions there is an identified process for the interaction, but the colleague and department chair align more as peers than organizational structure. In the cases identified, peer feedback was structured through a university process with supplemental materials and guides. A fellow faculty member would schedule a time for the review to be conducted and would then recommend opportunities for improvement. The annual performance review in a similar manner required faculty to first complete an annual review form, then meet with the department chair to discuss successes and opportunities for improvement. One participant noted that during an annual performance review the department chair recommended using some active learning techniques to increase student engagement and offered support and resources to accomplish that approach:

> "We are encouraged by our department chair. Everyone in the department is enthusiastic about, about learning how to teach better and how to facilitate students learning. So we'll do what's necessary and we actually discuss things and talk about it. I think our department is on the cutting edge of improving in that arena."

The lower left quadrant focuses on practices that are unstructured but are situated in an organizational perspective, *Unstructured-Organizational*. Cultural norms and past learning

experiences are also present in this quadrant as they are typically learned over a duration of time as a result of being a member of a broader social interaction and therefore develop knowledge from the culture. When asked about some practices and how they learned about it, several participants noted that they either saw them in their own educational experiences or something that they had done in their own practice and did not recognize it as an EBIP until they saw it in a more organized setting such as a conference session, conference paper, or journal article.

> "I mean my previous institution, they were already employing active learning in hands-on laboratories. I did a lot of curriculum development in doing these labs, and so I just picked up from my environment."

> "We've done it in the past? I can't say who had it first. Because we did it last semester but we did it before that too and I think I was just tired and fed up with them sleeping or not doing anything."

> "I learned a lot of it just by seeing existing curriculum as it stood"

In their work, Knight et al. [31] note that professional learning of teachers in higher education can be characterized as formal/non-formal and intentional/un-intentional. In this study, many of the peer and structured interactions involved intentional learning experiences through specific modes of knowledge transfer. Thus, cultural norms and prior learning experiences classified as unstructured and organizational represent unintentional learning experiences.

While cultural norms provide a tacit transfer of knowledge, there is the potential for them to limit the need to share knowledge of EBIPs. The idea that "it's always been that way", "it's the way we do things," and "it was already in place" tell us that cultural norms have the ability to stifle knowledge transfer.

The final quadrant, *Structured-Organizational*, is represented by more traditional forms of professional development that include attending sessions offered through the local campus CTL, educational conferences such as the ASEE Annual Convention, and departmental meetings where a representative from CTL or another educational expert would present on an EBIP. These types of interactions reflect what Shulman [26] describes as formal educational scholarship when the source of knowledge is acquired from scholarly literature devoted to understanding teaching practices and the student as learner [26]:

> "I got funding from CTLE to implement the inquiry guided learning and also the active learning."

Additionally, limitations to knowledge transfer existed as several faculty noted, "I don't play well with others," and "the approach I've used in the classroom was just kind of developed as a result of another technique."

Research Question 2: How does knowledge transfer of specific evidence-based instructional practices occur in an engineering faculty community of practice?

During the interview, when faculty indicated they were at least familiar with an EBIP, the follow-up questions solicited information regarding how they learned about the specific technique. Figure 3 identifies the relationship between which quadrant of knowledge transfer faculty learned about a specific EBIP.

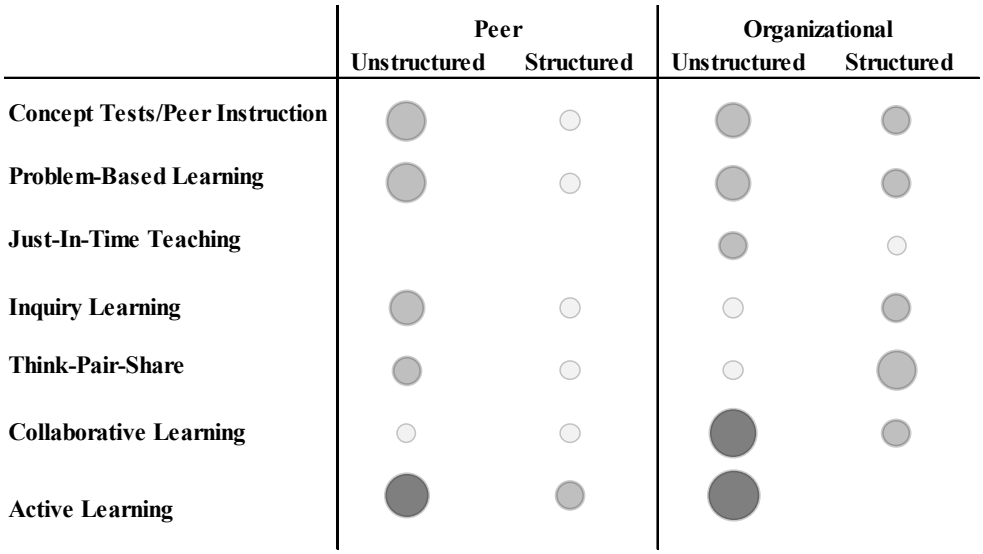

Figure 3. Participant identification of learning about an EBIP with respect to a category of knowledge transfer.

The findings illustrate that in this sample of a first-year engineering department CoP, traditional professional development opportunities such as research conferences, short courses, and on-campus teaching and learning workshops (seen in the *Structured-Organizational* quadrant of Figure 2) make up a small portion of the overall venues where faculty learn about EBIPs. In fact, next to these traditional approaches to enhance teacher knowledge, the *Unstructured-Peer* interactions that included informal conversations about pedagogy and observing a colleagues course was common across all EBIPs with the exception of just-in-time teaching and collaborative learning. This pattern supports the current efforts to integrate virtual faculty CoP in engineering education that support the frequent flow of information that can lead to learning from others experiences. This collaborative exchange of information was highly recognized as a means to learn about different active learning techniques. These conversations were commonly spurred by the need to increase student engagement and learning gains throughout a course.

An additional noticeable factor was the high identification that cultural norms for a course and common practices at another institution, prior student experiences, and past teaching experience strongly identified each of the EBIPs. Through these experiences each faculty member was at least exposed to the technique.

Conclusion

Despite traditional professional development arenas, knowledge transfer EBIPs occurs in a variety of settings and can rely heavily on peer interactions that are supported through focused CoP as seen in recent engineering education efforts through virtual communities of practice (i.e. WSKC). Outside of these, it can be identified that naturally occurring communities of practice

are also a source of catalyst for the diffusion of EBIPs. Since it is estimated that in professional environments knowledge is gained through informal means six times as much as formal, and that 75% of adults claim to be engaged in informal learning activities [31, 33, 30].

Additionally, the ability to observe, experience, and work in environments that support the implementation of EBIPs provides faculty with a strong impression. These experiences can then provide faculty the inspiration to identify opportunities to implement these practices, especially when a need is identified.

Future work will expand the presented work to explore CoP in other engineering courses, in physical sciences and mathematics departments, and their implementation of EBIPs. It is hypothesized that within departments, micro-communities are formed with respect to common courses, research areas, and social relationships that can provide opportunities to better integrate knowledge and use of EBIPs across the CoP.

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